ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL

THE RELATIONSHIP BETWEEN TEXTURE AND TENSION IN EARLY FRENCH SPECTRAL MUSIC

M.A. THESIS

Deniz Can BARIŞ

Department of Music

Music Programme

JUNE 2022

ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL

THE RELATIONSHIP BETWEEN TEXTURE AND TENSION IN EARLY FRENCH SPECTRAL MUSIC

M.A. THESIS

Deniz Can BARIŞ
(409191103)

Department of Music

Music Programme

Thesis Advisor: Assoc. Prof. Dr. Eray ALTINBÜKEN

JUNE 2022

ISTANBUL TEKNİK ÜNİVERSİTESİ ★ LİSANSÜSTÜ EĞİTİM ENSTİTÜSÜ

ERKEN DÖNEM FRANSIZ SPEKTRAL MÜZİĞİNDE DOKU VE TANSİYON ARASINDAKİ İLİŞKİ

YÜKSEK LİSANS TEZİ

Deniz Can BARIŞ
(409191103)

Müzik Anabilim Dalı

Müzik Programı

Tez Danışmanı: Doç. Dr. Eray ALTINBÜKEN

HAZİRAN 2022

Deniz Can Barış, a M.A. student of ITU Graduate School student ID 409191103, successfully defended the thesis/dissertation entitled "THE RELATIONSHIP BETWEEN TEXTURE AND TENSION IN EARLY FRENCH SPECTRAL MUSIC", which he prepared after fulfilling the requirements specified in the associated legislations, before the jury whose signatures are below.

Thesis Advisor : **Assoc. Prof. Dr. Eray ALTINBÜKEN** ....
Istanbul Technical University

Jury Members : **Assoc. Prof. Dr. Eray ALTINBÜKEN** ....
Istanbul Technical University

Assist. Prof. Dr. Emmanouil EKMEKTSOGLOU
Istanbul Technical University ....

Prof. Dr. Tolga TÜZÜN ....
Istanbul Bilgi University

Date of Submission : 3 June 2022
Date of Defense : 21 June 2022

To the temporariness and transparency of a set of expressions,

FOREWORD

Special thanks to my advisor, Assoc. Prof. Dr. Eray Altınbüken for all his support and his contributions to my thesis process, Assist. Prof. Dr. Manolis Ekmektsoglou for all his encouragement, and his contributions to both my composition studies, and my thesis, and Prof. Dr. Tolga Tüzün, who has an important place in my music education and musical approach, for all his contributions to my thesis.

June 2022

Deniz Can BARIŞ
(composer & performer)

TABLE OF CONTENTS

Page

ABBREVIATIONS

BWV	**:** Bach Werke-Verzeichnis: indicating the serial number in the catalogueof the works of J.S Bach
IRCAM	**:** Institut de Recherche et Coordination Acoustique/Musique
m., mm.	**:** Measure, measures
no.	**:** Number
op.	**:** Opus

SYMBOLS

kHz **:** Kilohertz

s **:** Second(s)

LIST OF TABLES

Page

LIST OF FIGURES

Page

THE RELATIONSHIP BETWEEN TEXTURE AND TENSION IN EARLY FRENCH SPECTRAL MUSIC

SUMMARY

The aim of this thesis is to shed light on the relationship between texture and tension in early French spectral music and to make conclusions about the changes in texture that occur during the tension-increasing and tension-resolving processes. The analyses include excerpts from Gérard Grisey and Tristan Murail's early pieces, both of whom are well-known composers and pioneers of French spectral music. The excerpts chosen were determined by taking into account the diversity of texture and tension curves. Along with the early period, an excerpt from second-generation composer Philippe Hurel's music is analyzed. Combined with the composer's approaches, the findings of research projects, approaches to texture and tension, the classifications for the texture of the music, and some parameters impacting the tension process serve as the primary sources of analysis.

The thesis's main flow includes a brief history of French spectral music, texture definitions and comparisons, common texture types, some textural developments that occurred in the first half of the 20th century prior to the French spectral music period, the timbral approach and its use in texture, definitions of musical tension and resolution, parametric and cognitive studies applied to these concepts, and analyses applied to clarify the relationship between texture and tension based on a parametric method.

The introduction, the study's purpose, and a brief history of French spectral music are included in Chapter 1. The period's approach, the process of formation, influences, composers and their compositional attitudes, and the employed composition techniques are discussed.

In Chapter 2, the texture is defined in line with the different approaches and definitions in the literature. Monophony, homophony, polyphony, and heterophony are defined under the title of common texture types and exemplified under this topic. Under the next subheading, some important developments and innovations in the texture of music and its components -in the first half of the 20th century, that is from the early 1900s to the first years of the French spectral music period- are discussed and exemplified. In the last part of Chapter 2, timbre, which has an important place in French spectral music is defined in line with different approaches, and its use in texture prior to the period is briefly discussed.

In Chapter 3, texture in French spectral music, its form as a result of the use of instrumental and orchestral synthesis techniques, static sound masses, micropolyphony, and the shapes of texture created by layering these forms are demonstrated with the excerpts from the music by the composers of the period. The primary source and approach utilized in this chapter is the categorization made by Kari E. Besharse on the texture of French spectral music.

In Chapter 4, concepts of tension and release in literature are defined and discussed in line with cognitive and parametric studies and approaches. In addition to associating parameters such as tonal harmony and melody, the concepts of consonance and dissonance, pitch movements, dynamics, tempo, rhythm, range in Western art music, and a number of studies, draw attention to the subjectivity and multidimensionality of the concept of musical tension, are discussed. The next subheading focuses on the process of tension and release in French spectral music, the period that the thesis aims to shed light on. Some experiments and studies carried out in this field are shared. In this section, the approaches of some spectral composers to tension, the results obtained from the studies of the researchers, the contribution of some physical properties, such as the harmony created on the basis of timbre, and the roughness of the sound to the tension process are presented.

Under the last heading of Chapter 4, the parameters to be used to determine the approximate tension curves and texture types in line with all these studies, the findings, and the approaches to be considered are specified. Selected excerpts of early French spectral music are analyzed with the help of the composers' notes, information gathered from the scores, parametric transcriptions, spectrograms, quotations, figures, and tables.

In the conclusion part, the data obtained as a result of the analyses are discussed, and the findings on the relationship between texture and tension are shared. The thesis is concluded with an overall assessment of the applied analyses and suggestions for possible further studies.

ERKEN DÖNEM FRANSIZ SPEKTRAL MÜZİĞİNDE DOKU VE TANSİYON ARASINDAKİ İLİŞKİ

ÖZET

Bu tezin amacı erken dönem Fransız spektral müziğinde doku ile tansiyon arasındaki ilişkiye ışık tutmak ve tansiyonun artış ve çözülüm sürecinde dokuda meydana gelen değişikliklere dair tespitlerde bulunmaktır. Bu amaç doğrultusunda yapılan analizler, Fransız spektral müziğinin öncü ve ilk bestecileri olan Gérard Grisey ve Tristan Murail'in seçilen erken dönem müziklerinin bölümlerini içermektedir. Bu bölümler, dokunun ve tansiyon eğrisinin çeşitliliği ve evrimi baz alınarak seçilmiştir. Erken döneme ek olarak, ikinci jenerasyon bestecisi olan Philippe Hurel'in eserinden alıntılanan bir bölüm de incelenmiştir. Doku ve tansiyon üzerine yapılan çalışmalar ve yaklaşımlar doğrultusunda elde edilen veriler, doku üzerine uygulanan sınıflandırmalar ve tansiyon sürecine etki eden bazı parametreler, besteci yaklaşımlarının da hesaba katılmasıyla beraber uygulanan analizlerin ana kaynaklarıdır.

Tezin ana akışı, Fransız spektral müziğinin kısa tarihi, dokunun tanımları ve bu tanımların karşılaştırılması, geleneksel doku tipleri, fransız spektral müziği dönemi öncesi 20.yy'ın ilk yarısında meydana gelen bazı dokusal değişiklikler, tını ve tınının doku içerisindeki varlığı, müzikal tansiyon ve çözülümün tanımları, bu kavramlar üzerine uygulanan parametrik ve bilişsel çalışmalar ve bunların sonucunda belirlenen parametrik analiz metodu doğrultusunda doku ile tansiyon arasındaki ilişkiyi açıklığa kavuşturmaya dair uygulanan analizlerdir.

Bölüm 1, giriş, çalışmanın amacı ve Fransız spektral müziğinin kısa tarihini içermektedir. Dönemin yaklaşımı, oluşum süreci, bestecileri, kompozisyonal tutumu ve kullanılan kompozisyon teknikleri anlatılmaktadır.

Bölüm 2'de doku, literatürdeki farklı yaklaşımlar doğrultusunda tartışılır. Monofoni, homofoni, polifoni ve heterofoni, geleneksel doku tipleri başlığı altında tanımlanarak 18. yy, 19. yy ve 20. yy batı müziği eserlerinden alıntılarla örneklendirilmiştir. Bu örnekler, G.F Handel, J.S Bach, L.W Beethoven, F. Chopin, J. Brahms, C. Debussy, O. Messiaen ve I. Xenakis'in müziklerinden alıntıları içerir. Bir sonraki alt başlıkta, 20.yy.ın ilk yarısı 1900'lerin başından Fransız spektral müziği döneminin ilk yılları olan 1970'lere kadar olan süreçte müziğin dokusunda ve dokuyu oluşturan müzikal bileşenlerde meydana gelen bazı önemli gelişmeler ve yenilikler tartışılarak örneklendirilmiştir. Bu yenilikler ve örneklendirmeler, Fransa'da ortaya çıkan empresyonizm akımı ile beraber M. Ravel ve C. Debussy'nin müziklerinde ortaya çıkan yeni doku biçimlerini, Arnold Schoenberg'in dokunun bir bileşeni olan melodiye tınısal yaklaşımı temsil eden klangfarbenmelodie kavramını, kökeni Henry Cowell'in piyano müziklerine dayanan ton kümeleri ve sonrasında ortaya çıkan orkestral ses kitlelerini ve bunların György Ligeti, Kryzsztof Penderecki, Iannis Xenakis gibi bestecilerin müziklerindeki kullanımını ve son olarak da György Ligeti'nin buluşu olan mikropolifonik dokuları içerir. Bölümün son kısmında ise Fransız spektral müziğinde de önemli bir yere sahip olan tını kavramı, farklı yaklaşımlar doğrultusunda tanımlanarak, dönem öncesi

müziklerindeki kullanımı Olivier Messiaen, Edgard Varèse, Pierre Boulez, Karlheinz Stockhausen, Giacinto Scelsi gibi bestecilerin yanında Fransız spektral müziği bestecileri Gérard Grisey, Tristan Murail ve Kaija Saariaho'nun da bazı yaklaşımlarını içeren alıntılarla aktarılmıştır.

Bölüm 3'te, Fransız spektral müziğinde doku, enstrumantal ve orkestral sentez tekniği ile ortaya çıkan biçimi, statik ses kitleleri, Ligeti'nin buluşu olan mikropolifoni ve bunların katmanlanarak meydana getirdiği biçimler çerçevesinde işlenip başta Gérard Grisey ve Tristan Murail olmak üzere Philippe Hurel ve Kaija Saariaho gibi dönem bestecilerinin müziklerinden alıntılarla örneklendirilmiştir. Bu bölümde yararlanılan ana kaynak ve yaklaşım, Kari E. Besharse'nin Fransız spektral müziğinin dokusu üzerinde yaptığı sınıflandırma olmuştur. Müziklerde özellikle enstrumantal ve orkestral sentez tekniğinin sonucunda meydana gelen ses kitlelerinin öne çıktığı görülmektedir. Polifoniden farklı olarak mikropolifoninin standart yapısının aksine yavaşlatılmış, gerilmiş biçimlerde ve mikro ölçekli katmanlı dizilimler halinde meydana geldiği gözlemlenmektedir.

Bölüm 4'te tansiyon ve çözülüm kavramlarının literatürdeki yeri, gerçekleştirilen bilişsel, parametrik çalışmalar ve yaklaşımlar doğrultusunda tanımlanarak tartışılır. Batı müziğinde tonal armoni ve melodi, konsonans ve disonans kavramları, kadans, perde hareketleri, dinamikler, tempo, ritim gibi parametrelerin müzikal tansiyonla ilişkilendirilmesinin yanında tansiyon kavramının öznelliğine ve çok boyutlu oluşuna da dikkat çeken bir takım çalışmalar ve görüşler paylaşılmıştır. Bir sonraki alt başlıkta, tansiyon ve çözülümün tezin ışık tutmayı amaçladığı dönem olan Fransız spektral müziğindeki sürecine odaklanılmıştır. Bu alanda gerçekleştirilen bazı deneyler ve çalışmalar paylaşılmıştır. Bu bölümde kimi dönem bestecilerinin tansiyona yaklaşımları ile beraber, araştırmacıların çalışmalarından elde edilen sonuçlar, tını bazında yaratılan armoni ve sesin pürüzlülüğü gibi bir takım fiziksel özelliklerinin de tansiyon sürecine olan katkısı görülmüştür.

Doku ve tansiyon ile ilgili yapılan sınıflandırmalar, yaklaşımlar ve çalışmalar, tezin ana odağı olan erken dönem Fransız spektral müziğinde doku ve tansiyon arasındaki ilişkiye dair yapılacak tespitleri mümkün hale getirmektedir. Bölüm 4'ün son başlığında ise analiz edilecek erken dönem Fransız spektral müziklerinden alıntılanan bölümlerin yaklaşık tansiyon eğrilerini ve doku tiplerini saptamak için kullanılacak parametreler, yararlanılacak bulgular ve yaklaşımlar belirlenmiştir. Müziklerin tonaliteden ve algılanabilir geleneksel melodik hatlardan uzak oluşu sebebiyle tansiyon analizlerinde incelenecek parametreler, dinamik seviye, yoğunluk, tını, ses menzili ve hareketleridir. Erken dönem müziklerinin seçili bölümleri, besteci açıklamaları, partisyonlar üzerinden elde edilen veriler, parametrik transkripsiyonlar, alıntılar ve tablolar yardımı ile analiz edilmiştir.

Sonuç kısmında, analizler sonucunda elde edilen veriler tartışılmış, doku ile tansiyon arasındaki ilişkiye dair bulgular paylaşılmıştır. Bu çalışma, uygulanan analizlerin genel değerlendirmesi ve konu üzerine yapılabilecek muhtemel çalışmaların önerilmesi ile sonuçlanmıştır.

1. INTRODUCTION

There are various elements, each of them playing an important role in music composition. Harmony, rhythm, tempo, structure, texture, form, and dynamics are some of the underlying parameters. In history, musical parameters, like everything else, have been in a state of flux, and under development. Especially in Western art music history, these developments have been occuring with different musical movements, under the leadership of specific composers. In past centuries, and particularly from the beginning of the late 19th, and early 20th century, these changes, due to the developments in technology, accessibility, and musical knowledge have become increasingly more frequent.

Since the beginning of the 20th century, pioneering composers in the 2nd Viennese school, Soviet Union, Italy, and France pioneered the formation of movements such as minimalism, spectralism, electronic music in history. As a result of these movements, with the developing approaches and definitions of musical parameters, unusual variations began to emerge in the texture and structure of music. This brought along new perceptions and analyzes / listening tendencies.

Especially since the early 1970's, the concept of timbre started to come to the fore in music. This would generate the spectral movement. The timbral approach in music begins to produce different sonic results. However, we cannot deny that new texture types, structural changes, tension-release relations have emerged. With the new approaches in music, a lot of research has been conducted, and is still being carried out in the field of spectral music.

In the following sections, aside from a brief history of French spectral music, the definition of texture, its conventional types, and the changes that took place in the first half of the 20th century will be examined and demonstrated within the framework of some important developments. Then, the categorizations and approaches applied to the texture of French spectral music, the concepts of tension and resolution, and some studies and approaches to musical tension applied to French spectral music will be discussed. In essence the study will be on the direct relationship between texture and tension.

1.1 Purpose of Study

As a musician and composer, I was more interested in the formal and textural aspects of music and the associated changing musical tension processes. The effect of structural and textural changes that emerged in music in the periods when the traditional form, harmony, and tonality began to be moved away from the middle of the 19th century are inevitable, rather than the forms and textures of classical period western music such as sonata, concerto, theme and variations, homophony and polyphony. With the emergence and application of spectral understanding and its spread throughout the world in the second half of 20th century, I felt the need to study on this relationship between French spectral compositions, which I claim are in interaction with one another, such as texture, and tension in music.

The aim of this thesis is to shed light on the textural changes that occur in early French spectral music where tension builds and releases, and to make determinations about the relationship between texture and tension. The synthesis of studies on texture and tension and the parametric analyzes will be made in this direction are the main sources to achieve this goal.

1.2 A Brief History of French Spectral Music

Spectral music was created in France in the early 1970's as a result of experiments and studies based on the physical properties of sound and sound spectra, by composers such as Gérard Grisey, Tristan Murail, Hugues Dufourt, Michaël Lévinas, and a group of instrumentalists known as L'Itinéraire; it is a musical approach that they themselves developed. The main material of the music is the recorded sounds and the frequency data obtained as a result of their analyzes. Furthermore, one of the important factors that form the basis of spectral music is the fact that these analyzes inspired composers during the creation of music (Fineberg, 1999).

Gérard Grisey and Tristan Murail are two of the most well-known pioneer composers, both of whom laid the groundwork for the French spectral period. Founded by Pierre Boulez, IRCAM established the foundations of spectral music and developed significant studies and advancements for electronic music, which interacted in several ways with the music of this era. This institute has conducted extensive research in the spectral field. Composers such as Grisey and Murail's students, Philippe Hurel, Marc-André Dalbavie, and Jean-Luc Hervé, who we might refer to as the second generation of the spectral period, continued their spectral research at IRCAM in the post-1980's. Another important late spectralist is Kaija Saariaho, and while she has not worked directly with Grisey or Murail, she readily acknowledges their impact on her music (Anderson, 2000).

In 1979, French composer Hugues Dufourt coined the term "spectral music" in an article, yet it was Tristan Murail who provided the most basic and appropriate explanation, despite the fact that Dufourt had coined the term. Spectral music, according to Murail, is more of a compositional attitude than a set of new techniques. As a result, spectral compositions come in a variety of styles and structures. Another common belief among spectral composers is that sound and music change over time. The resulting sounds and timbres can be shaped over time to produce musical effects. The sound manipulation techniques used in this way are only the means of achieving the main sonic goal (Fineberg, 2000). Spectral Music, which emphasizes a change in the way of thinking about music, is not music based on traditional categories such as melody, harmony, and counterpoint (Zattra, 2018).

When we examine the formation process of spectral music, we notice the influence of numerous composers. When one delves into the origins of music, one may find the marks and influences of composers such as Olivier Messiaen, Edgard Varése, Giacinto Scelsi, György Ligeti, and Karlheinz Stockhausen. Messiaen made analogies and discussed the complex tones of percussion, harmonic and inharmonic spectrums in his music. He composed pieces that were inspired by the connection between harmony and timbre. As examples, Oiseaux Exotiques (1955) and Couleurs de la Cité Céleste (1963) can be cited. Varése composed numerous pieces in which he used the concept of timbre as a compositional principle. Some of these principles included the use of harmonic clusters on instrumental timbres and the use of sound blocks. Intégrales (1925) can be used as an example. Scelsi, an Italian composer, was another pioneer associated with spectral music. In some of Scelsi's music, the pitch content is lost in favor of harmonics, beats, and certain unidentified sound characteristics. Prolonged textures, gradual and ever-evolving processes found in his music can also be associated with spectral music composition. In this regard, the Fourth String Quartet (1964) is one of his most notable pieces. Ligeti's distinctive characteristics, including his density changes and constantly evolving textures in his texture-based compositions such as Atmosphères (1961) and Lontano (1967), influenced the music of Grisey, Murail, and second generation spectral composer Kaija Saariaho. Several pieces by Stockhausen can also be considered early examples of spectral composition. In Stimmung (1967) for example, the harmonic spectrum based on a fundamental pitch is manipulated and the spectrum partials are occasionally emphasized. Additionally, the processes by which Stockhausen associates his music's oscillations between dissonant and consonant timbres with tension and resolution through analogy to human breathing are observed (Anderson, 2000).

The music of Giacinto Scelsi, in particular, has been a major source of inspiration for the development of French spectral music as well as the music of Grisey and Murail. Murail had interactions with Scelsi since he was a student in Rome (Cornicello, 2000). Harmonics, beats, and difference tones are predominant in Scelsi's music. Although there was no spectral research in Scelsi's harmonic thought at the time, the sustainable textures and the continuous and gradual development of formal processes had a strong influence on Murail and others. Traces of these processes can be found, particularly in Murail's music. Simultaneously, he is a composer who discusses spectral subjects such as scale density, dynamic, spatial position, particles, and the concept of roughness prior to the formation of spectral music and the computer generation that followed the 1960's. In this sense, an argument can be made that, French spectral music is based on Scelsi's works which have aesthetic features such as structural elements, the ideal of spatial mass in which sounds are obtained by separating them, the separation of complex sounds into their components, and the loss of distinguishability of the relationship between pitches. Among the important works written for these applications in Scelsi's music are Four String Quartet (1964) and Four Orhcestral Pieces on a Single Note (1959) (Anderson, 2000).

Although composers of this period, such as György Ligeti, Karlheinz Stockhausen, Olivier Messiaen, Giacinto Scelsi and Edgard Varése emphasized timbre and color in their music, timbre remains the main element in the music of spectral composers . We may claim that this is the one of the most essential components, especially in the work of Murail and Grisey, among the most well-known composers of the time. In a presentation given at Darmstadt school in 1971, Grisey claimed that the materials related to the timbre process in the composition came from the natural growth of the sound, the macro-structure, rather than the other way around. To put it another way, there is no simple material like a melodic cell, a complex of notes, or note values (Rose, 1996). In an article, Tristan Murail explained the spectral approach to sound as follows:

> Rather than describe a sound by describing its 'parameters' (timbre, register, volume, duration), it is more realistic, more in keeping with physical reality and perception, to consider a sound as a field of forces, each force pursuing its own particular evolution. Such an approach empowers us to work more precisely upon sounds, to perfect instrumental techniques in the context of an understanding of sonic phenomena. It allows us also to develop a compositional technique based on the analysis of sounds, and to make of their internal forces a starting point for the composer's task (Murail, 2005, p. 123).

Conducting spectrograph readings of the harmonic spectra of various instruments, converting these spectra to musical notes, and assembling the resulting sound clusters can be thought of as the primary elements of the spectral composition process (Bowen, 2010). Technological advancements were one of the most essential factors in making these sound analyses possible. The origins of spectral music can be traced back to the computer, which, along with the advancement of new technology, was used to obtain data such as sound analysis, partial resolution, and the amplitude values of sound. The timbre concept used by composers was heavily influenced by electronic music techniques (Rose, 1996).

Together with instrumental synthesis, electronic music techniques were a significant source of inspiration for spectral music. Numerous techniques employed in electronic music have served as inspiration for strategies used to shape spectral music. Additive synthesis is one of these techniques. Additive synthesis is the technique of creating complex sounds by combining and adding multiple basic sounds-namely, sine waves. This technique is applied through Fourier transform analysis. The Fourier transform is an analytical theorem that simplifies complicated signals by splitting them into their frequency components. As a result, it provides a straight forward framework for thinking about hearing and making sounds. By combining the sounds, it becomes possible to perceive the individual components of the sound, making it easier to discern the emergent global timbre (Fineberg, 2000). This process is critical in analyzing the sound of spectral music and transferring it to instruments. Frequency shifting is another technique influenced by analog electronic devices. The components of the sound are shifted equally in the positive or negative direction using this technique. Spectralists have also been motivated by techniques like as frequency modulation and ring modulation. While frequency modulation allows for the creation of inharmonic spectra, ring modulation provides the opportunity to obtain more complex spectra by adding or subtracting parts from different spectra with the help of a modulator (Fineberg, 2000).

2. TEXTURE, ITS EVOLUTION IN THE 20TH CENTURY

2.1 Texture

Considering the evolution and changes in the components of music over time, it may not be possible to bring an up-to-date definition to the concept of texture in music. However, there are different definitions and perspectives in the related literature. To start with a definition in the music dictionary, music consists of horizontal and vertical elements, just like a woven fabric. The main elements that make up the texture of the music are the consecutive sounds that represent the melody on the horizontal line and the simultaneous sounds that create harmony vertically (Randel, 2003). When we examine this approach, we see that a broad definition of texture has been established based on melody and harmony in horizontal and vertical lines. We might argue that this is a definition that is not particularly applicable to music that lacks melodic elements.

Another more comprehensive definition is that texture refers to the way melodic, rhythmic, and harmonic materials are knitted together in a composition. Texture needs to be considered more specifically, according to Benward and Saker, who formed this definition, as textural changes mark the structural divisions of music and often complicate harmonic analysis. Texture is frequently defined in terms of density and range in music (Benward and Saker, 2009). According to this approach, texture is defined by considering the relationship between sound density and range which is based on possible complexes and formal divisions.

Unlike the definition by Randel in the Harvard Dictionary of Music, Oxford Music Dictionary describes texture as a term used when addressing a musical structure's sound properties. The term can refer to the overall or vertical aspects of a piece of music, as well as the way sounds are combined, qualities such as tone color or rhythm, and musical performance characteristics, such as articulation and dynamic levels (Oxford Music Online, 2001). Here, in opposition to Benward and Saker's definition, performance features such as dynamics and articulation are also included in the musical components that shape the texture. In his book titled Structural Functions in Music, theorist Wallace Berry explains that:

> The texture of music consists of its sounding components; it is conditioned in part by the number of those components sounding in simultaneity or concurrence, its qualities determined by the interactions, interrelations, and relative projections and substances of component lines or other component sounding factors (Berry, 1976).

There are many components that make up the texture of music, depending on how we define it and how we approach it. The resulting texture type will differ based on the musical elements used and how the sounds are combined. Therefore, it would not be wrong to explain the musical texture as a whole consisting of the building blocks and elements that make up the music, such as density, harmony, timbre, rhythm, dynamic, duration, and silence that make up the music.

2.2 Common Types of Texture

2.2.1 Monophony

Monophony is one of the fundamental traditional texture types, and it refers to a single melody or single sound as its basis. Monophony is defined as a melodic line performed by a single instrument in the traditional sense (Besharse, 2010). Additionally, in the Harvard Dictionary of Music, monophony is defined as music that, in contrast to homophony and polyphony, is composed of a single melodic line with no additional parts or accompaniment. In various branches of early church music, including Gregorian and Byzantine chant in Ancient Greek, 13th century Spanish cantigas and Italian laude's, European folk music, and Eastern music, this type of texture can be heard in a variety of ways (Randel, 2003). The monophonic texture can also be enhanced by different octaves of the same pitch. Octave doubling is called parallelism (Benward and Saker, 2008). Monophony examples are given in the images below (See figures 2.1, 2.2 and 2.3).

Figure 2.1 : Ave Maria, Gregorian chant, monophony.

Figure 2.2 : Olivier Messiaen, Quatuor pour la fin du temps (1941) melody played in different octaves and unisons simultaneously.

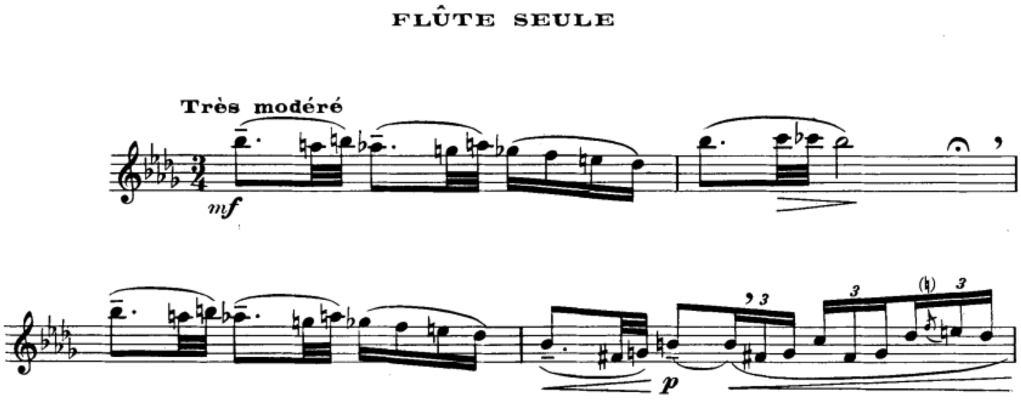


Figure 2.3 : Claude Debussy, Syrinx (1913), solo flute melody.

2.2.2 Homophony

Homophony means homonymous texture. It is a type of texture that includes a melodic line and other lines that accompany it creating harmony. The definition by Monte is similar. In music, homophony is a texture in which the primary piece is supported by one or more additional lines that bring out the harmony (Tubb, 1987). Although this texture type expresses interconnected voices and homonymy, sometimes the primary sound may be temporarily accompanied by an interacting secondary structure. It is the texture in which the bass line is usually in an inverse or other counterpoint relationship with the primary voice or voices (Berry, 1976). In general, upper voices in texture are more active and dynamic than the other voices, thus they have a wider melodic range. Although the stepwise motion is adopted as a rule in high pitches, jumps are quite common. This is also prevalent in the bass line (Hyer, 2001). Homophonic texture started to attract attention with the rise of the concept of figured bass, which was a particularly Baroque period accompaniment technique. During the classical period that followed, homophony became the norm, and composers engaged in much more contrast and intense structures than in the Baroque period (Benward and Saker, 2008). Some examples of homophonic texture from music by Beethoven and Chopin are given in the images below (See figures 2.4 and 2.5).

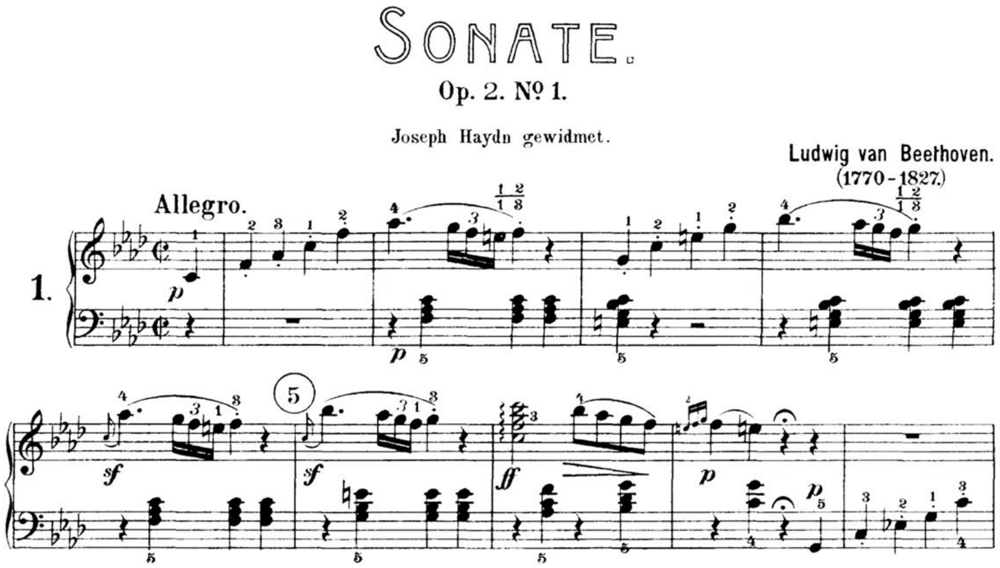


Figure 2.4 : L.W. Beethoven, Sonata No.1 in F minor, Op. 2 No.1 (1795) opening theme.

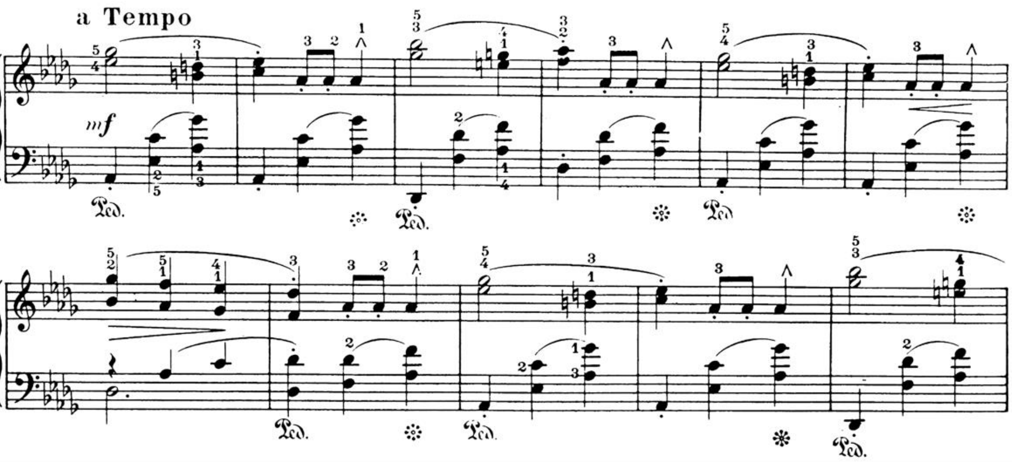


Figure 2.5 : F. Chopin, Waltz in E flat major, Op. 18 No.1 "Grande Valse Brilliante" (1834).

Homophonic texture includes various sub-texture types according to some structural differences. One of them is homorhythmic texture. In homorhythmic texture, all sounds move in the same rhythm. Sequential intervals in two-part writing can also be considered as a type of polyphony that produces chords in three or four-part writing (Randel, 2003). The four-part harmonies of choral melodies may be given as an example of homorhythmic texture type (See figure 2.6).

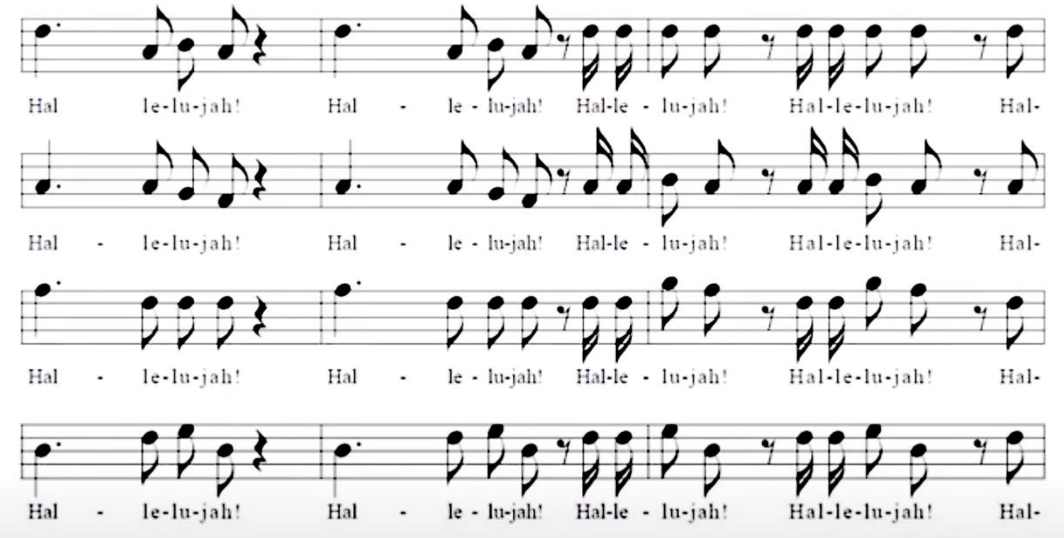


Figure 2.6 : G.F. Handel, Messiah HWV 56 (1741) chorale, same rhythm.

2.2.3 Polyphony

Polyphony refers to a texture that contains multiple voices. It is a texture term used to denote various categories in music. These categories may include; music composed of more than one part, music in multiple parts, or a style in which all or some of these musical parts move with some degree of independence. Getting to the root of the word, "polyphonos" (many-voiced) and "polyphonia" appeared in ancient Greek without the connotation to the term music. After classical antiquity, it was also used as an adjective to describe non-musical phenomena such as bird sounds, multiple echoes, and crowded human voices. The variety of parts, the equal importance and development of separate parts, and the simultaneous use of more than one structure are the main characteristics that make up the polyphonic texture (Bithell, Cooke, Frobenius and Zemtsovsky, 2001). In another music dictionary definition, polyphony includes the simultaneous movement of an individual design of many voices which are combined with similar movements and identical rhythmic characteristics, as opposed to monophony or homophony. At the same time, polyphony is synonymous with counterpoint, except the differences in emphasis. There are many theories about the first appearance of polyphony. While some studies accept the 10th century as a beginning, others argue that its roots go back to earlier periods, eastern and primitive music (Randel, 2003). While polyphony literally means "multiple voices" according to Berry, it can be used to express significant independent multi-voiced texture between lines in traditional musical compositions (Berry, 1976). Some examples of polyphonic texture are given in figures below (See figures 2.7 and 2.8).

Figure 2.7 : J.S. Bach, Fugue No.24 in B minor, BWV 869 (1722-1742).

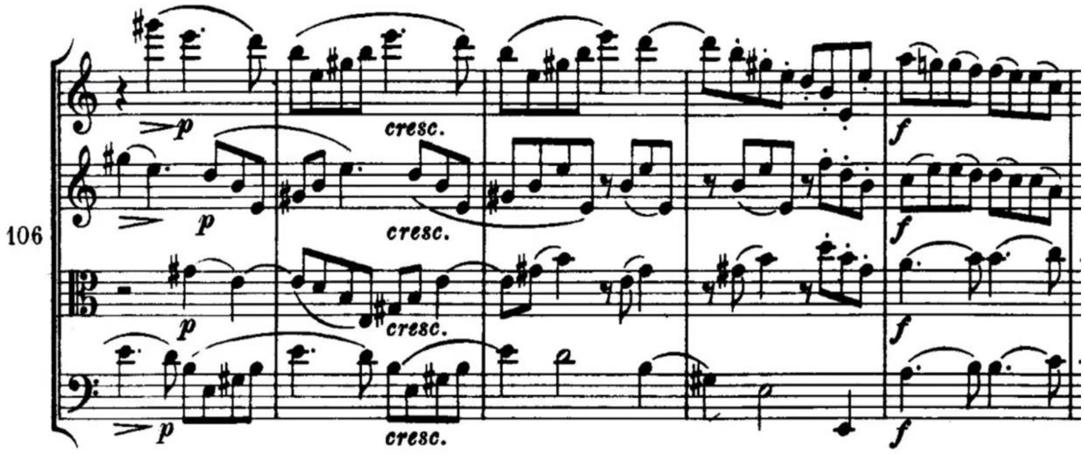


Figure 2.8 : Johannes Brahms, String Quartet No.1 in C minor Op. 51 No. 1 (1873).

2.2.4 Heterophony

Heterophony is a type of texture that emerges in different cultures as compared to other texture types, and it is obtained through the process of additions and improvisations. In another definition, heterophony is a term used to describe a type of polyphony that is improvised on the spot. An instrumentalist who performs by adding extra tones or embellishments to the singer's melody and the singer who sings his melody simultaneously are examples of this (Randel, 2003). While these additional notes, embellishments, or voices are difficult to identify, they can encompass a wide range of very minor differences, from song form to orchestra or the most complex contrapuntal structure to the most basic. Even the sounds produced by the first violin section in an orchestra, while they play a melodic line, could be considered as an example of this. Nowadays, the term heterophony is frequently used to characterize the accidental or intentional variation of the line that is defined as the melody, particularly in ethnomusicology. Although this can be found in western classical orchestral writing between the cello and double bass parts, it is essential to non-European music such as the gamelan music of Southeast Asia. The term is widely used in the Middle Eastern and East Asian multi-accompaniment vocal music genres. The instrument creates a new version of the vocal part that is more embellished. In addition, its use in the monophonic music tradition, which is sung as a group, is also very common (Cooke, 2001). According to Partlas, heterophony which is inherently associated with oral and collective music creation, cannot be defined in a standardized manner because there are no analogies or written examples of it to be found in Western written music, making it impossible to provide a standard definition (Partlas, 2016). However heterophony is also observed in Nekuia (1981) by Iannis Xenakis. An excerpt from the piece is provided in the figure below (See figure 2.10).

Figure 2.9 : Iannis Xenakis, Nekuia (1981), heterophony.

2.3 Occurrences of Alteration in Texture

Towards the beginning of the 20th century, texture in music begins to become more complex, multiply, and diversify in comparison to traditional simple texture types such as monophony, homophony, polyphony, and polyrhythms and patterns. Music developed into something far more complex than these four traditional textures during and near the end of the 20th century. It was at this point that musical categories became more fluid and ambiguous, and the range of techniques and materials used in composition began to expand. For example, second Viennese school composers such as Arnold Schoenberg and Anton Webern envisioned a music in which the melody is based on timbre rather than pitches, and made applications in this direction in their music. Schoenberg used the term "klangfarbenmelodie" for this application in his theory. Webern's music includes melodic lines that he created to emphasize the difference in timbre between instruments (Besharse, 2010). The usual melodic structure in music gives way to fragmented segments designed by focusing on dynamics, duration and most importantly timbre. We may conclude that this is an indication of the evolution and the fact that the melody in the traditional texture types has ceased to be an important component of the texture of the music. Similar to melodic evolution, various new approaches and applications began to emerge in the sound components that make up the texture. The impressionist art movement, which was active in France towards the end of the 1800s, brought along new textural reforms in music in terms of composition.

2.3.1 Impressionism

The impressionist movement began in France in the late 19th century, when some painters such as Monet, Renoir produced paintings that gave the impression of a scene painted with available outlines and details, avoiding sharp lines, and trying to express perceptions of nature. In the same way, the composers of the period, especially Claude Debussy in particular, interpreted these subjects with an impressionist approach, conveying the moods and emotions in their compositions (Kennedy, 2003). This style is characterized by a strong emphasis on the texture of the music. In Debussy's music, even in pieces with a traditional texture, we might notice the dominance of independent motives, unaccompanied, angular melodies, and vertical sounds that are used solely for the purpose of color (Kostka and Payne, 1995). Wallace Berry explained that the style and technique of impressionism gives fundamental importance to texture in music as follows: "An obvious example of this is the technique, in impressionism, of ornamentation of a fundamental harmonic scheme by the idiosyncratic, uniquely characteristic, parallel movement of auxiliary chords within dense textures of interdependent lines" (Berry, 1987, p.201).

The piano piece "Reflets dans l'eau" by Claude Debussy is one of the examples of this technique in use (See figures 2.10 and 2.11). The figurations and imitations of nature provide a rich harmonic chemistry. The use of harmonic and rhythmic elements provides an abstract, translucent and blurry textural output, avoiding stereotypical textural structures (Webb, 1962).

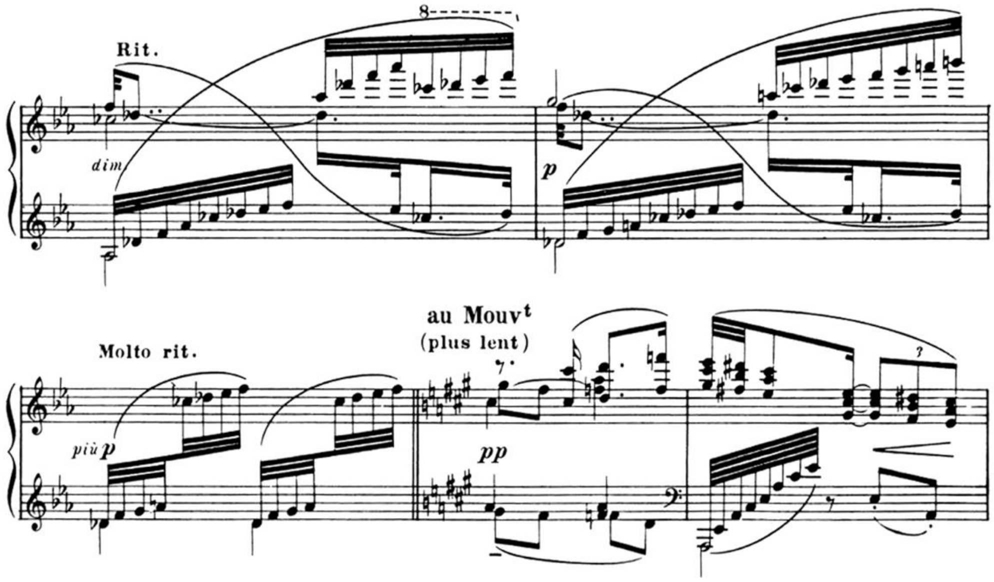


Figure 2.10 : Claude Debussy, Reflets dans l'eau (1905) mm. 63-67.

Figure 2.11 : Claude Debussy, Reflets dans l'eau (1905) ending section.

Furthermore, Debussy was the first composer in the 20th century to apply layered textures directly. If the first ten measures of his orchestral work "Nuages", which he composed in 1899, are examined, the layer formed by clarinet and bassoons in the first measures is followed by another layer consisting of flutes and horns, together with the English horn applying the similar motive. Following that, measures 6 and 7 include a treble-layered texture created by divided violins and timpani (Erickson, 1975). This layering technique shows its effect throughout the texture of the music.

Another important composer who contributed to the textural evolution in the Impressionist period was Maurice Ravel. The asymmetric-rhythmical accompaniment materials, complex syncopated rhythmic figurations, especially used in piano music, reveal a new textural pattern. The first part of "Gaspard de la nuit", and "Ondine", one of the most important examples of impressionist music are significant examples of this. Consisting of a chord and a note added to the chord, this chord pattern creates an unprecedented rhythmic figure associated with trembling water (Ivanchenko, 2015) (See figure 2.12).

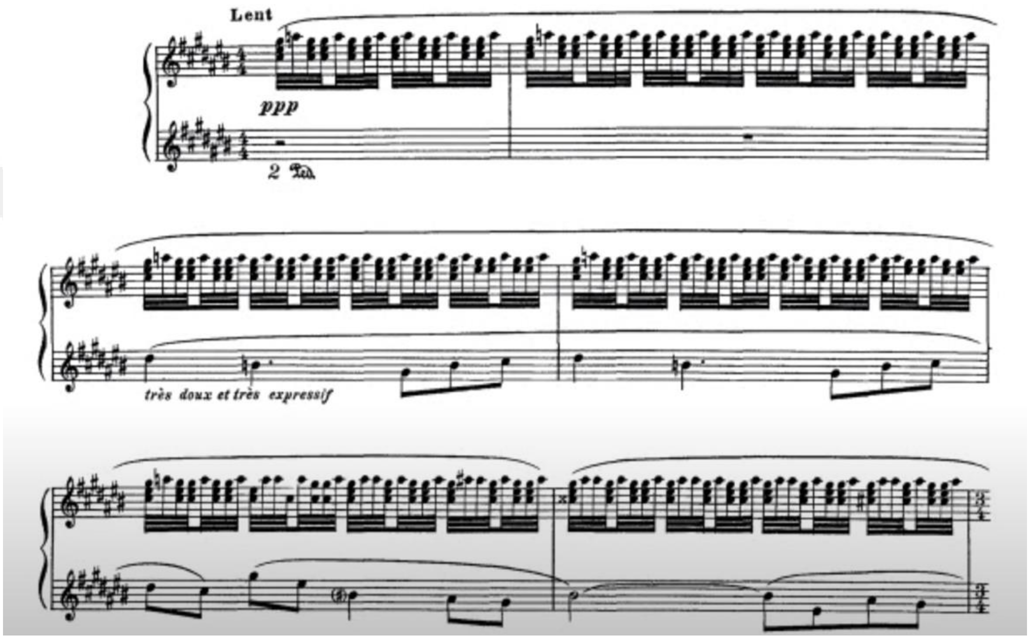


Figure 2.12 : Maurice Ravel, Gaspard de la Nuit, No. 1, "Ondine" (1909), introduction part, interlocking melody with accompaniment part.

The unique techniques applied by the composers of this period, based on harmony, rhythm, and ornaments, together with the descriptiveness of the Impressionist thought, became an important part of the evolution of musical texture.

2.3.2 Melody in Another Dimension, Klangfarbenmelodie

As mentioned in the introduction of the chapter, another important approach that plays a role in the evolution process of texture is considering the melody in another dimension, which is an important component of traditional musical texture. There are many elements such as rhythm, dynamic, tempo, articulation, timbre, which make up the melody with linear continuity. Concentrating on timbre, one of these elements, the melodic entity is defined not as linear continuity, but as timbral.

The concept of klangfarbenmelodie, introduced by Arnold Schoenberg in 1911, proffered one of the seeds of this change. Klangfarbenmelodie, which claims that the timbre transformation of a single pitch can be perceived as being equivalent to a melodic continuity, has been accepted as a practice in which successive tones gain a comparable importance to pitch (Cramer, 2002).

Melodies created based on timbres will also bring various musical possibilities. As Schoenberg says in Robert Erickson's book:

> If it is possible to make compositional structures from sounds which differ according to pitch, structures which we call melodies, sequences producing an effect similar to thought, then it must also be possible to create such sequences from the timbres of that other dimension from what we normally and simply call timbre. Such sequences would work with an inherent logic, equivalent to the kind of logic which is effective in the melodies based on pitch. All this seems a fantasy of the future, which it probably is. Yet I am firmly convinced that it can be realized (As cited in Erickson, 1975, pg. 13).

Klangfarbenmelodie, which means tone melody, extended the pointillistic approach by providing a different timbre for each note. The uniqueness of the qualities of individual notes is emphasized and enhanced (Cope, 1997). The use of Schoenberg's timbral transition between motives are given in image below (See figure 2.13).

Figure 2.13 : Arnold Schoenberg, Five Orchestral Pieces Op.16 Movement V (1909).

Anton Webern, a student of Schoenberg, is another composer who skillfully used a variation of the concept of klangfarbenmelodie with his pointillistic style and approach. Pointillism is a musical style that consists of separated notes, whic are are created using dynamics, articulation, spaces, and octave displacements, or any combination of these. The music's flow is affected by sharp leaps and gaps, and it is fragmented by the absence of recognizable pitch shifts, making it exceedingly difficult to locate and follow the destinations (Cope, 1997). His pointillistic style is closely related to the concept of klangfarbenmelodie (Hamberger, 2012). Webern's music contains motific segments that are defined by a single instrumental sound rather than timbral shift and note transfer, where the relationships between motivic elements are carefully calculated. The orchestral arrangement called Bach Ricercare can be given as an example (Erickson, 1975) (See figure 2.14).

Figure 2.14 : J.S. Bach, Ricercar a 6, orchestrated by Anton Webern.

Another important element in Webern's musical language is symmetry. In Five Pieces for Orchestra Op. 10, It is possible to see this symmetrical structure together with the timbral process. There is a timbral symmetry between the instruments, where motivic segments used are placed in a symmetrical form by reflecting each other with the timbral features of different instruments. As seen in the beginning of the first movement of the music, the celesta in the measures 1 and 10 are colored with bowed string harmonics, while the mirroring between the trumpet and the harp in the 10th and 12th measures are further examples (Zeller, 2020) (See figure 2.15). The concept of klangfarbenmelodie has an important place in the change of musical texture. Thinking about timbre, a significant trend of the 1900's, would bring about many approaches and techniques that would create further innovation in the texture of music. Sound mass and tone clustering is another example of this.

Figure 2.15 : Anton Webern, Five Pieces for Orchestra Op. 10 (1913) motivic segments.

2.3.3 Tone Clusters and Sound Mass

John Vinton referred to the sound mass and tone clustering trend in an article as follows:

> Composers began to show an interest in sound (as opposed to a particular classification of sounds) as soon as they began taking liberties with the metrical tonal system. This is not revealed in the use of new sound-sources but in the way composers used the sources at hand, and in particular by the increased attention they gave to timbre, to novel solo and ensemble effects, to density, chord spacing, register and other details of texture, and to subtleties of dynamics and articulation (Vinton, 1974, 307).

The sound mass can be described as the notes produced by numerous instruments combine to generate a large sound block and mass. Each sound assigned to the instruments is considered to have the same dynamic and attack characteristics in general. And although the individual characteristics and nature of these sounds are not clearly perceived, the primary result is a dense chord. Thus, the most essential qualities of the sound mass in the musical texture are its density, timbre characteristics, and gaps. The mass is usually continuous but it has restricted motions in itself (Besharse, 2010).

The genesis of the sound mass texture may be traced back to Henry Cowell's invention and application of pitch clusters on the piano. Pitch clusters, alternatively referred to as tone clusters, are dense chords generated simultaneously by the consecutive sounding of whole and half-tones and the chromatic scale structure (See figure 2.16). The performance note taken from the piano music in which Cowell uses the tone cluster is also shown in the image below (See figure 2.17).

Pitch or tone clusters are employed by numerous composers in orchestral and ensemble music as well as piano works. Early examples of clusters are seen in the music of composers such as Bela Bartok and Charles Ives, as well as Cowell. A little later, towards the middle of the 20th century and beyond, it is possible to see orchestral clusters in the music of composers such as Iannis Xenakis, György Ligeti, Krzysztof Penderecki (Besharse, 2010).

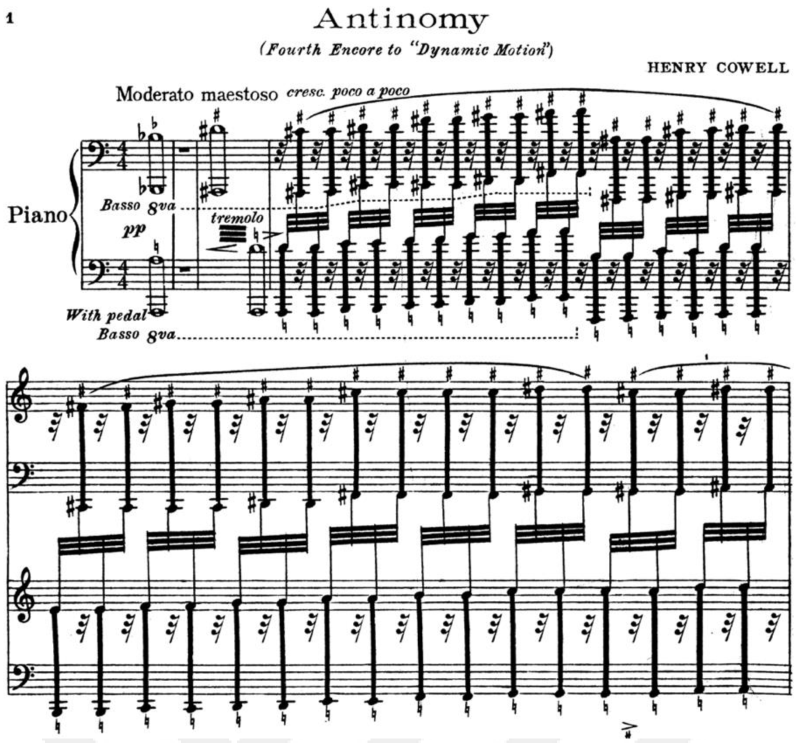


Figure 2.16 : Henry Cowell, Fourth Encore to "Dynamic Motion", IV. Antinomy (1916).

Figure 2.17 : Henry Cowell, Fourth Encore to "Dynamic Motion" IV. Antimony (1916), explanation of tone clusters.

Due to the amplitude level of the sound, its density ratio, and the spectrum region it covers, it is possible to conclude that the usage of tone clusters in the orchestral works results in a more noticeable and effective sound mass in the texture. According to Lester:

> In these works, clusters or bands of pitches are continually present; every semitone in every octave is played continuously. As a result, the very notion of pitch in these works becomes virtually indistinguishable from texture (Lester, 1989, pg. 287).

The use of sound masses is quite common in György Ligeti's orchestral works though his approach to sound mass differed from the fixed interval tone clusters used by Cowell, and in other piano pieces. Ligeti's orchestral piece, Atmosphères, contains sound masses with a canonical structure that are spread throughout the texture (See figure 2.18). In general, the texture of the music is formed of continually moving sound masses with unexpected gaps between them. Canonical sound masses created with the counterpoint approach are introduced gradually and faded unison when new instruments are introduced. The key elements that describe the texture of the music are the string section, which consists of massive sustained clusters, the canonical line with 48 voices, the linearly added pitches, sudden spaces, and stops (Rollin, 1979).

In terms of sound mass and sonic sound palettes, Krzysztof Penderecki is another composer with a variety of examples. Threnody for The Victims of Hiroshima, Penderecki's worldwide breakthrough piece, includes textured sound masses and clusters written on 52 string instruments. The cluster structure is written in the 18th measure of the music in the excerpt below (See figure 2.19). The instruments are divided into five cluster groups, each with its own set of pitches to be sustained for 20 seconds. In this instance, Penderecki abandoned traditional notation, in favour of written language that resembled the graphic notation. With the sequential entry of the instruments it covers, each cluster completes and lengthens its palette. At the end of this 20-second segment, five separate cluster groups are layered one on top of the other at different moments, forming the texture of the music and generating a dense sound mass. A symmetrical pitch set with microtones was employed, with density, range, and spacing all playing a significant role in the texture of the passages. Furthermore, the manipulated sound palettes throughout the music contribute to the evolution of the music's texture while also creating a large-scale contrast. The main sonoristic characteristics of the piece, such as rapid change, sharp contours, cut and overlapping micro-textures, melody, and its lack of pulse and meter, greatly show their effects, even in the first minutes (Maslowiec, 2008).

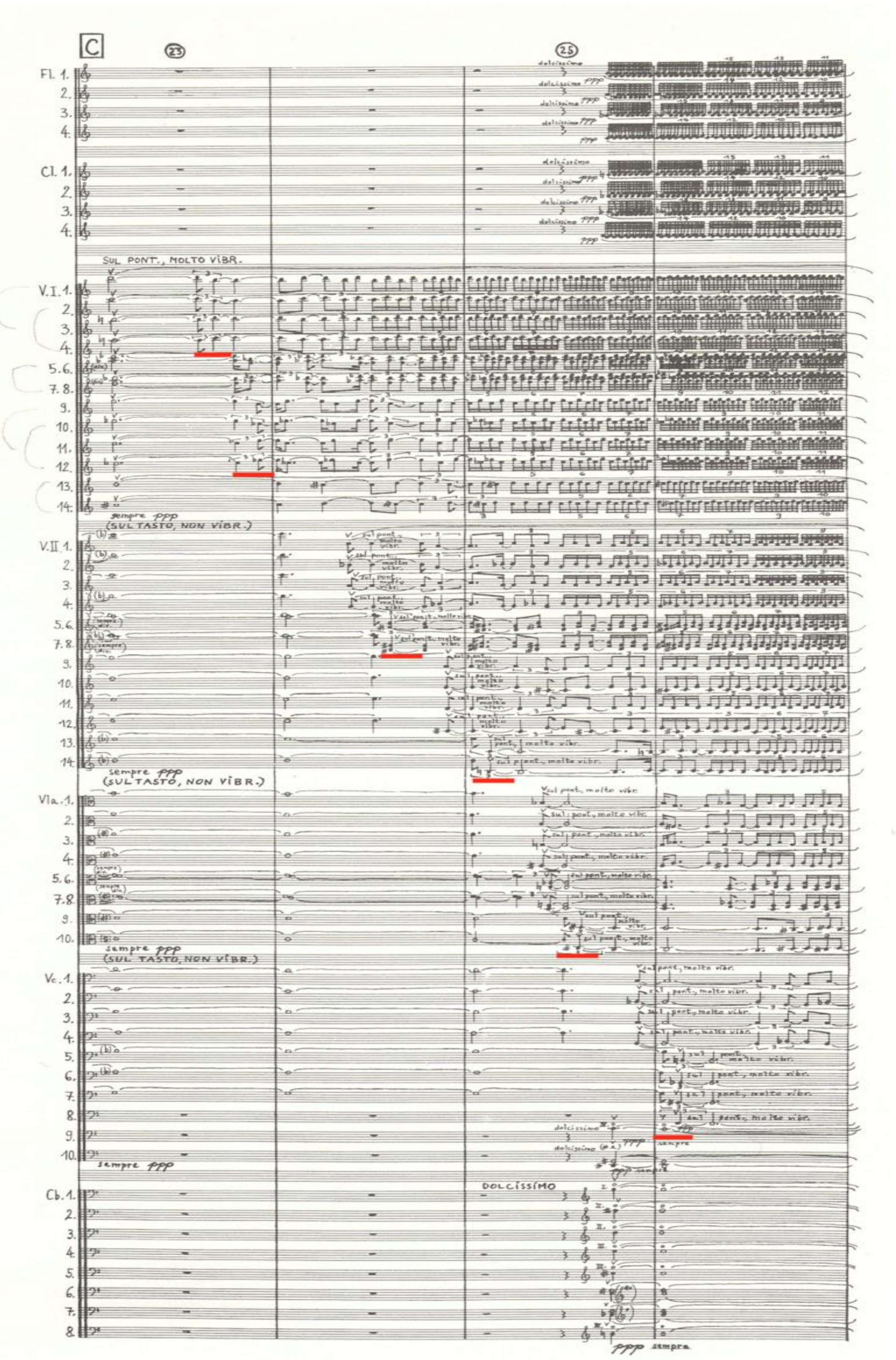


Figure 2.18 : Excerpt from György Ligeti's Atmosphères (1961), rehearsal mark C, canonic sound mass gradually introduced.

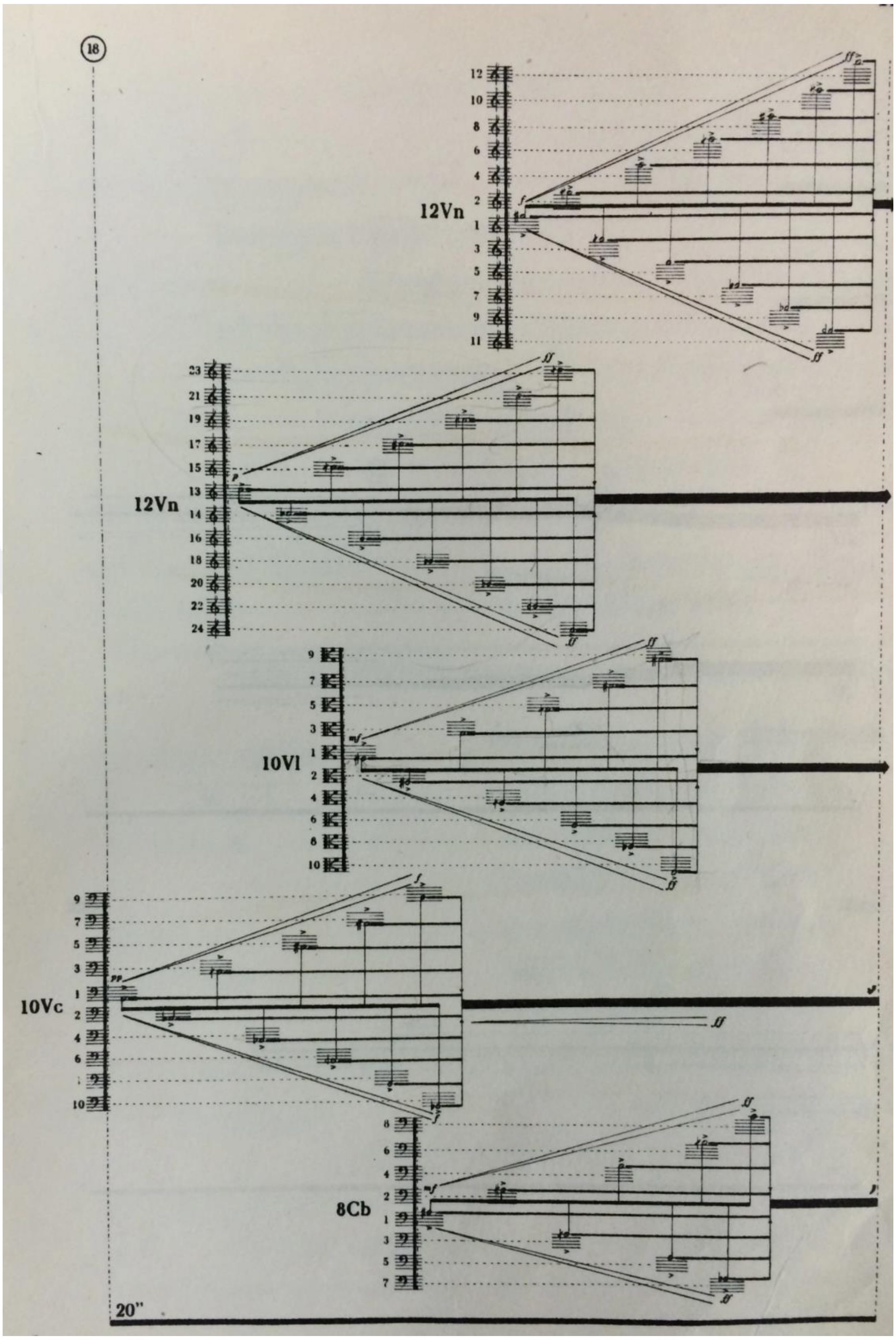


Figure 2.19 : Krzysztof Penderecki, Threnody for the Victims of Hiroshima (1960), m. 18, cluster groups.

Iannis Xenakis is another composer who makes extensive use of masses of sounds in his compositions. Xenakis coined the term "stochastic music" to describe a mathematical probabilistic approach to composing. This approach, which emerged in the years 1953-

55 when Xenakis introduced probability theory in music composition, was first seen in the compositions of Metastaseis (1953) and Pithoprakta (1955) written for orchestra. In Pithoprakta, the composer used these probability distributions to control orchestral sound masses. The use of probability functions in music, according to Xenakis, allows for a variety of techniques, enabling for example, the creation of , and articulation of sound masses inspired by the musical aspects of natural events such as hail and rain hitting hard surfaces, or crowds of hundreds of thousands of people (Luque, 2009). Metastaseis (1953) is a work that could be used as an example of a texture made up of sound masses in this sense (See figure 2.20). If we look at the beginning of the piece, the individual strings are introduced slowly, and a large sound mass is reached by using a glissando technique to cover the full register of the entire orchestra with increased dynamic intensity (Matossian, 1986).

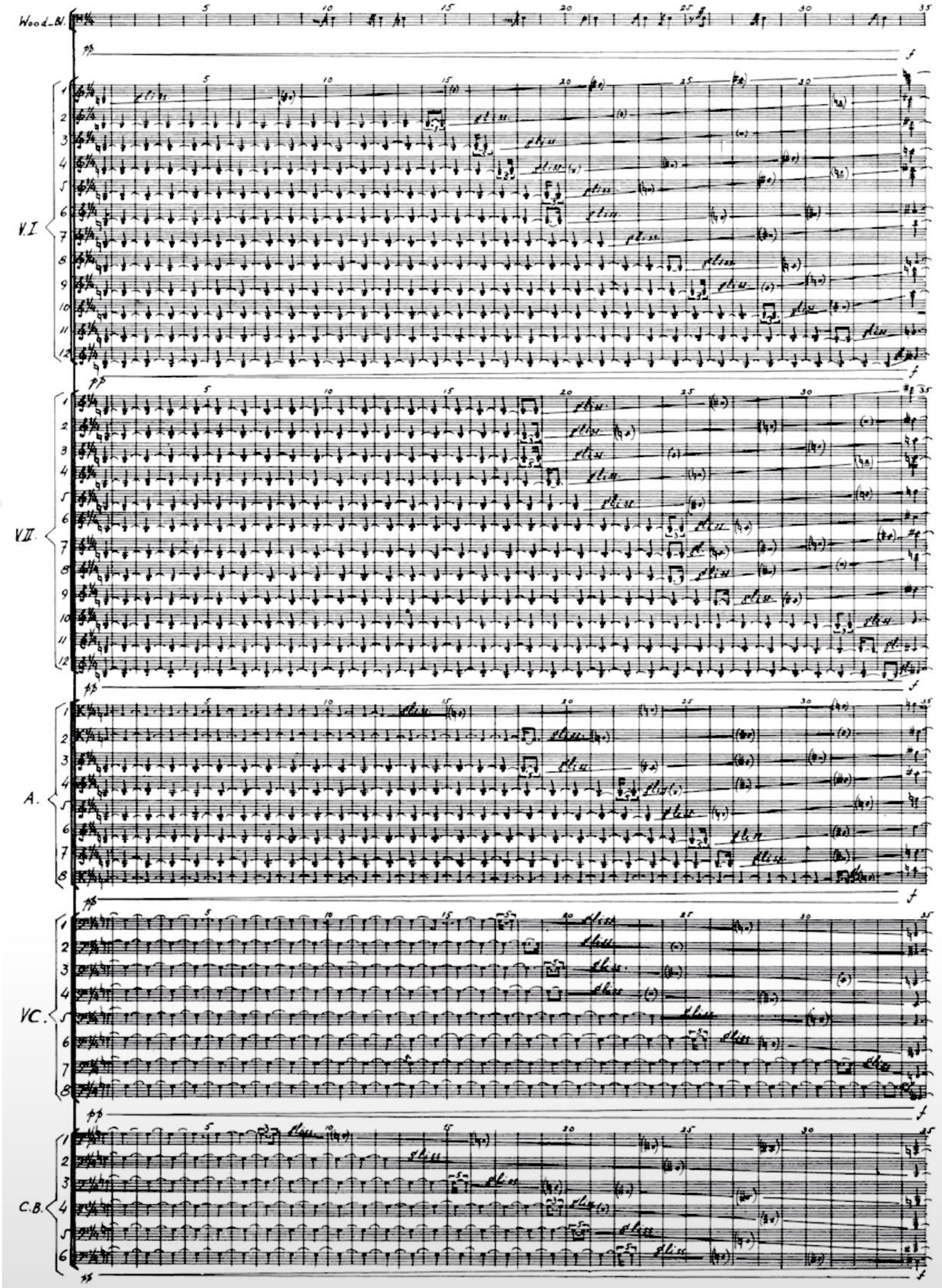


Figure 2.20 : Iannis Xenakis, Metastaseis (1953-54), opening sound mass.

2.3.4 Micropolyphony

Micropolyphony, which was developed by György Ligeti, was another key application that contributed to the evolution of texture. Sound mass generally represents a static sound block while micropolyphony denotes motion. In the following paragraph, Ligeti explains his reasoning for using this new term as well as the textural idea:

> I called this type of composition micropolyphony because individual rhythmic processes in the polyphonic network dip below the line where they become blurred. The texture is so dense that the individual voices are no longer perceptible as such and only the fabric as a whole is apprehensible as a superordinate form (As cited in Floros, 2014).

In Micropolyphony, the main compositional attitude is considered to be additive timbre and harmony, and composers create the texture of the music with this thought in mind. Similar to how a sound mass is generated, the resulting qualities are created by combining the outputs of all the sounds that contribute to the texture together. The focus is on the elements coming together to form a blurry structure and creating a mass by creating additional timbre, rhythm and density. Ligeti's unique idea of polyphony is based on the concept of smearing, a psychoacoustic phenomenon. Smearing can be defined as an auditory mechanism limit that blurs together and becomes indistinguishable as a result of several tones following each other very quickly. Ligeti worked on this idea in his electronic music studio (Besharse, 2010). Ligeti makes the following statement to express his approach:

> When I want to work with the phenomenon of smearing I must take into consideration that each instrument is able to play tone successions no faster than 1/16 of a second... If I want to compose with smearing, I must interweave several voices with one another... I chose the term "micropolyphony" for the technique of weaving many voice (As cited in Besharse, 2010, p. 62).

As a result, Ligeti effectively blended a variety of quick, slightly shifting sounds together to create a micropolyphonic texture to achieve the desired effect. His large-scale orchestral composition named Requiem, composed for soprano, mezzo-soprano, choir and orchestra between 1963-65, and Atmosphères (1961) are important examples of micropolyphonic texture application (See figure 2.21).

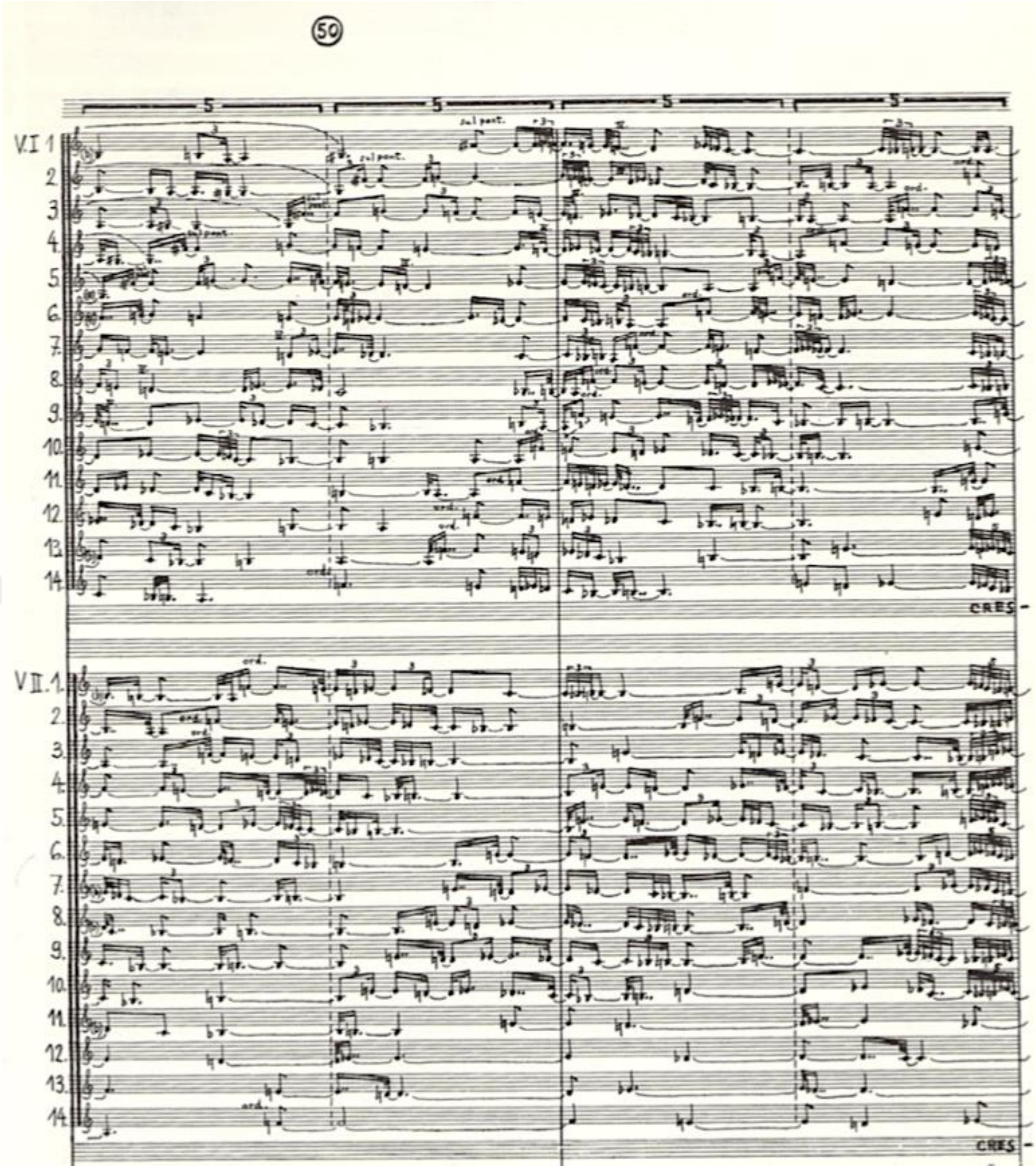


Figure 2.21 : György Ligeti, Atmosphères (1961), rehearsal mark 50, micropolyphonic texture on violins.

Constructed with a micropolyphonic texture, Requiem can also be associated with the metaphor of the sound of a train that slowly progresses from the lowest depth to the higher. It might also be thought of as a polyphonic texture intensified with chromatic pitches (Floros, 2014). Traditional compositional methods were almost entirely absent from Ligeti's 1960's music. For instance in his large scale composition Atmosphères rhythm, melody, and harmony are eliminated from the music. A prominent characteristic of such music is a structure that works in favor of texture and timbre. There is no perceivable melody, harmony is constructed of clusters and sets of semitone-derived masses. His self-described micropolyphony is realized by a complex and helical texture that transcends audible counterpoint. It contains a compositional style that develops completely new foundations for the time period (Searby, 1997). Atmosphères (1961) was immediately performed throughout the world, recorded several times, and then widely imitated (Griffiths, 2010).

2.4 Timbral Approach

Along with the modern orchestra in the 20th century music, instruments began to be used in a more flexible way with their identities becoming more active. The enrichment of the sound repertoire and the flexibility of standardized sound hierarchies led to the creation of timbre blends within complex objects (Boulez, 1987). Tone, one of the important issues of 20th century, started to become an important element of music. As mentioned in Schoenberg's concept of klangfarbenmelodie, which he described as a timbre-melody in the previous section, the tendency to focus on a single sound has grown exponentially over the years. In fact, timbre is a musical term that comes to designate more complex tonal qualities, but the meaning of this term has not been fully defined. It can be used to determine the tonal characteristics of the sound obtained from an instrument family or a particular instrument. Timbre, which means the color or quality of sounds, can also be conceptually separated from pitch and loudness (Grey, 1975). If we talk about the different definitions and approaches to timbre, the explanation approved by the American Standards Association in 1960 was as follows:

> Timbre is that attribute of auditory sensation in terms of which a listener can judge that two sounds similarly presented and having the same loudness and pitch are dissimilar. Timbre depends primarily upon the spectrum of the stimulus, but it also depends upon the waveform, the sound pressure, the frequency location of the spectrum, and the temporal characteristics of the stimulus (As cited in Grey, 1975).

Even the most quoted definition has led to many different interpretations. According to Grey, it can also include any acoustic subsets other than note and pitch, as deduced from this explanation (1975, p.1). Merriam-Webster defines timbre within the framework of two perceptions: the quality given to sound by its overtones, such as the resonance by which the ear recognize and identifies a voiced speech, or the quality of tone distinctive of a particular singing voice or musical instrument. In this definition, resonances and the original overtone qualities of the source that produces the sound come to the fore. In Oxford Music dictionary, timbre is explained as a term describing the tone quality of the sound. For example, clarinet and oboe, which sound the same note with the same loudness, produce different timbres, but have a more complex quality than pitch and loudness, which can be represented as high-low for pitch and soft-loud for loudness. The timbre is the synthesis of various factors. The frequency spectrum of a sound, the growth rate and diversity in amplitudes of its different partials are of great importance for characterizing timbre (Campbell, 2001).

Composer Michel Chion approaches tone/timbre with a similar definition. Tone is a sonic physiognomy, which we define as sounds emanating from a source, whether imaginary or real (As cited in Smalley, 1994). In this definition, it is briefly considered as a term used to determine the physical characteristics of the sound source.

In the continuation of the section, while looking at the relationship between timbre - which is a multidimensional term - and the texture of music, attention will be drawn to the functions of timbre as an important component of texture and the new layers it brings with it, rather than its psychoacoustic dimension.

Among the main elements of textural development, as mentioned before, are the density of sound, spaces and the relationship between voices. Elements such as pitch and timbre can be considered as secondary micro-elements that contribute to the texture, but when many individual tones with different characters come together, an ambiguous relationship will emerge between texture and timbre. For example, when looking closely at an impressionist painting, it may be possible to see individual brushstrokes and different colored layers. When viewed from a farther distance, separate colors start to become blurred, forming a new formal whole, a new color emerges. If we associate this example with music, the different sounds coming out of the instruments and the different timbre qualities of these sounds will directly affect how we hear the texture. A new set of timbral ensemble will be created. In this case, timbre becomes a multidimensional physical feature especially for multi-layered additional textures created in 20th century music (Besharse, 2010).

> The role of color or timbre would be completely changed from being incidental, anecdotal, sensual or picturesque; it would become an agent of delineation like the different colors on a map separating different areas, and an integral partofform (As cited in Erickson, 1975, p.52).

If we consider some of Edgard Varèse's music from the mid-twentieth century, such as Deserts (1950–54), the stratification of the texture comes to the fore with the use of ensemble timbre. The piece utilizes the ambiguity between the general texture and the individual elements of the texture, which includes the chord pitches and their composite sounds . As with the music of Varèse, the timbral approach, called fused ensemble timbre in the texture of orchestral and ensemble music, is also effectively seen in the music of Pierre Boulez. In this approach, timbral individuality is drowned in a more generic sound of the total in these blends mix of the conducive components. Boulez's music for Pil Selon Pli (1962), written for solo soprano and orchestra, is characterized by loud, rapidly decaying sounds that form a unified musical object in which numerous separate instrumental timbres are dissolved (See figure 2.22). In comparison to Varèse's ensemble timbre, textures with a higher diversity and number of individual instrumental timbres are apparent (Erickson, 1975). In most parts of the music, it is seen that almost all individual notes are heard in various instrumental timbres.

Figure 2.22 : Pierre Boulez, Pli Selon Pli, IV. Improvisation III sur Mallarmè (1962), rehearsal mark 41.

As an example of the relationship between timbre and texture, we might look at post-spectral composer Kaija Saariaho’s 1980 composition "In Traume". Here the composer uses non-dynamic harmonic material to give color to the ensemble in this piece for cello and piano. The material provides areas that are modified by a variety of events occurring at the timbral and texture levels of the composition. She endeavoured to produce static textural networks at various levels in which tensions are created with traditional instrument techniques and extended techniques that form part of the harmony (Saariaho, 1987).

Along with the timbral perspective, new approaches and applications based on the concept of harmony evolved in the texture of the music. Harmony is comprised of chords, which are a component of the texture. The technique of sound synthesis, as discussed in Chapter 1 of this thesis, brings a harmonic approach to timbre, allowing the construction of harmonies through timbre and the establishment of timbre as a form of harmony. A basic pitch is formed by combining spectral components, and as such, it is a chord. Similarly, a chord is a collection of partial components, and is thus referred to as a timbre. The fact that harmony and timbre can be associated in this way enables manipulations of timbre to be used to explore new scales capable of reproducing particular concepts in harmony, such as consonance and dissonance. This link between timbre and harmony is apparent in the works of several spectral composers, including Grisey, Murail, and Saariaho (Pressnitzer, McAdams, 2000). The textural forms formed by the timbre harmonies generated by sound synthesis will be demonstrated more clearly in the following chapter. Regarding the unity of timbre and harmony, Murail makes a statement as follows:

> Most of my pieces, in fact, are built on structures which are not direct spectral observations: this is what I call frequential harmony. These harmonies are conceived outside the domain of equal temperament, even tempered quarter- or eighth-tones and form an unlimited harmonic realm, which happens to be contiguous to timbral space; thus placing us in a domain where harmony and timbre are more or less the same thing (Murail, 2000, p.8).

As mentioned in the previous heading, timbre is also a prominent component in György Ligeti's music. In addition, timbral approach plays a significant role in the music of composers such as Olivier Messiaen, Giacinto Scelsi and Karlheinz Stockhausen, as mentioned earlier.

3. TEXTURE IN FRENCH SPECTRAL MUSIC

3.1 Instrumental and Orchestral Synthesis

The relationship between spectral music and texture can be explored in several ways. The first is to offer insight on the structural aspect of pure tone analysis, which is the primary focus of spectral music. The sonogram machine, an important technical device in spectral music, is a tool for visually describing the sequence of frequencies that make up the sound itself. When we examine the sonogram data, we notice that the temporal plane is divided into horizontal and vertical axes. This graph, which represents the components, frequency data, and amplitude of the sound, will also provide us with a new visual representation of the data for each specific sound (Besharse, 2010) (See figures 3.1 and 3.2).

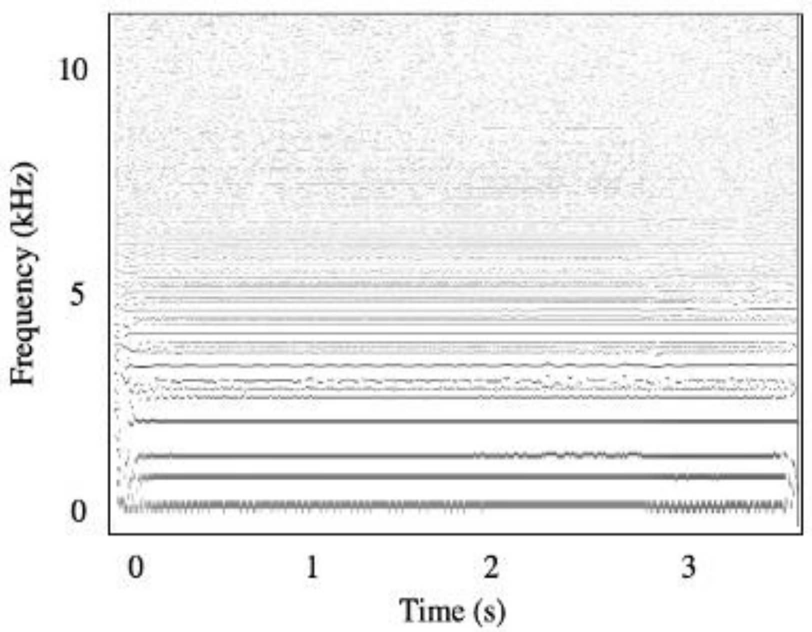


Figure 3.1 : Sonogram of a cello playing D2 note.

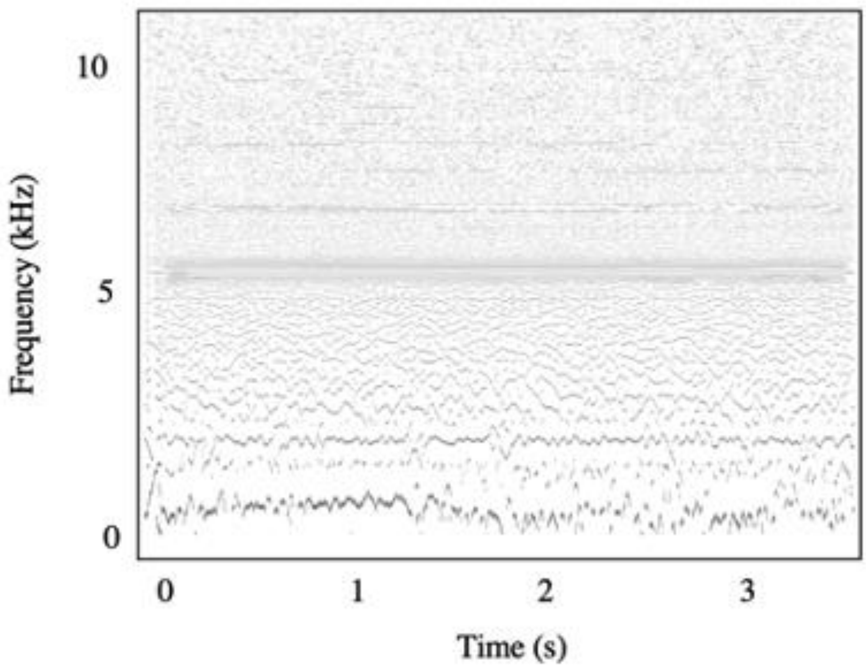


Figure 3.2 : Sonogram of a flute playing D#4 note.

As can be seen in the sonogram graphics above, the sounds produced by each of the two instruments have a unique visual structure. Kari E. Besharse (2010), in the book "The Role of Texture in French Spectral Music", makes an analogy to the relationship between spectral music and texture, saying, "Spectral music is by its very essence a textural music because the spectrum itself is already textural, sculptural in nature" (p.78). It is possible to say that music contains a textural structure both horizontally and vertically within the temporal flow. In composition, the composer creates a horizontal and vertical structural and textural organization in the flow of time. When we consider the score, we may notice that the frequencies in many spectral music pieces are stretched as continuous and structured horizontal lines.

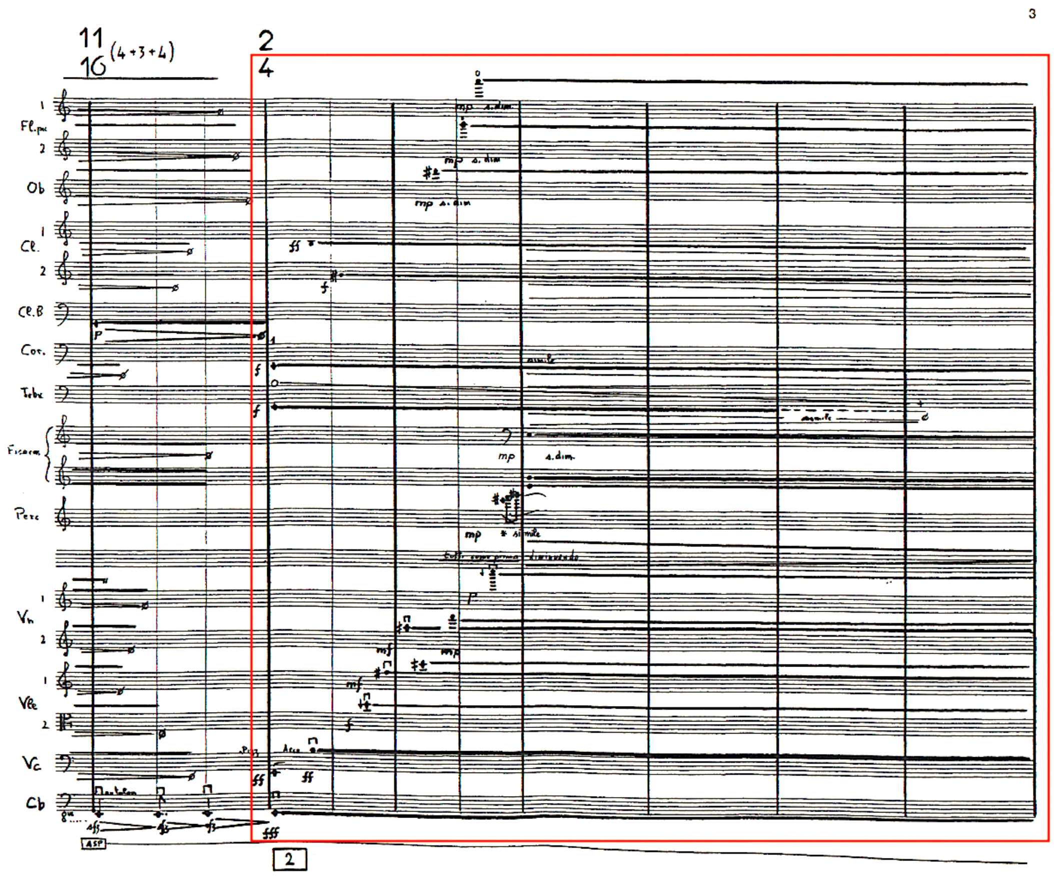


Figure 3.3 : Gérard Grisey, Partiels (1975).

Gérard Grisey was the first spectral composer to apply sonogram analyses to the composition process. In the work "Partiels", Grisey used the sonogram of a trombone playing the E1 pitch. From here, he converted the frequency and amplitude data he obtained into musical notation and orchestrated it. Orchestral synthesis was applied by assigning each partial to different instruments. When examined texturally, it is clear that the spectrum material used in Grisey's Partiels is distinct and mostly divided in horizontal and vertical lines throughout the instruments. This is presented in the figure below (See figure 3.3). The spread of the spectrum to all orchestral parts and the construction of massive sound blocks, as seen in Grisey's Partiels, lead to another significant texture type in spectral music: "Sound mass." In other terms, it's referred to as "Fused Timbre." The origin of this texture type dates back to the early 20th century, with Henry Cowell's invention of pitch clusters, explained in detail in the previous section.

3.2 Static Soundmass

In Chapter 2, sound mass was defined and examples were given in the context of tone clusters. The texture applied in the spectral period includes a significant amount of static sound mass. We have already seen how Grisey transfered the sonogram data of a trombone sound to the orchestra. When used in this manner, instrumental and orchestral synthesis create static sound mass, one of the common texture types in spectral music. Composers such as Grisey and Murail used slow and perceptible changes in the texture of their music and static sound masses that evolved gradually over time. As an example, we might look at Murail's composition "Sables." Murail uses the following words to describe the music's texture:

> The music of Sables is a music made from masses of sound, where individual notes are nothing more than grains of sand, bereft of significance, but whose accumulation furnishes the music with both its form and its content, just as grains of sand supply a dune both shape and substance (Murail, 2005, pg.123).

As previously stated, Grisey's Partiels example vividly demonstrates the static sound mass texture created with the instrumental synthesis technique. The content of the formed sound mass and the stage of its production might be examined in order to investigate the texture's formation process. The forte attack of the trombone is heard at the beginning of the work, along with the repeated gesture of the double bass with decreasing determination, while the sustained trombone sound gradually rises. This trombone sound seeks to achieve metamorphosis by participating in timbre fusion, which involves orchestrating and forming the frequency and amplitude data of a certain sound, which is again obtained from the instrument itself. While the underlying trombone color can still be heard, a new sonic field emerges (Fineberg, 2000). This results in sound masses that are both continuous and static, forming the texture of the music (See figure 3.4). In addition, regarding the impressiveness of music, after Grisey and Murail, most second and third generation spectral composers stated that their interest in the musical potential of the sonic phenomenon was based on their first time hearing this music (Fineberg, 2000).

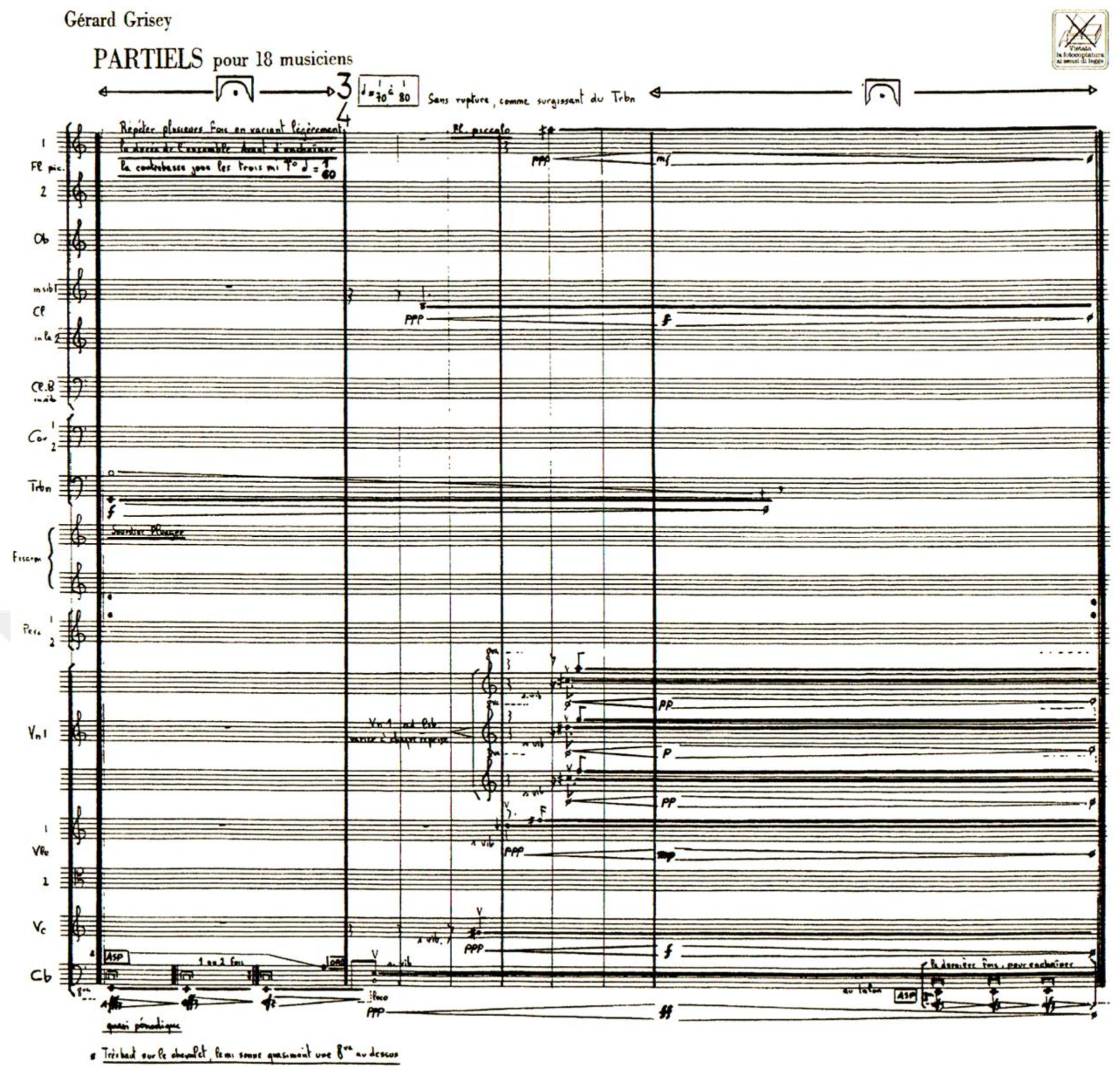


Figure 3.4 : Gérard Grisey, Partiels (1975) opening section.

Textures containing this static mass are frequently embellished with melodic gestures, percussive elements to emphasize the entry of individual notes, and rhythmic variations. The texture of the music is diversified over time by combining these elements with the timbre component and changing the density and spatial distribution of the sound. In many spectral works, distortions gradually occur in the fundamental harmonic spectrum, the instability and tension are increased with created fusion. Static sound mass textures that are diversified with similar applications can be found in the music of Tristan Murail (Besharse, 2010). Desintegrations (1983) by Murail, was composed for 17 instruments and computer generated tape. The score example below shows this static texture, with a section matching to the first minute of music (See figure 3.5). Murail made the following statement about the general content and focus of the piece:

> Désintégrations was composed after extensive work on the notion of "spectrum". All the material used in this piece (that on tape as well as in the score), its microforms, its systems of evolution, have as their origin analyses, decompositions or artificial reconstructions of harmonic or inharmonic spectra. Most of the spectra are of instrumental origin. Those particularly employed are low piano sounds, brass, and cello sounds (Murail, 1983).

Throughout the composition, numerous sounds with distorted natural spectra are used extensively. The harmonic spectrum formed in this direction is gradually extended in certain parts, and the colors to be emphasized are strengthened by extracting specific sounds from this spectrum and adding new ones over time (Fineberg, 2000).

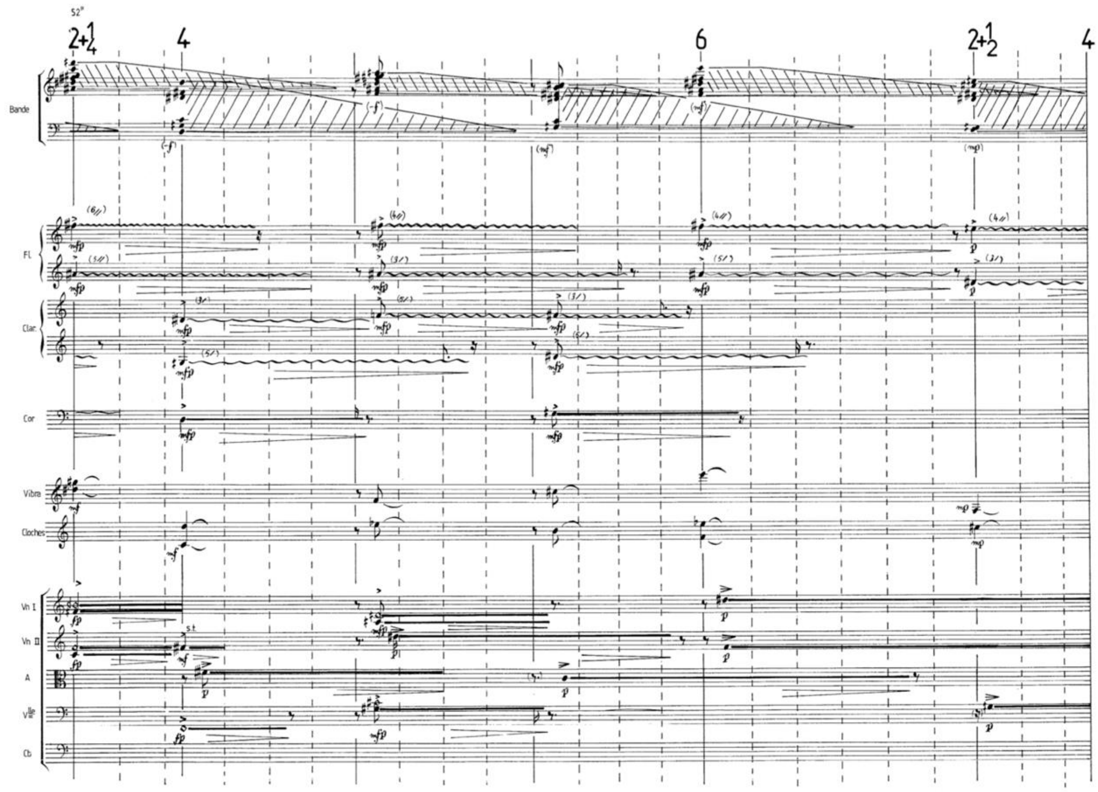


Figure 3.5 : Tristan Murail, an excerpt from Désintégrations (1983).

Additionally, static masses could be found in the music of composers from the post-spectral period such as Philippe Hurel and Kaija Saariaho. Hurel is renowned for creating more independent forms than early spectral music models. This is demonstrated by his sparing use of subliminal transformations during formal transitions. Hurel's Pour L'Image (1987) is composed of a series of variations that transform into one another, and determining the entry and exit points of a variation is extremely difficult (Pugin, 2001).

Static sound masses of varying densities and speeds frequently contribute to the texture of music in this variation form (See figure 3.6).

Figure 3.6 : Philippe Hurel, Pour L'Image (1987), rehearsal mark C.

As is the case with a large number of Kaija Saariaho's orchestral compositions, static sound mass textures appear in Verblendungen (1984). In Verblendungen, a work for orchestra and quadrophonic tape with a radical stylistic design, the tape introduces noise and intense sound bands; and while these sound bands rise towards the consonant spectrum, the orchestra moves in the opposite direction and drifts from the harmonic material created at the beginning towards a dense noise texture (Anderson and Saariaho, 1992). At times, these drifting, noisy, and dense fused timbres generate static mass textures in music.

The examinations in this chapter on the music of various composers show that the texture type consisting of sound masses is extremely distinctive and prevalent in French spectral music. The following chapter will look into the layered textures and the micropolyphonic structures that are employed or layered within them.

3.3 Layering and Micropolyphony

Micropolyphony, as well as the existence of static mass texture, could be said to be effective in spectral music. While the presence of sound masses in texture is static and gradual, micropolyphonic textures generally represent energy and motion. As a result, spectral micropolyphony in music preserves spectral material and timbre fusion while also contributing to the material's more unstable and active progression. Micropolyphony, as observed in static mass textures, can create a wholistic and moving mass formation accompanied by rhythmic, pitch-based, and timbre evolutions that occur in individual sounds in spectral music, similar to Ligeti and other composers' textures. Rather than individual sounds perceived in musical texture, the main output is the composite properties of the whole (Besharse, 2010).

In spectral compositions, layered textures are one of the most common texture types. This texture type, which is formed by adding many sounds or spectra formed by different instrument groups, includes a layered structure sometimes with micropolyphony and sometimes with sound masses. This can be seen in Grisey's Modulations. Numerous instrument combinations are folded over each other to create a wide and dense sound mass. The simple micropolyphony established between a few distinct instruments in this piece evolves into richer micropolyphonic textures with the addition of more voices over time, and the resulting sound mass becomes the main focus (Besharse, 2010) (See figure 3.7).

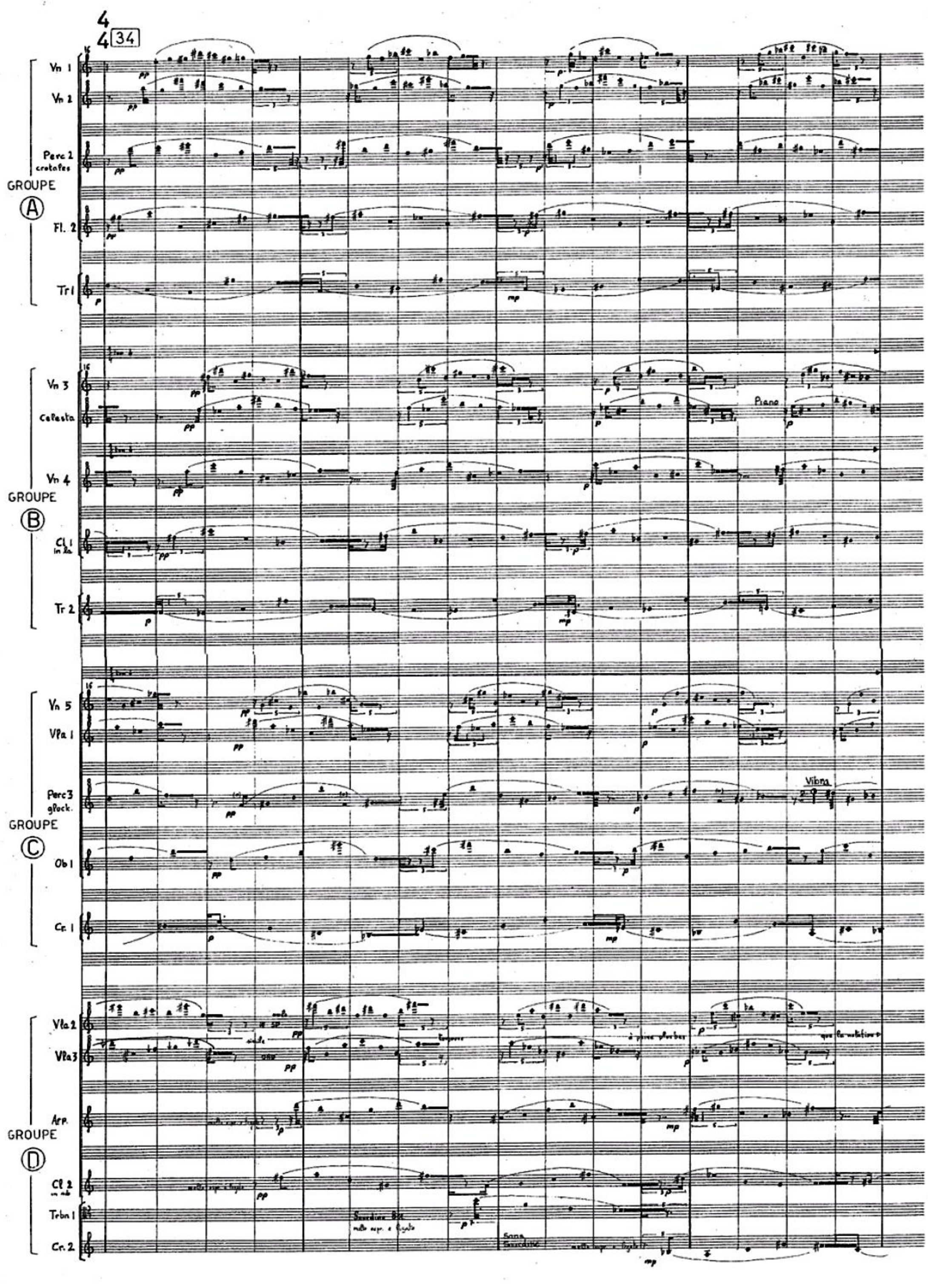


Figure 3.7 : Gérard Grisey, Modulations (1976), excerpt from the rehearsal mark 34.

In Talea (1986), written for five instruments, with a lower density compared to the previous orchestral piece written by Grisey, a micropolyphonic texture reminiscent of Ligeti's texture on a small scale is evident. In micropolyphony, very fast rhythms and a dense use of pitches are usually observed. The micropolyphony seen in Grisey's music however, is generally slower, more static, with the emphasis being on sound masses rather than typical polyphony (Besharse, 2010). In the example of Talea (1986), the sounds are not constant and continuous; the use of gaps in some layers create an interruption. Instead, a layered polyrhythmic texture is seen consisting of sequential motives that ascends and descends in a certain range scale. It differs from the usual micropolyphonic features, but due to the note diversity, intensity and lack of continued rhythmic alignment, it causes the focus to be on the overall effect of the texture (See figure 3.8).

Figure 3.8 : Gérard Grisey, Talea (1986), rehearsal mark 15, micropolyphony.

Micropolyphonic textures are regularly employed in the music of another spectral composer, Philippe Hurel. When creating his music, Hurel employs techniques that emphasize the progressive transition of sonic material from one section to another. All of these continuous transitions are usually handled using more conventional variation forms (Lelong, 2001). Especially in the music of Pour L'Image (1987) and Figures Libres (2000), it is possible to encounter accentuated, sharp, sometimes continuous and scattered micropolyphonic texture (See figure 3.9). In Figures Libres, texture is placed into a faster, slower, and accentuated micropolyphonic development over time, and it is activated and deactivated in specific sections of the music (See figure 3.10).

Figure 3.9 : Philippe Hurel, Figures Libres (2000), mm. 16-22.

Figure 3.10 : Philippe Hurel, Figures Libres (2000), mm. 62-71.

In the music of Tristan Murail and post spectralist composer Kaija Saariaho, the use of micropolyphony is often seen in small instrument groups distributed over layered textures in the orchestra, and they exist for a shorter period of time. They are not used in a form that has developed over time and spread to a significant part of the texture. Saariaho's orchestral composition Du Cristal (1989) could be used as an example of how micropolyphonic passages are used in layered textures (See figure 3.11). The overall important characteristic of music is the continuously drifting orchestral sound mass. In this respect, it is possible to say that the piece has an approach inspired by multi-layered orchestral works such as Atmosphères or Lontano by Ligeti, and the spectral music texture of Grisey and Murail.

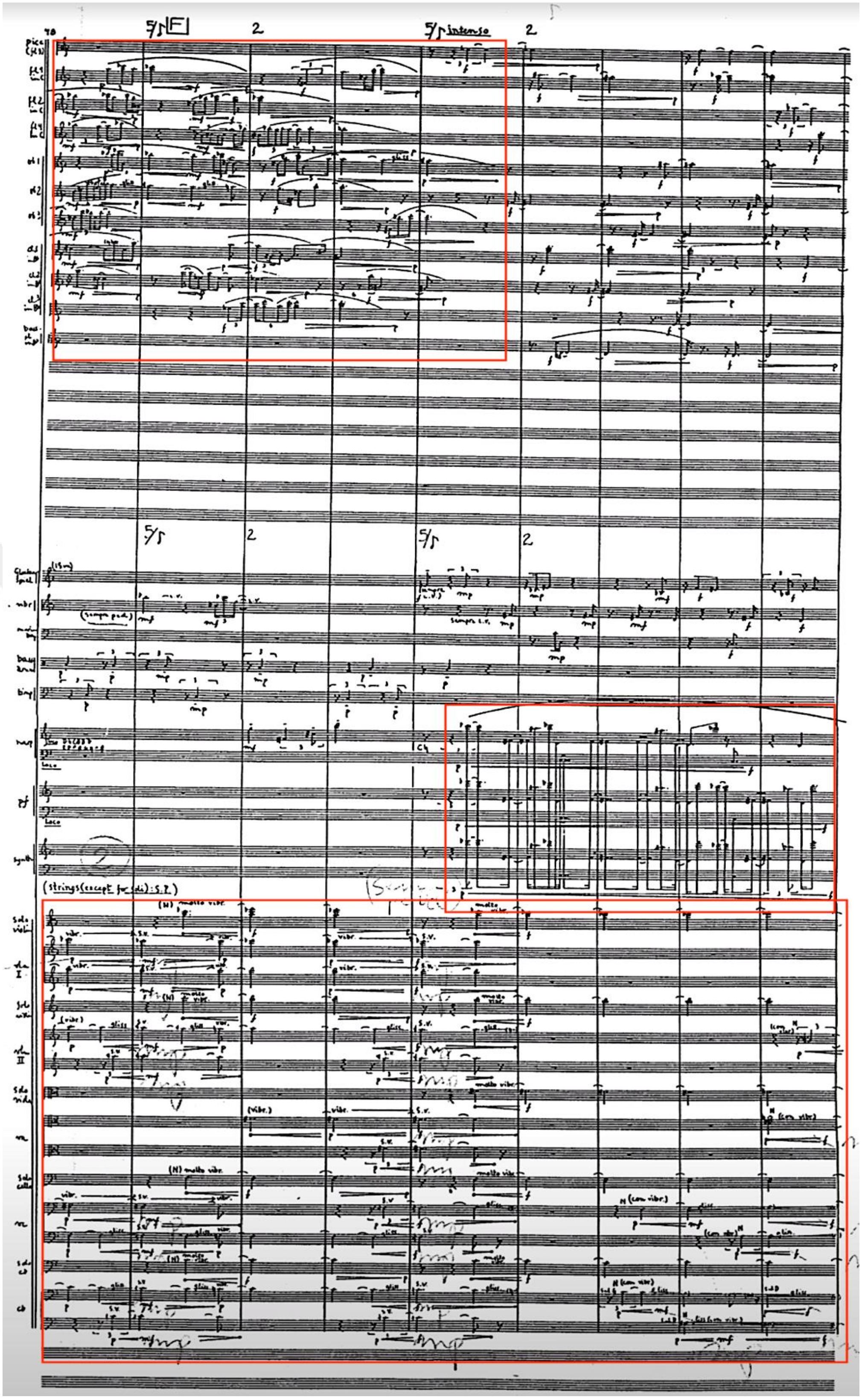


Figure 3.11 : Kaija Saariaho, Du Cristal (1989), mm. 78-86.

In spectral music, the most prevalent forms of layered texture are those that emerge from layering micropolyphonic parts with a static sound mass. While instruments that generate static sound masses have prolonged sounds, instruments or instrument sets that generate micropolyphony have quicker rhythms and motivic fragments. These sub-textures are prevalent in various instrument families, depending on their timbre characteristics. While winds typically apply a micropolyphonic structure, the static mass structure is provided by the strings (Besharse, 2010). Tristan Murail's L'Esprit Des Dunes (1994) for 11 instruments and electronics contains polyrhythmic quick figures, including wind instruments, set against layered static sound masses. This textural effect appears on a recurring basis throughout the piece (See figure 3.12).

Figure 3.12 : Tristan Murail, L'Esprit Des Dunes (1994), mm. 286-290.

In this chapter, significant textural features such as instrumental and orchestral synthesis, static sound masses, layered textures, and the use of static sound mass and micropolyphony in layered textures in French spectral music were discussed using examples from the pieces by Tristan Murail, Gérard Grisey, Kaija Saariaho and Philippe Hurel, all being notable names in spectral music.

4. THE RELATIONSHIP BETWEEN TEXTURE AND TENSION IN EARLY FRENCH SPECTRAL MUSIC

4.1 Tension and Release Process in Western Art Music in General

The study of tension and resolution has long been important to Western music theory, and is still the subject of ongoing discussion. Music consists of structured sounds. By examining and interpreting, these structures can evoke a personal musical experience for the listener. This experience may also be linked to emotional experiences. The transformation of these parts into emotions and reactions is a multi-layered process. It is just as complex. The concept of tension and dissolution in music is the key to obtaining information about this process (Farbood, 2006). Musical tension analysis and studies can be considered from two different perspectives. One is cognitive and perceptual, the other is the more traditional analytical approach associated with technique and parameters of music. If the definitions in the literature are examined, the data shows that the concept of tension is considered on a cognitive and technical basis.

In music, tension and release are frequently referred to metaphorically as a dynamic process by musicians and composers. As Farbood (2006) said previously, musical tension may generate a variety of non-musical emotional responses in the listener, such as tension in the body or in social situations. These similar life experiences create a convergence of meaning for tension between individuals. This has led to the consideration of musical tension as a practical indicator of emotional experience, with scientific research associating it with emotional experience. Music theorists typically address tension in a piece of music through the angle of phrasing structure. According to certain empirical investigations, tension builds up throughout the sentence, peaks near the finish, and then tends to decrease. According to Storr (1972), the basis of all uses of tension is in its relationship to the inevitable decrease in tension, "release" (As cited in Vines, Nuzzo and Levitin, 2005, p.138).

Tension in music is closely related to the formation of expectations, the violation of expectations, and the expectation of solution and resolution (Koelsch, 2012). Parallel to this definition, similar to Storr's tension-release relationship, another explanation states that tension in music is directly related to the listener's expectation. The listeners expectation to release or relax, according to Vernon, is what creates tension in music. The usage of elements in the composition as well as some techniques may help to build this expectation and increase tension. Parametric moves such as repetition, dynamic increase, gradual or rapid motion to high or low pitches, and syncopations in consonance and dissonance may create tension (Vernon, 1975). Despite this definition, which states that listener-oriented expectation can be changed by different applications of musical parameters, attention could be drawn to Farbood's explanation. Farbood (2006) states that musical tension is difficult to measure but relatively easy to describe in qualitative terms. Increasing tension can be defined as a sense of culmination or an increase in uncertainty, while decreasing tension can be defined as a feeling of dissolution and satisfaction. However, there is no universal concept of theory that explains how different musical parameters are combined in the process of creating a general feeling of tension (Farbood, 2006).

Musical tension, according to Farbood, is subjective and multidimensional. Therefore, it is a difficult concept to formalize. Farbood presents a quantitative, parametric model of musical tension based on the empirical data acquired during experiments in his study on global modeling of musical tension. Throughout this process, musical parameters such as harmony, pitch height / treble, melodic expectation, onset frequency, tempo, and rhythmic order were taken into account when preparing the samples given to the subjects. At the end of the study, it was emphasized that, given that the modularity of factors are dependent on the musical and cultural backgrounds of the listeners, some reasonable estimates can be made even if the possibility of finding a truly global model seems impossible. However, even if the listeners have the same listening background, it is underlined that the perception of a high-level phenomenon such as tension in music is subjective and open to individual interpretation (Farbood, 2008).

In addition to the cognitive approach, the concept of consonance and dissonance based on sound intervals has been accepted and applied in classical music theory as a tension-resolution relationship. Perfect consonance includes P1 (unison), P8 (octave), P4 and

P5 intervals, while imperfect consonances are intervals of 3rd and 6th, and dissonance occurs in the 2nd and 7th intervals. In acoustic theory, dissonance in the sound occurs as a result of the physiological response to the "beat" phenomenon determined by features such as distance between notes, loudness, and their overtones. It has been argued that as the beats increase, we experience higher tension. Beats and accents are not produced by consonant intervals. These two concepts are associated with absolute intervals in an equal temperament tuning system. The concept of tension has been linked to the musical structure's continuity in this context. The consonance has a low tension since it is static and stable, hence it does not require continuity. Dissonance, on the other hand, includes high tension because it's dynamic and unstable. It necessitates the relief of this tension, hence its continuance (Leeuw, 1964). The fact that the interval connection between notes and their motions are the factors that contribute to tension and resolution in music, demonstrates how melody and harmony play a significant role in determining tension. As a result of this, it is possible to conclude that this method is suitable for identifying tension and resolution in tonal music composed within the framework of melody and harmony, or in works composed in the equal temperament system, which include melody and harmony components. However, when evaluating the dissonance effect that increases tension, music theorist Wallace Berry emphasized that factors such as the degree of simultaneity of pitch movements, the registral levels at which they occur, the dynamic levels, the relative timbres, the articulation style, and the rhythmic values of the notes are also significant factors that affect the severity of the dissonance effect. For this reason, interval differences and note degrees are only one of several elements considered when evaluating the dissonance that generates tension (Berry, 1976).

Cadences are another example of a tension-resolution relationship that is known in classical tonal music harmony. A prime example is authentic cadence. This musical event occurs when the major chord built on the dominant scale degree, most of the times in the form of a dominant 7th chord, resolves to the tonic chord built on scale degree 1, considered as the tonal center. In this case, the dominant seventh chord on the scale degree 5 is regarded as an unstable and dissonant harmony that must be resolved to the stable and consonant tonic chord on the scale degree 1. In this cadence, instability is viewed as a source of tension, while its resolution is perceived as a source of release. This pattern, which incorporates numerous facets of the tension-resolution concept in music, is particularly prevalent and well-known in the majority of 18th and 19th century tonal music (Pressnitzer, McAdams, Winsberg and Fineberg, 2000). In a study on the modeling of tonal tension, Lerdahl and Krumhansl mention the relationship between harmonic and melodic motion and musical tension in tonal music as follows:

> By "tonal tension" we mean not an inclusive definition of musical tension, which can be induced by many factors, such as rhythm, tempo, dynamics, gesture, and textural density, but the specific sense created by melodic and harmonic motion: a tonic is relaxed and motion to a distant pitch or chord is tense; the reversal of these motions causes relative relaxation. Because tonal tension is a uniquely musical phenomenon (unlike such factors as fluctuations in loudness, speed, or contour), it is perhaps the most crucial respect in which music tenses and relaxes (Lerdahl, Krumhansl, 2007, p.329).

Additionally, several research projects on timbre have revealed that it plays a significant influence in the relationship between musical tension and release. In the context of tonal/metric and atonal/nonmetric music, one of the studies explores the effect of timbre on tension and relaxation. The participants, who included musicians and non-musicians, were given excerpts from the tonal and metric and non-tonal and nonmetric repertoires, and these excerpts were presented in a piano version with a single timbre and an orchestral version with several instruments. Within the setting of these two opposing examples, it has been observed that it is the listeners' hierarchical musical information which leads to musical tension and relaxation, as it is heard in music. Consequently, the participants were able to perceive a sense of coherence and unity even in complex musical pieces. In terms of timbre, it was discovered that the existence of timbre modifications greatly altered the perception of tension and relaxation, while decreasing the perception of unity in the orchestral version compared to the piano version. While different instrument sources are perceived in the orchestral version, a complex chord structure phenomenon stands out in the piano version. The data gathered from the study's analysis confirm that timbre has a significant impact in the sense of musical tension and relaxation (Paraskeva and McAdams, 1997).

Theorists have investigated tension and resolution in music using technical harmonic parameters, melodic contour and pitch motion, and dissonance and consonance relationships, but many experiments have been undertaken that considering the listener's impression of these aspects. Without a doubt, tension and resolution have an equivalent in both the listener and the music itself. However, since this study will analyze the relationship between tension and the texture of music, the psychological or cognitive aspect, which is subject to perceptual diversity, will be not evaluated.

4.2 Tension and Release Process in French Spectral Music

In Western art music, the subject of tension was generally expressed in the axis of harmony and melody. However, in the music of the spectral period, as seen in the music of contemporary music composers towards the middle of the 20th century and after, the use of sound materials lacking perceptible pitch structure and the compositional approach of the period are considered, the musical tension based on melody and harmony loses its validity (Havdara and Hlinka, 2020). However, much the same as in tonal music, the relationship between tension and resolution in spectral music has a significant impact on compositions. Discordant harmony and harmonic complexity that deviates from the traditional notion of pitches might result in a stressful ending. Important musical elements such as the usage of non-pitched percussions and timbre fusions produced by extended instrument techniques, for example, could be used to support musical discomfort. As a result of this emphasis, the tension level in music will increase. Accordingly, the listener will experience tension perceptions such as the climax and attaining the peak (Cornicello, 2016).

One of the cognitive research approaches to tension in spectral music has been a modeling of the function of musical roughness and inharmonicity in the perception of musical tension. The roughness is caused by fast amplitude fluctuation in the 20 to 200 Hz region. Simultaneous tones at close frequencies occurring in this range may create rough beats (Pressnitzer, McAdams, Winsberg and Fineberg, 2000). If the frequency components are integral multiples of the frequency of a specific pitch, the combination is defined as harmonic. Inharmonicity occurs when any frequency component is not a whole-number multiple of the fundamental pitch (Rose, 1996). The aim and proposal of the study by Havdara and Hlinka was to transfer tension perception with a neurodynamic musical tension modeling based on a spectral representation of the sound in the axis of roughness and inharmonicity. As a result of the research, roughness and inharmonicity were found to be crucial components of perceived tension, and a potential neurodynamic explanation for musical tension was presented (Havdara and Hlinka, 2020).

In addition to the roughness and inharmonicity, there is a study that examines the tension of the music and the efforts of the performer in a bodily sense. In this work for Grisey's Prologue, which he composed for solo viola in 1976, the increasing tension is linked to the relationship between the performer and the instrument; the tension of the sound encodes the efforts of the performer. In this study, the performer's bodily movements are viewed as subjective evaluations of a concrete and objective acoustic signal. The link of effort and body stress in performance with musical tension, rather than the sound itself, draws the listener's attention. In line with this perspective, it is emphasized that the climax of Grisey's Prologue and the reason behind the perception of high-tension is not the elements expected to increase the tension in music such as acoustic loudness and timbre intensity, but the effort and energy required to produce and reflect these features (Jakubowski, 2020). The extreme bow pressure applied on the viola, the transition from standard techniques to extended instrument techniques are some of the factors that play a role in the association with this embodied tension. (See figure 4.1)

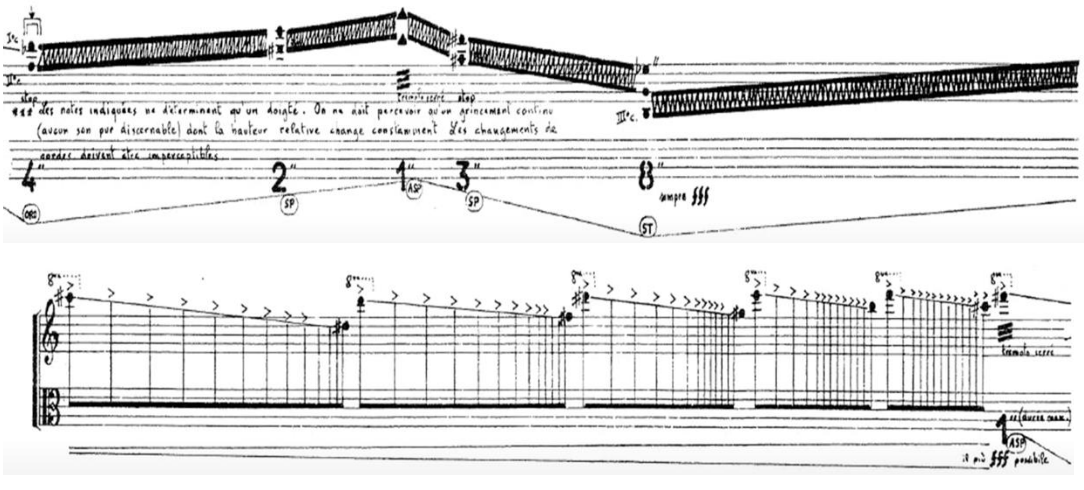


Figure 4.1 : Gérard Grisey, Prologue (1976), an excerpt from the climax section, extreme bow pressure on viola in high register, increase in tension.

In spectral music, irregular rhythms, harmonicity and inharmonicity, periodicity and aperiodicity are all some of the effective components that contribute to the music's tension. Different tension graphs emerge as a result of the oscillations between these components compressing and widening the sound masses (Arrel, 2008). Grisey uses the analogy of human breath to separate the segments of his work Periodes (1974) into three sections: breathing, exhaling, and resting. Tension that is dynamic and rising in intensity, relaxation that is dynamic and progressive, and static peridocity. The periodicity in the piece creates a dominant and distinctive weight by rotating in repetitive circles until it creates a new energy and evolution (As cited in Har, 2019).

The gaps between transitions in the design of Saariaho's musical forms are an effective means of creating tension. Using this strategy, several of her compositions demonstrate how the absence of large-scale tensions in harmonic material is compensated for with sudden transitions between different materials, thereby creating a musical dynamism. The piece in Traume (1980), for cello, piano and electronics, is an example of this. With the tensions generated by static harmony and extended instrument techniques, a network of textures at various levels is realized. The division of traditional harmony sequences into different textures enables the tension between "noise" and "sound," as well as between the various textures that contain this sound material, to be adjusted (Saariaho, 1987).

Saariaho also applies the concept of consonance and dissonance, which is an important equivalent of tension and resolution, on the axis of sound and noise in her music. According to Saariaho, sound and noise might serve as a substitute for the concepts of tension and resolution in the abstract and atonal sense. Given that noise is an extreme type of dissonance in the physical sense, a noisy and rough texture relates to dissonance, whereas a smooth and fluid texture corresponds to consonance. Saariaho employs this axis to develop musical expressions and larger forms, hence building musical tension (Saariaho, 1987, p.94). The excerpt below illustrates the timbral axis applied in this way (See figure 4.2)

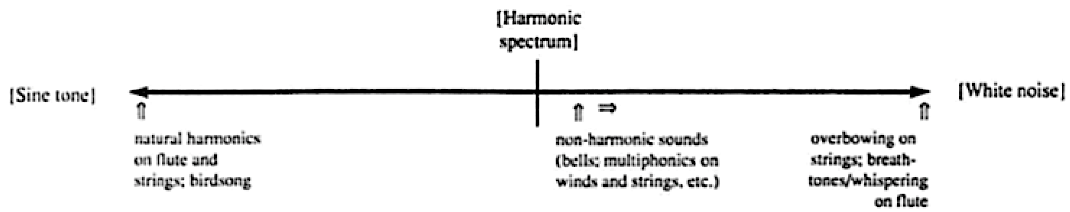


Figure 4.2 : Kaija Saariaho's timbral axis. Adapted from (Pousset, 2000, p.83).

As mentioned above, roughness appears in the music of Hugues Dufourt's La Tempesta d'après Giorgione (1976) as a component that plays a part in the perception of tension. The music is structured as a latent tension movement that goes almost to its own outburst. The roughness perception that plays a role in this tension movement is transmitted by the wind instruments used in the low register. The gap between the partials of the instrumental sounds remains quite narrow compared to the critical band. For this reason, these partials interact with the critical band and this generates the perception of roughness (Pressnitzer and McAdams, 2000).

4.3 Analysis Revealing The Relationship Between Texture and Tension in Early French Spectral Music

As previously stated, it is difficult to speak about a perfectly measured sense of tension. However, the parameters investigated and the tension models discovered through study and experiments enables us to make a number of significant and accurate tension and resolution assessments. The tension analyses in this study will all be conducted in accordance with some of the determinations based on earlier studies in this field.

Textures as a sound mass, micropolyphony, orchestral synthesis, and their layered structures in French spectral music were examined and demonstrated in Chapter 3 using excerpts from the music of the period's composers. In Chapter 4, some studies, experiments and findings on specific musical parameters related to the musical tension process were shared.

Texture determinations will be made based on the textural examples mentioned in Chapters 2 and 3, Ligeti's invention micropolyphony, and Kari E. Besharse's (2010) textural categorizations of French spectral music, such as sound mass, micropolyphony, and their layered arrays: the subject of which is the main question of this thesis. Traditional texture types including homophony and polyphony will also be taken into account.

In spectral music, which lacks tonality and conventional melodic structure, the texture is often shaped by static structures emphasizing the timbre component and spectral sound clusters generated using the additive synthesis technique. For this reason, note by note analysis may not reveal the general effect of the music at every point while analyzing textures (Besharse, 2010). Loudness can be associated with the dynamics used in music. Density, on the other hand, can be thought of as a concept that increases and decreases with the amount of pitch and attack used horizontally and vertically.

Loudness is an important contributory parameter that contributes to tension in music. It is possible to say that dynamic increase creates tension even when a fixed pitch is taken as basis without any change (Farbood, 2006). One of Farbood's experiments on the parametric modeling of musical tension was on loudness. As a result of this experiment, it was concluded that although there is a direct proportionality between the increase in loudness and the increase in tension, the perception of tension is somewhat masked in cases where the pitch is monotonous without any change (Farbood, 2006). At this point, when examining the tension increase and decrease, it is necessary to consider pitch movements in addition to loudness.

According to Kari E. Besharse (2010), density may be classified horizontally and vertically. Tension and relative dissonance rise as vertical density increases. Increased horizontal density is connected with increased speed and energy. Tempo changes, such as stretching and prolongation, can contribute to relaxation. From this point of view, it can be said that the density occurring in the texture has a positive correlation with the musical tension.

Garot and Eithan (2011) made findings regarding register, loudness, and tempo factors in their research on musical tension and dynamic auditory parameters. The loudness component is essential in building tension. Accelerando (acceleration in tempo) and pitch movements towards higher registers were found to be effective in increasing tension, and revealing high-tension data. Additionally, the combinations of parameters showed some different results. The strongest tension in the high register was obtained by combining the pitch rise and accelerando with the dynamic increase. Contrary to overall tendency, when loudness decreases in the low register, pitch fall is more effective at increasing tension than pitch rise. When multiple parameters were considered, those moving in opposite directions simultaneously were percieved to be rather average, as opposed to more tense when combined. (Garot and Eithan, 2011). The findings regarding loudness, register, and tempo factors, all of which contribute to musical tension, are substantially similar to those of Illie and Thompson's (2006) study. Increased dynamic level, pitch rise, and accelerated music are all indicators of increased tension (Garot and Eithan, 2011). These findings will be used to determine the points at which tension increases and decreases when parameters such as loudness, register, and tempo are evaluated.

Timbre is another important factor that contributes to the perception of musical tension. Various studies on the connection between timbre and musical tension were conducted. Roughness, as a timbre dimension, is a characteristic of sound that emerges as a result of rapid amplitude fluctuation in the 20-200 Hz frequency range. Simultaneous tones with similar frequencies in this range may result in rough beats. Roughness, a dimension of non-tonal orchestral timbre, was found to contribute to the perception of tension in research undertaken in this direction (Fineberg, McAdams and Pressnitzer, 2000). Similar results were found in another study. This research analyzes some specific properties of timbre such as roughness, inharmonicity, spectral flatness and centroid. According to the findings presented here, inharmonicity, roughness, and spectral flatness all significantly contributes to tension. The ratio of these factors increases in essentially the same way as the increase in tension. In particular, these increases in roughness and inharmonicity level were found to have a strong positive correlation with increasing tension (Farbood and Price, 2017). When the components of a spectrum are not integral multiples of the fundamental frequency, it is said to be inharmonic. If the overtone components of a fundamental frequency are in their net values, there is harmonicity (Rose, 1996). In this respect, analyzing the pitch data gathered throughout the score, timbre harmonies formed with specific spectrum in spectral music may be used to analyze the inharmonicity-harmonicity process. Due of the strong link between roughness and inharmonicity as tension increases, an approximation of the roughness ratio may be obtained by using inharmonicity levels. Inharmonicity and harmonicity levels, as parameters belonging to the timbre dimension, will be analyzed in line with the spectrum centers used in music and their manipulations over time. Their contribution to tension will be discussed.

To sum up; tension curves aimed to be reached in the parts of selected early French spectral music to be examined will be determined approximately based on the findings obtained from tension studies on loudness, density, range, tempo and timbre components. The selected early pieces of French spectral music are the works of Gérard Grisey and Tristan Murail, both pioneers and major composers of the style and period. Additionally, the relationship between texture and tension in the work of second generation composer Philippe Hurel will also be briefly mentioned.

The methods which will be used to analyze the parameters are following:

1. In order to come to a conclusion on the density rate, the amount of vertical and horizontal pitch and attack in the complete timespan will be examined.

2. The change and fluctutaion in the dynamic data in music(s) will be analyzed for loudness.
3. While analyzing the shift of range and register, in addition to the score data, the melodic range spectogram graphics generated by Sonic Visualizer software will be used.
4. Spectrum centers will be examined to determine the timbral changes, the pitches which are used will be transcribed and projected into a harmonic table; this way the used frequencies will be seen and the manipulation and changes that occur in the spectrum will be revealed. Thereby these sound palettes will be compared to the partials of the spectrums which are in use, to look at the harmonicity and inharmonicity rates.
5. Tempo and the rhytmic structures will also be studied and evaluated in the following paragraphs.

4.3.1 Excerpt 1, Partiels (1975) by Gérard Grisey

Partiels is the third composition in a six-part series called Les Espaces Acoustiques composed by Gérard Grisey in 1975. The music was composed for 18 instruments including two flutes, oboe, two clarinets, bass clarinet, two horns, trombone, accordion, two percussion instruments (two players), two violins, two violas, cello and contrabass. The instrumental additive synthesis technique is a type of compositional technique used in music. The E1 (41.2 Hz) pedal sound of the trombone was recorded and a sonogram analysis was used to determine the sound's harmonic frequency components. As a result, some selected components were synthesized and distributed to the orchestral instruments (Rose, 1996). The E1 spectrum serves as the series' timbral center. The first 32 partials of the E1 frequency's overtone series are given in the figure below (See figure 4.3).

Figure 4.3 : First 32 partials of E1 spectrum. Adapted from (Rose, 1996, p.7).

Ring modulation is another technique that is used. By adding and subtracting the frequency values of the partials between two selected spectrums, ring modulation produces the combinations (Fineberg, 2000). The figure below illustrates the technique (See figure 4.4)

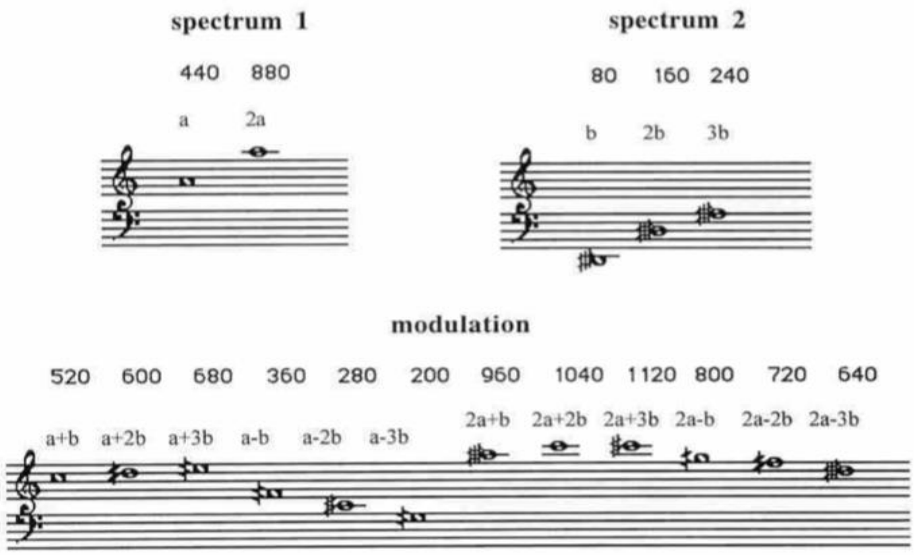


Figure 4.4 : Ring modulation technique. Adapted from (Fineberg, 2000, p.97).

The selected excerpt of the music includes 23 measures which corresponds to approximately 25 seconds, starting from rehearsal mark 26. The episode is introduced with the clarinet and horn playing the Db4 pitch unison. With the subsequent addition of violin and viola, the pitch spreads over a wider range as a result of the inclusion of other instruments in the orchestra through both vertical and horizontal increases. The increase in density reaches its peak at the measure 20 and is reduced with sudden filtering in the last four measures (See figures 4.5 and 4.6).

Figure 4.5 : Beginning of the excerpt 1, rehearsal mark 26 from Partiels (1975) by Gérard Grisey.

Figure 4.6 : Continuation of the excerpt 1, from Partiels (1975) by Gérard Grisey.

A similar curve can be observed for loudness. If we look at the dynamic data, one of the violas and a cello start with p while all the other instruments enter from pp. All dynamics increase aperiodically up to the 20th measure with a crescendo to ff. Since the violin, clarinet and horn are always active, they reach ff with an uninterrupted crescendo while the viola, cello and contrabass arrive in a fragmented and interlocking manner. It can be said that the entire orchestra is on a general rise from the pp to the ff level. In parallel with the rapid filtering and reduction of density in the last four measures, the dynamic level decreases up to pp and ppp values. The increase and decrease in loudness and density move in sync with each other (See figures 4.5 and 4.6).

In order to understand the amount of increase and decrease in inharmonicity, the pitches that are not included in the partial components of the E1 overtone series were determined and their amounts per measure were calculated. Notes that are not in E1 spectrum are circled on the score (See figures 4.5 and 4.6). A more gradual increase is observed in the first 10 measures compared to the last 10 measures. Pitches out of the E1 fundamental spectrum appear to be more common on clarinet, violins and horns. The amount of inharmonic pitch reaches its peak when dynamics and density reach their highest level. In the last part of the excerpt, as in other parameters, inharmonicity is filtered dramatically in the last 4 measures and the excerpt ends with the 7th, 10th and 16th partials of the spectrum, Db4 1/6 lower, G#4 and E5 pitches. According to the total amount of pitch used, it is possible to say that inharmonic pitches are weighted in general.

Although the increase rate is more irregular, its approximate curve is somewhat similar to those of loudness and density. Although the meter and tempo of the section are stable, the distance between notes are gradually narrowed after the measure 10, giving an accelerando effect, and a ritardando effect is created by increasing distance in the last four measures. There are no sharp transitions, rises or falls in terms of register. With the violin and the double bass in the measures 4 and 6, the lower and higher pitches are fixed to a large extent. It continues in the same way until the last three measures. As the density decreases, the range pallet narrows again and collects into mid register (See figure 4.7). The change of the range palette over time is given in the figure below.

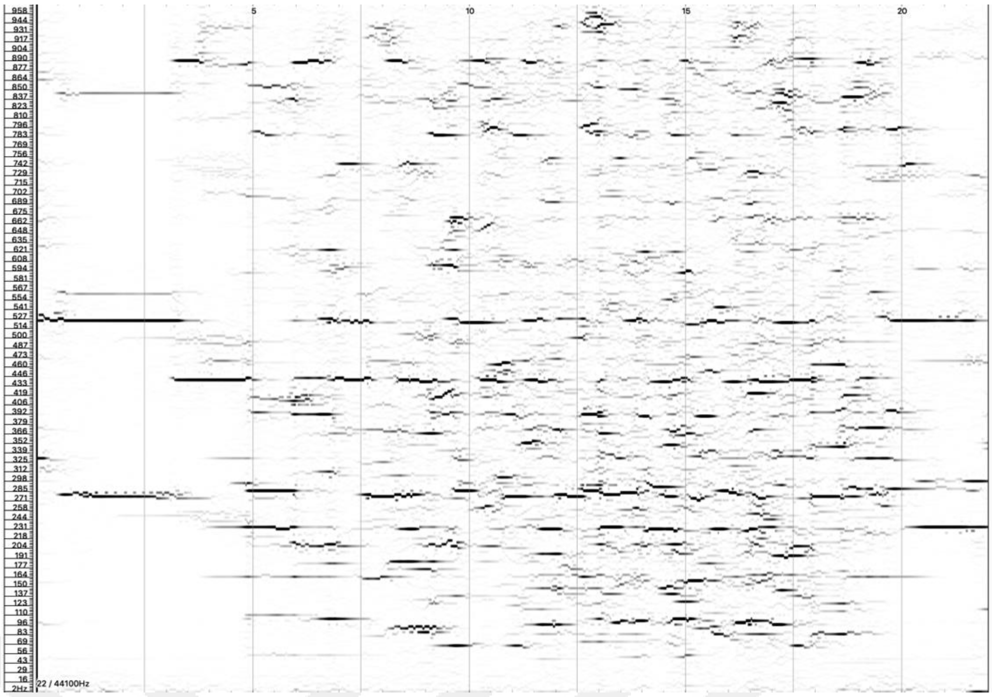


Figure 4.7 : Range palette of the excerpt 1, frequency vs time, from Partiels (1975) by Gérard Grisey.

When the excerpt is examined texturally; It is possible to say that it has a micropolyphonic characteristic. As explained in the Chapter 2, micropolyphony, which is the invention of György Ligeti, is the progressive loss of perceptibility of the lines as a result of the continuous movement of a large amount of pitches in an asynchronous rhythmic structure of the layers in the texture, and as a result, a blurred sound cluster is formed. The texture in the examined excerpt also has micropolyphony-like features due to the non-metric arrangement of the layers, the lack of a counterpoint relationship, and a constantly accelerating motion. However, it is a fact that the overall effect is not as strong as it is slower and less layered compared to a standard micropolyphony. Therefore, it may be more appropriate to consider the texture type as slow or stretched micropolyphony.

An approximate tension curve was obtained with the data gathered in line with the parameters examined on the score. The important points in tension curve are the increasing and decreasing processes. Tension starts at low level and builds up to measure 20 with an increase in loudness, density, inharmonicity and accelerating tempo. In the last four measures, it decreases tremendously with a sharp reduction in the musical components, and a contraction in the register. The macro visualization of texture type, tension curve and some parametric processes are given in the table below (See table 4.1).

Table 4.1 : Overall visualization of the excerpt 1, from Partiels (1975) by Gérard Grisey.

Texture Design	**Slow Micropolyphony**																						
Tension Curve																							
Loudness (Dynamics)	**pp**																		**ff**				**ppp**
Density (Pitch amount)	**2**	**2**	**2**	**3**	**4**	**5**	**8**	**9**	**9**	**10**	**11**	**11**	**15**	**15**	**17**	**16**	**19**	**19**	**22**	**17**	**12**	**7**	**4**
Inharmonic pitch amount	**-**	**1**	**1**	**1**	**3**	**2**	**5**	**6**	**4**	**7**	**5**	**8**	**13**	**12**	**11**	**10**	**11**	**15**	**13**	**11**	**9**	**2**	**1**
Bar Numbers	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**

4.3.2 Excerpt 2, Partiels (1975) by Gérard Grisey

The other excerpt of Grisey's Partiels covers the one-minute portion between the 42nd and 45th rehearsal marks. There is a vertical structure compared to excerpt 1 and it consists of cluster blocks. With the sustained pitches of the strings and brass sections and the arpeggio figures played by the wind instruments rising to a higher register, all the instruments are added on top of one another, and spread over a wide range to form the first cluster block. The first cluster is repeated in a 12/8 time signature with regular accents in a homorhythmic structure divided into 12 equal beats. It has a high dynamic level consisting of fff and ff. The second cluster block repeats in three beats lasting about 2 seconds at the same dynamic level but in a decreased tempo (See figure 4.8).

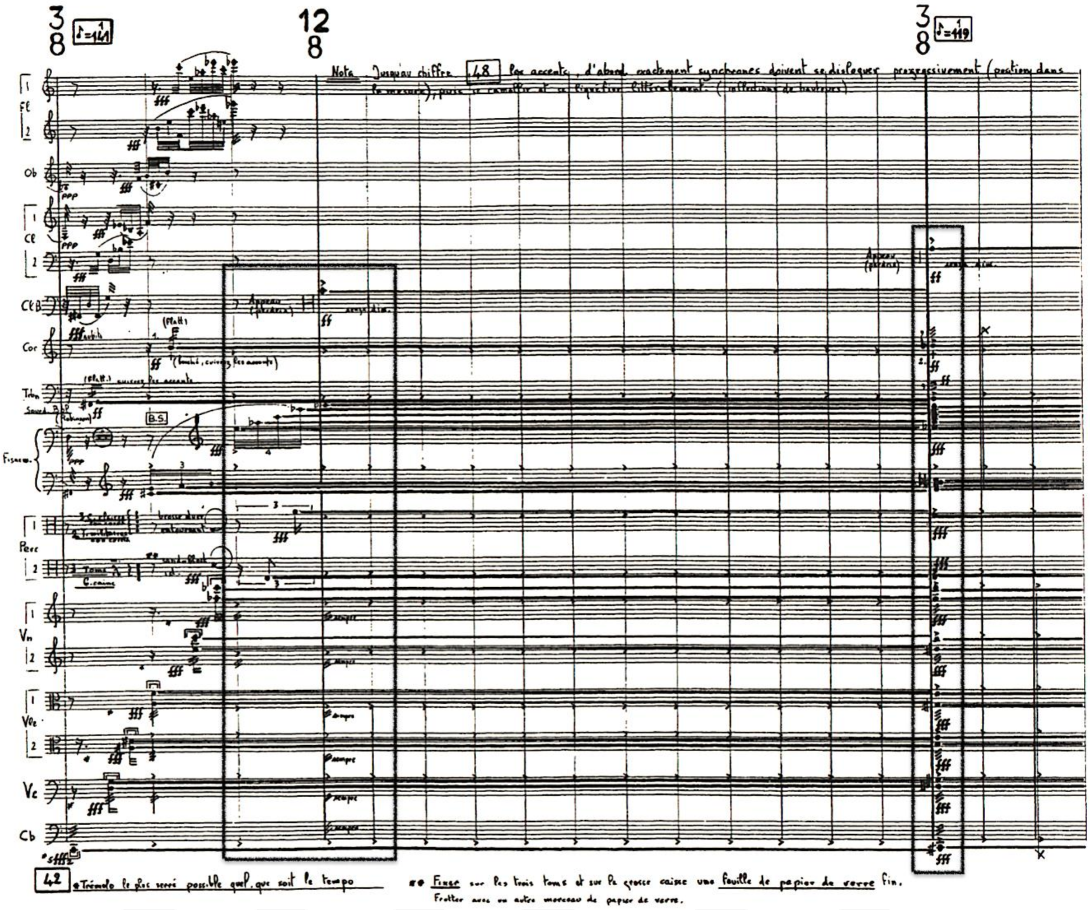


Figure 4.8 : Beginning of the excerpt 2, rehearsal mark 42, from Partiels (1975) by Gérard Grisey.

The third cluster which comes in rehearsal mark 43 continues at a slower tempo with the dynamic level falling to ff and f where the accented attacks of the instruments do not fall into synchrony. The fourth cluster has a similar dynamic level but its accented attack points become more and more irregular (See figure 4.9). The fifth cluster block, which comes in at rehearsal mark 44, is dynamically reduced to f and mf, and is slower than the previous one in terms of tempo. The accented attack points are much more irregular and the distance between attacks is longer. In addition, short glissandos played at different times are added to the accented beats of the strings. Compared to the previous parts, the amount of accents also start to decrease gradually (See figure 4.10).

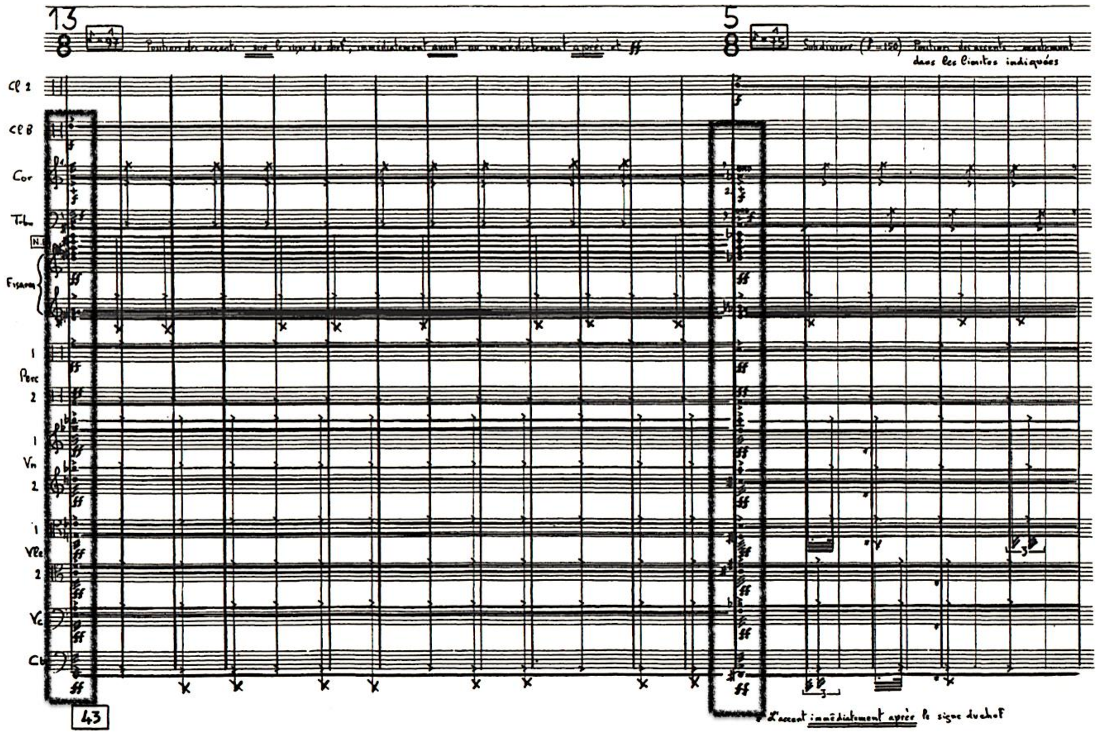


Figure 4.9 : Excerpt 2, rehearsal mark 43, second and third cluster, from Partiels (1975) by Gérard Grisey.

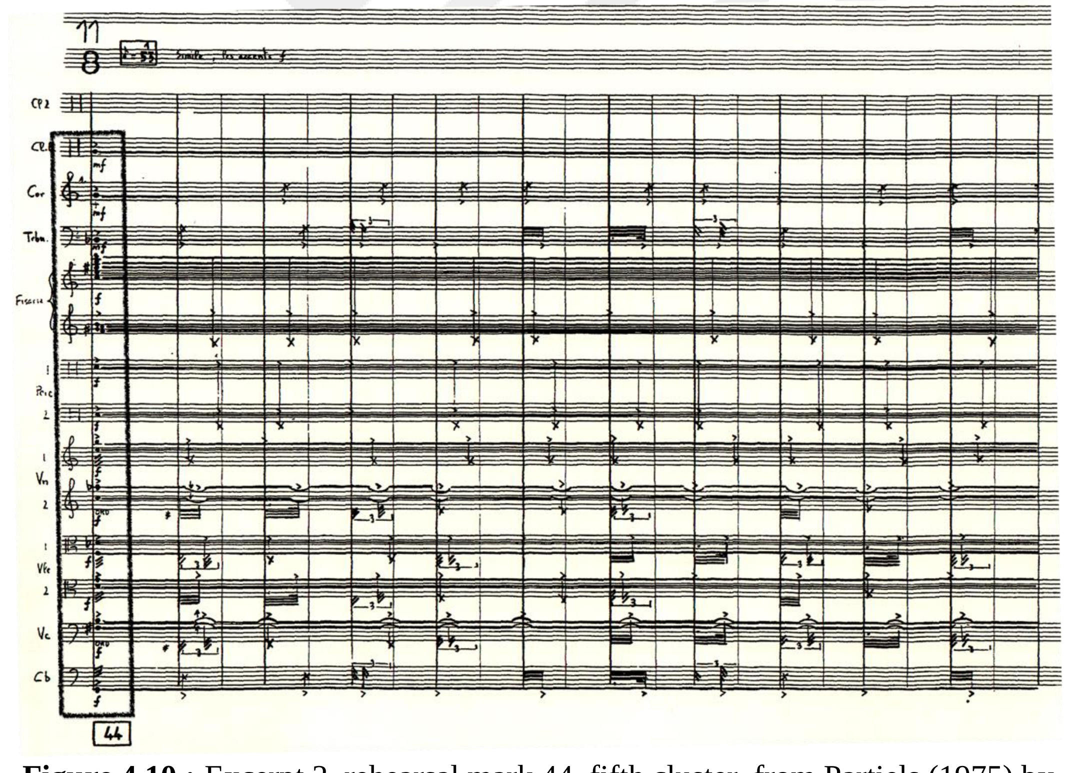


Figure 4.10 : Excerpt 2, rehearsal mark 44, fifth cluster, from Partiels (1975) by Gerard Grisey.

The sixth cluster gets slower and is dynamically lower. Glissandos become wider and more static with the use of shorter crescendos and decrescendos. At the end of the excerpt, the seventh cluster is formed at rehearsal mark 45, with mp and p dynamic marks, forming the lowest dynamic level of the excerpt. Here the texture reaches its widest state, where the distance between strokes is maximum (See figure 4.11).

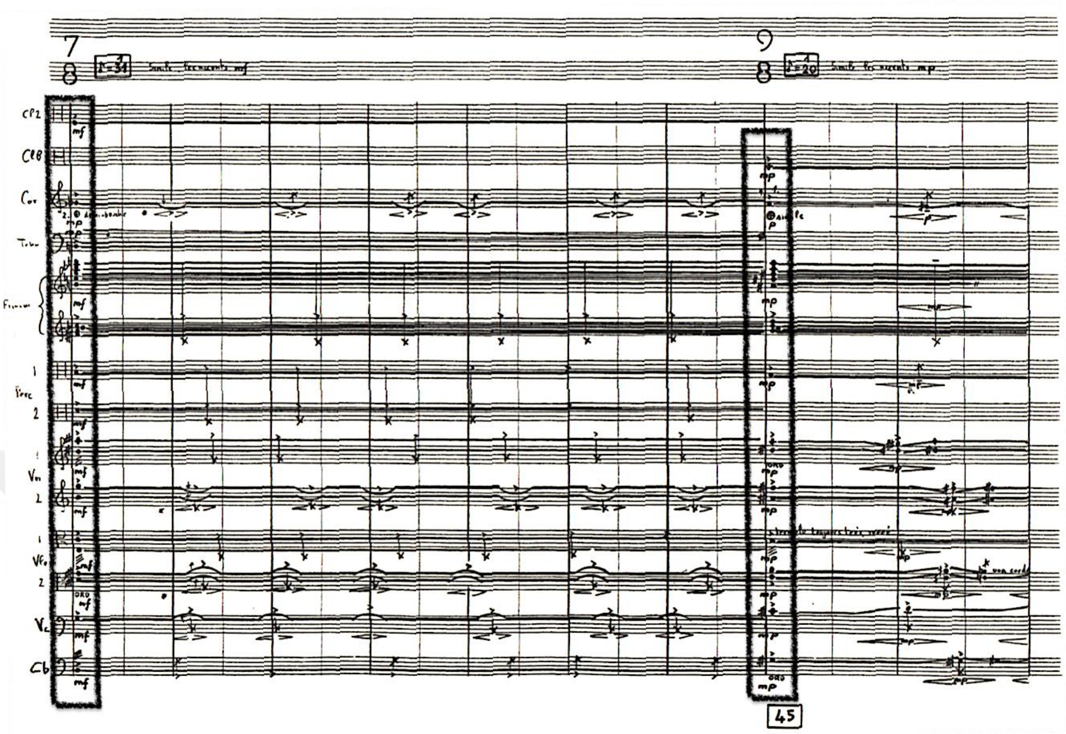


Figure 4.11 : Excerpt 2, sixth and seventh cluster, rehearsal mark 45, from Partiels (1975) by Gérard Grisey.

If we consider the excerpt in terms of its timbral characteristics, the inharmonicity at the beginning gives way to harmonicity. If we examine this on the basis of the E1 spectrum, which is the timbre center of the music, it is observed that the partial amount of the spectrum increases slightly between rehearsal marks 42 and 45. The increase does not include a super-balanced curve between each cluster, but it is possible to say that the harmonicity ratio increases over time in a global sense. However, if we examine these seven cluster blocks in terms of register, the range pallet narrows gradually until the end of the excerpt. The cluster scale where the highest and lowest pitches are Gb6 and C2 gradually narrows and moves towards Db6 and G#3 pitches, with pitch fall occurring in the high register, and pitch rise in the low register. Arrell (2008) defines the harmonic progression in this part of the music as wedge-shaped harmonies. The harmonic structure, harmonicity level and range palette of the excerpt are given below (See table 4.2 and figure 4.12).

Table 4.2 : Harmonic structure of the excerpt 2 and harmonicity level based on E1 spectrum, from Partiels (1975) by Gérard Grisey.

Total amount of pitch :	22	22	22	22	22	19	19
Partial amount of the E1 spectrum :	5	7	10	8	10	11	10
Percentage :	**% 22**	**% 31**	**% 45**	**% 37**	**% 45**	**% 58**	**% 53**

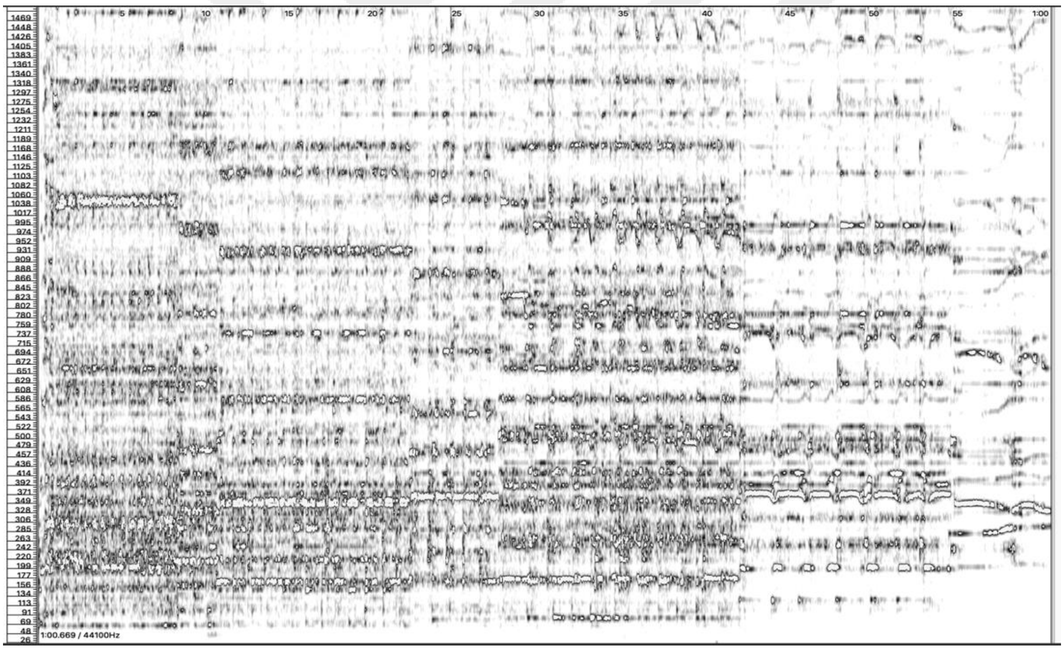
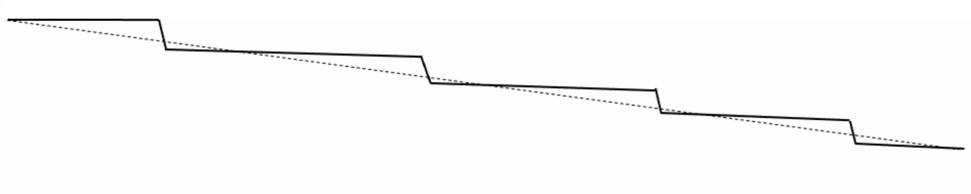


Figure 4.12 : Range palette of the excerpt 2, frequency vs time, from Partiels (1975) by Gérard Grisey.

The register movements between cluster blocks, loudness, transition from periodicity to aperiodicity, and the tempo slowing down, all result in a gradual tension decrease. If we look at the density, although the total pitch amount per cluster continues to be stable until the last part, the significant decrease, narrowing and change in other parameters may be enough to lead us to a gradual decreasing tension curve over time. If the excerpt is examined in terms of texture, there is a sound mass characteristic, as the whole excerpt contains mass of sounds consisting of seven clusters and these orchestral blocks have a continuity without any distinct gaps. The first 10 seconds, dominated by the first and second clusters, can be considered as a homorhythmic sound mass due to its rhythmic stability and simultaneity. In the process, from rehearsal mark 43 to the end of the excerpt, we can say that the texture transforms into a static sound mass, especially after rehearsal mark 44, due to the increase in aperiodicity and the gradual decreasing and spreading movement within the texture (See table 4.3).

Table 4.3 : Overall visualization of the excerpt 2, from Partiels (1975) by Gérard Grisey.

Texture	Homorhythmic Soundmass		→				Static Soundmass
Tension Curve							
Loudness (dynamics)	**ff** **fff** periodic accents →	**f** **ff**	**f** **ff** aperiodic accents →	**f** **ff**	**mf** **f** aperiodic accents + glissando's →	**mp** **mf**	**p** **mp**
Density (pitch amount)	**22** cluster 1	**22** c2	**22** c3	**22** c4	**22** c5	**21** c6	**19** c7
Time (seconds)	**8''**	**2''**	**12''**	**5''**	**15''**	**12''**	**6''**
Rehearsal Mark	42		43		44		45

4.3.3 Excerpt 3, Périodes (1974) by Gérard Grisey

Composed by Grisey in 1974, Périodes is the second piece of "Les espaces acoustiques" series. The piece written for flute, clarinet, violin, viola, violoncello, contrabass and trombone. Périodes also employs the harmonic spectrum of the E1 fundamental pitch, which serves as the series' harmonic center. In Grisey's music, the manner in which he moves in and out of the spectrum varies greatly depending on the section (Feron, 2011). The piece consists of a three-part cycle: inhalation, exhalation and rest. Grisey explains this three-part cycle with the analogy of the respiratory rhythm. The inhalation sections are defined as the processes of increased tension and complexity. Exhalation sections are associated with simplicity and relaxation (Grisey, 1974).

The excerpt of the music to be examined is from rehearsal mark 5 to rehearsal mark 7. Its approximate duration is 1 minute and 40 seconds. The excerpt starts with the fppp attack of flute, clarinet and strings, along with the pedal sound of the trombone, while the pitches rise and fall into a narrow register with glissandos lasting four seconds. The strings form a periodic structure with the continuous sequences of crescendo from f to p and with short glissandos starting from D3 to the low and high registers, the flute plays trills at the same pitch (See figure 4.13). Towards rehearsal mark 5, for 13 seconds, string glissandos get shortened to a pitch bend, then the pitch bends are narrowed, and turned into tremolos. Trombone and clarinet continue to their periodic attacks. As the dynamic level of the flute increases from p to fff, the amount of attack increases sharply by evolving from a slow trill to a flutter tongue (See figure 4.14).

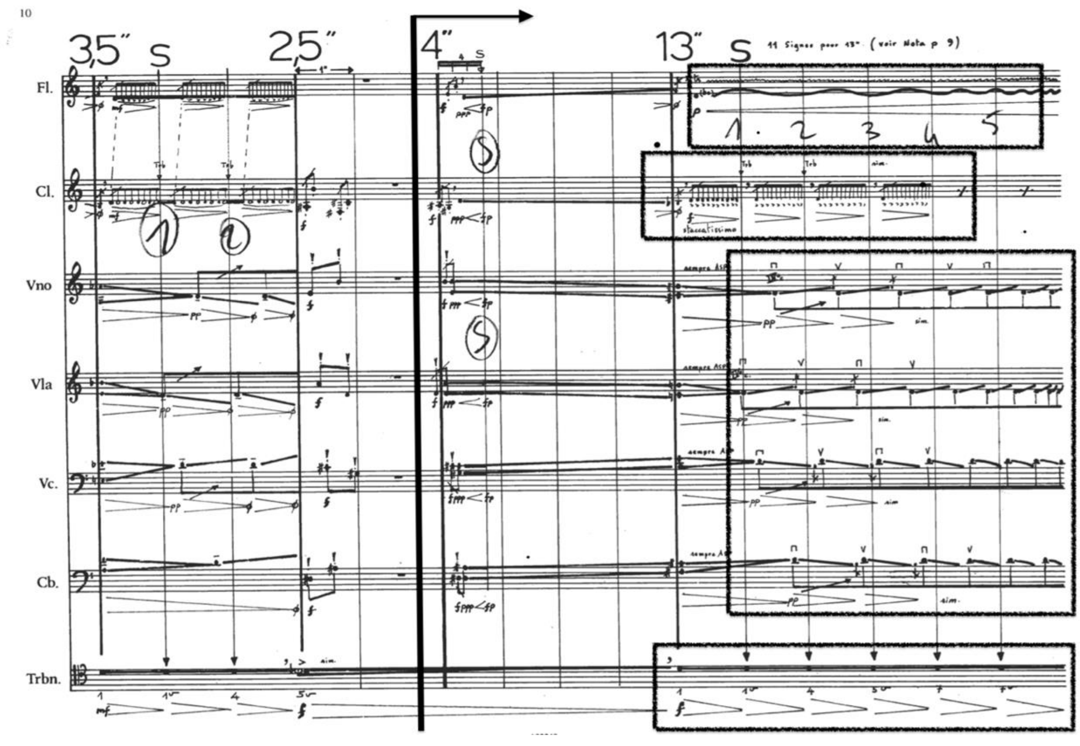


Figure 4.13 : Beginning of the excerpt 3, from Périodes (1974) by Gérard Grisey.

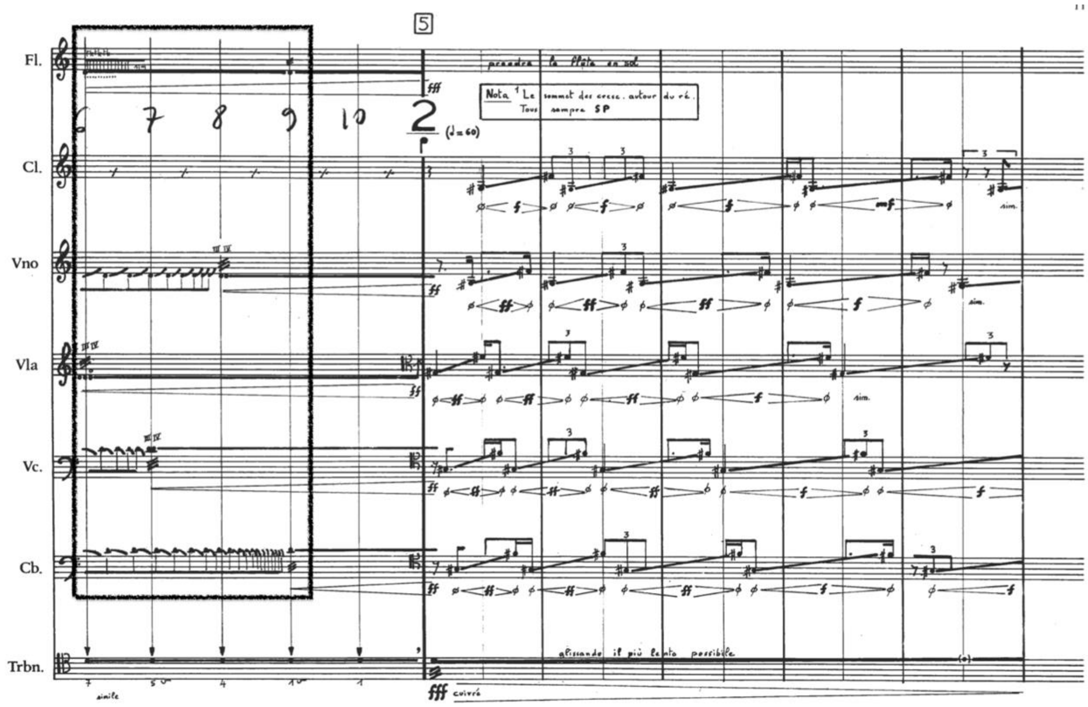


Figure 4.14 : Continuation of the beginning section of the excerpt 3, rehearsal mark 5, fast tremolos, from Périodes (1974) by Gérard Grisey.

In the section from the beginning to rehearsal mark 5, the tempo accelerates, the pitch and attack amount increases both vertically and horizontally, and the dynamics show a sharp increase as a result of the applied manipulations. Therefore, this part can be considered as the place where tension increases. While the tension is almost constant in the first 4 seconds, it gradually increases throughout the next section, which lasts for 13 seconds. The section starting at rehearsal mark 5 begins with a strong trombone attack with the flutter tongue, and glissandos that other instruments apply out of sync with each other. All of the glissandos are played between G#3 and F#4, the 5th and 9th partials of the E1 spectrum. The dynamics are expressed as increasing and decreasing fluctuations from silence to f and ff. With the dynamic level of the trombone falling from fff to silence, the range palette of the section is placed in G#3 at the low and F#4 at the high register. With the decreasing dynamics, lengthening glissandos and dynamic fluctuations, the density and loudness level begin to decrease gradually. As a consequence of these changes, the rhythmic pulse begins to disappear (See figure 4.15).

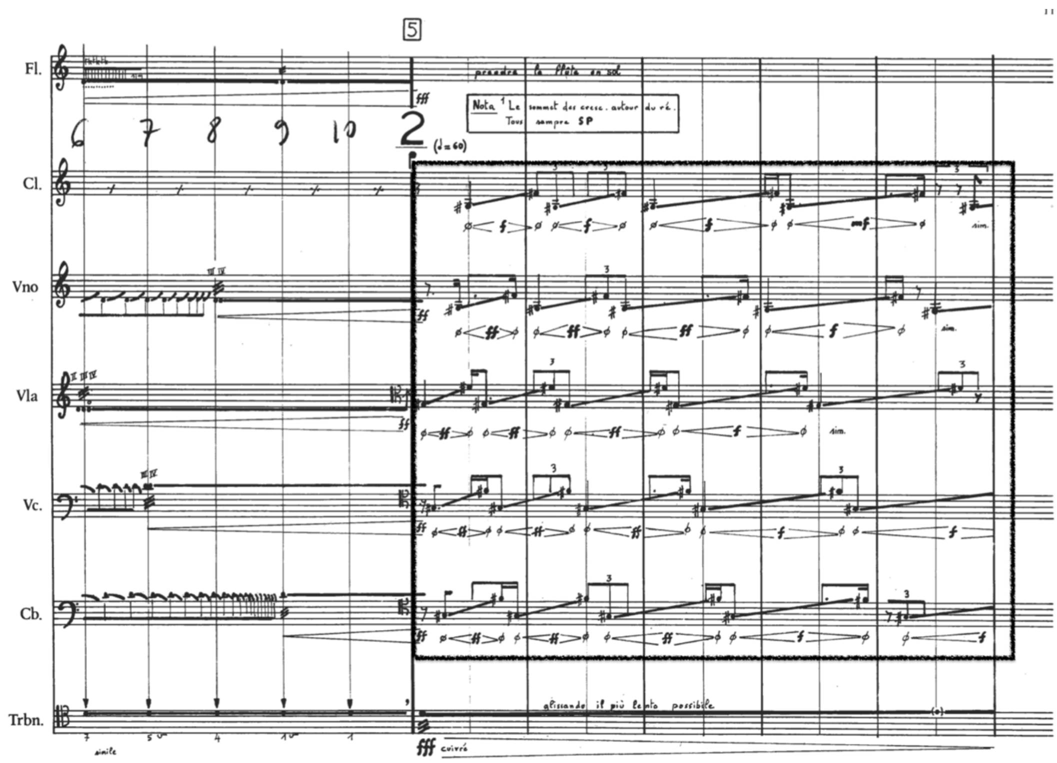


Figure 4.15 : Stretched glissandos and dynamic fluctuation, rhythmic pulse starts to disappear, r. m. 5, excerpt 3, from Périodes (1974) by Gérard Grisey.

At rehearsal mark 6, the continuous glissando structure between the G#3 and F#4 pitches is introduced with the flute as a chromatic scale divided into 11 equal beats from G#3 to F#4. The scale has a chromatic array containing the 5th, 6th, 8th and 9th partials of the E1 spectrum. It is possible to say that the partials that cannot be perceived in the glissando structure are made more detectable in a scale form (See figure 4.16).

Figure 4.16 : Chromatic scale between G#3 and F#4, overtone partials of E1 spectrum, excerpt 3, from Périodes (1974) by Gérard Grisey.

Glissandos periodically transform to this scale and begin to be played by all instruments in the continuation at rehearsal mark 6. Each instrument creates a period by repeating the scale asynchronously with measure times divided into different beats. The texture also evolves from elongated sounds to a micropolyphonic appearance in this process

(See figures 4.17 and 4.18). The different beat groups of the layers divided per measure are filtered periodically by subtracting pitches towards the rehearsal mark 7 and the density gets reduced both vertically and horizontally. During this process the dynamic level decreases gradually to pppp.

Figure 4.17 : Introduced chromatic scale divided into different beats, reh. mark 6, excerpt 3, from Périodes (1974) by Gérard Grisey.

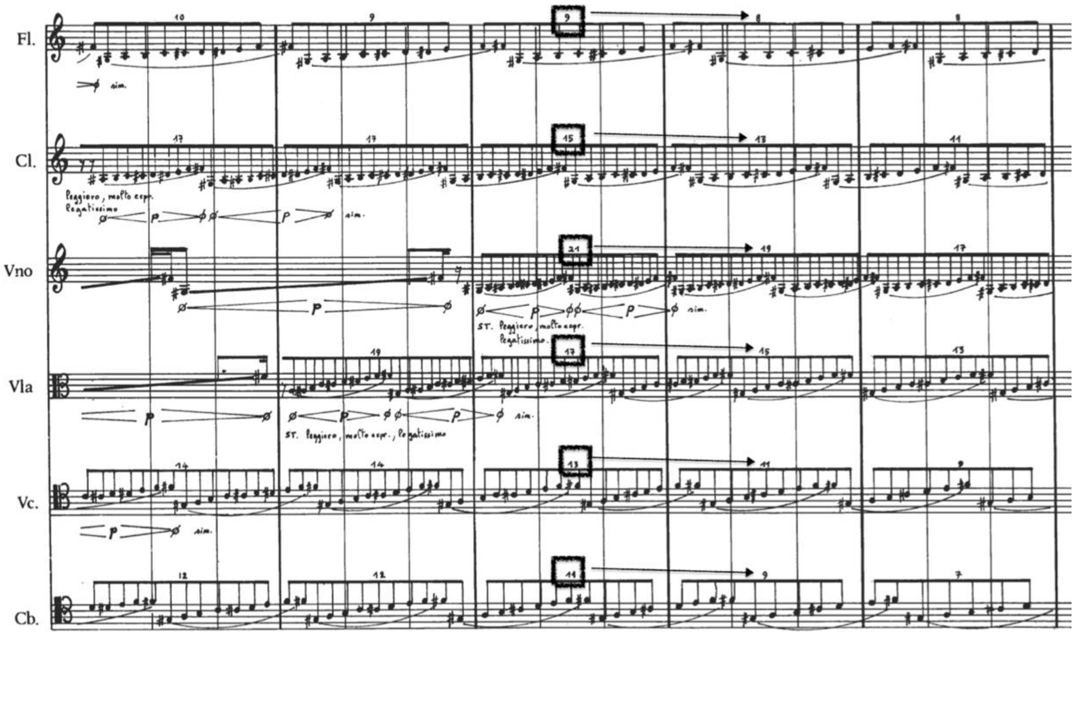


Figure 4.18 : Reduction in each division levels, continuation of reh. mark 6, excerpt 3, from Périodes (1974) by Gérard Grisey.

As the ratio in each division level is gradually reduced, the amount of pitch per measure decreases and the distance between attacks increases, resulting in a gradual reduction in density. In the meantime a deceleration occurs in tempo. Parallel to this, the constantly decreasing dynamics also proves that the tension level decreases gradually until rehearsal mark 7. Although each instrument consistently applies a scale in different forms, the range palette remains stable in most of the section. On a small scale, pitch rise repeats in cycle, but no drastic movement to the high and low registers is observed cumulatively (See figure 4.19).

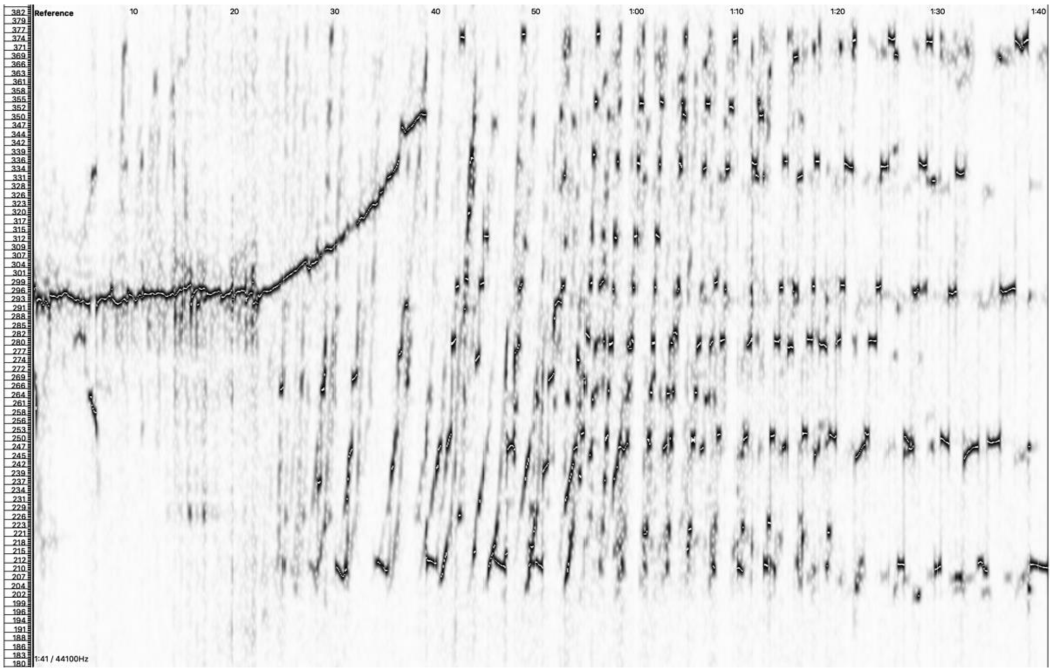


Figure 4.19 : Overall range palette of the excerpt 3, frequency vs time, from Périodes (1974) by Gérard Grisey.

It is possible to say that the change in the level of inharmonicity also contributes to the decrease in tension. The glissandos played between the 5th and the 9th partials (G#3 and F#4) of the E1 spectrum are filtered over time in the form of a specific scale consisting of 11 pitches. Thus, in addition to the 5th and the 9th partials, the 6th and the 8th partials (B3 and E4) become evident. In the time remaining towards the rehearsal mark 7, the pitches that are not in the overtone series of the E1 spectrum within the scale are gradually reduced and the 5th, 6th and 9th partials are emphasized with the decreased pitch amount at the end of the excerpt (See figure 4.20). The image below shows the final system of the excerpt where the tension reaches its lowest level (See figure 4.21).

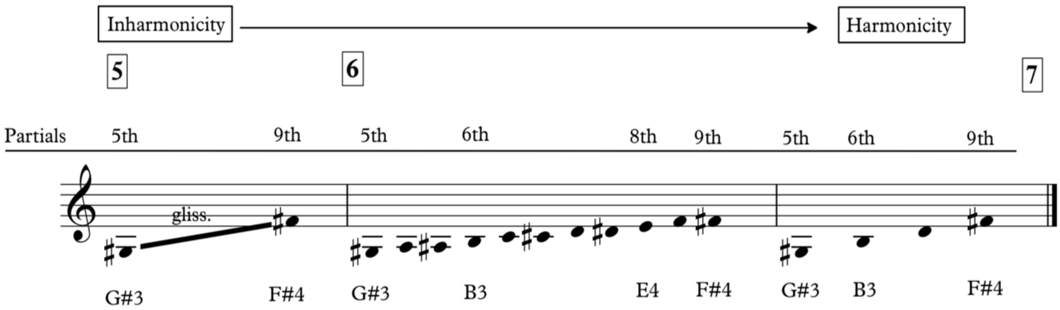


Figure 4.20 : Harmonicity replaces inharmonicity through the excerpt 3, from Périodes (1974) by Gérard Grisey.

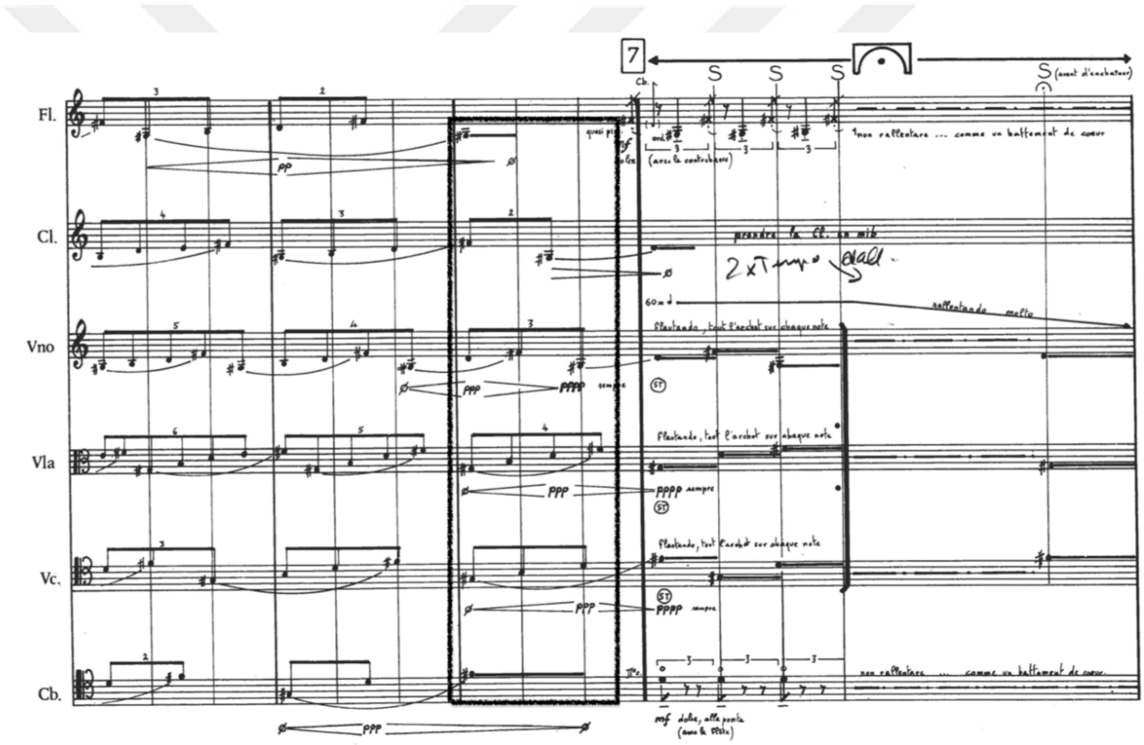
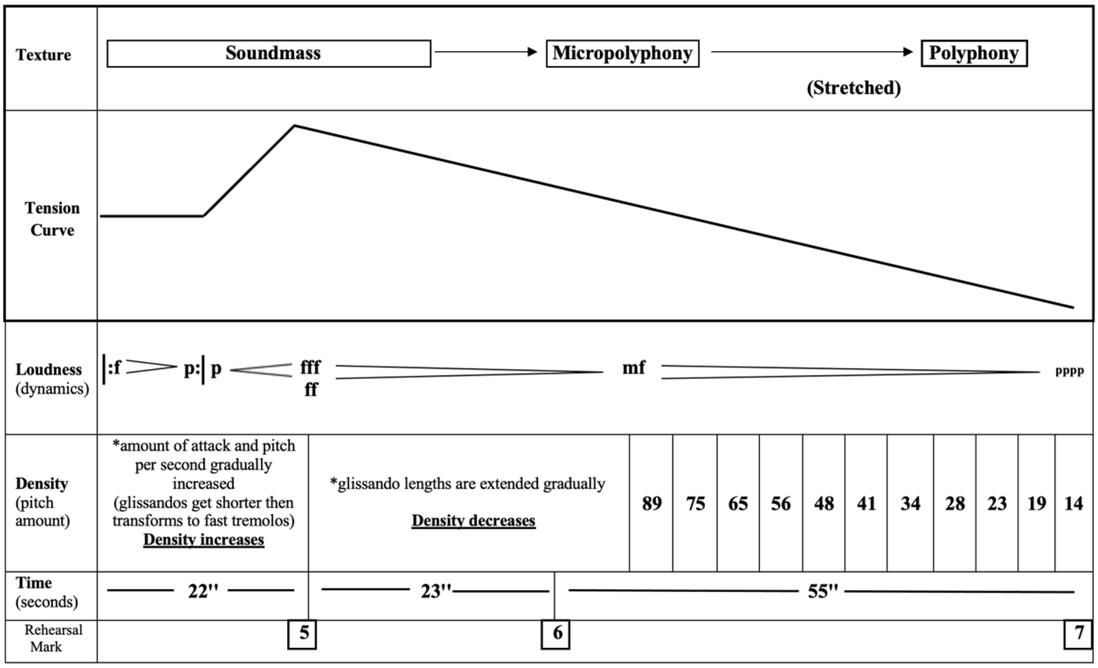


Figure 4.21 : End of the excerpt 3, rehearsal mark 7, from Périodes (1974) by Gérard Grisey.

At the beginning, texture type shapes are seen as small-scale static sound mass. The intertwining of prolonged pitches, glissandos and asynchronous dynamic fluctuations can be considered as a sound mass effect in general. After rehearsal mark 6, the stretched glissandos and the broad mass structure give way to micropolyphony. The fact that each layer is in a continuous and fast-moving structure with different rhythmic divisions can be associated with the global micropolyphonic effect (See figure 4.18). The different and crowded movements of each instrument's lines are filtered over time and the micropolyphonic effect disappears. The micropolyphonic feature is stretched and slowed down over time, losing its overall effect. For this reason, this part of the texture can also be considered as polyphony. The texture movement of the excerpt, the approximate tension curve and some parametric changes are demonstrated in the table below (See table 4.4).

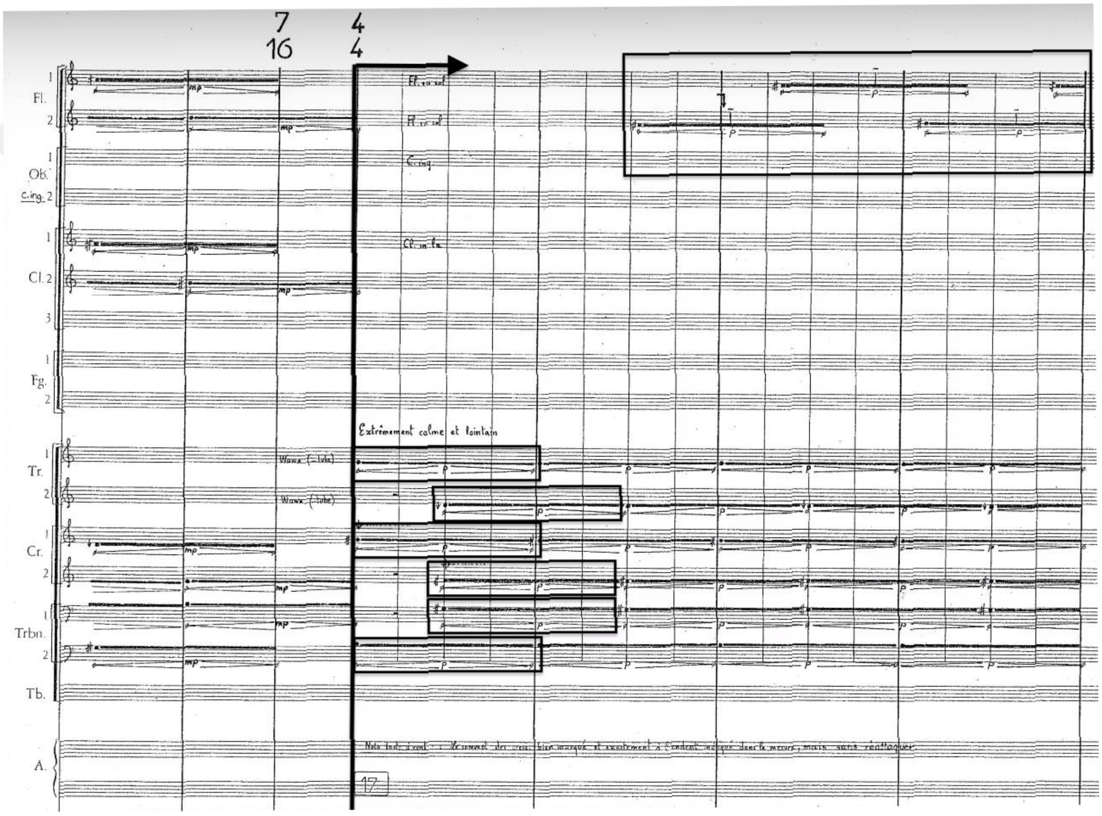
Table 4.4 : Overall visualization of the excerpt 3, from Périodes (1974) by Gérard Grisey.



4.3.4 Excerpt 4, Modulations (1978) by Gérard Grisey

Modulations (1978) is the fourth piece of Grisey's Les Espaces Acoustiques series. The piece is composed for a large ensemble of 33 musicians. The instrumentation includes winds, brasses, percussion, harp, piano, hammond organ and strings. The timbral center of the piece is E1 spectrum as in Periodes (1974) and Partiels (1975). Everything is in motion in Modulations and concepts such as inharmonicity and periodicity come to the fore in this motion. Some modulation processes such as harmonic and partial spectra, formants, white noise, and filtering are applied (Url-1). In Modulations, the balance between harmonicity, and inharmonicity and the alterations between tension and relaxation are manipulated (Baillet, 2000).

The excerpt to be analyzed is between rehearsal marks 17 and 19, approximately 1 minute and 20 seconds long and it features brass instruments such as trumpet, horn, trombone and flute as a woodwind. The section begins with a homogeneous timbre consisting of the 5th, 6th, 7th, 8th, 9th and 10th partials of the E1 harmonic spectrum. Here the E1 spectrum is clearly emphasized. There is a repetitive dynamic fluctuation between silence and p with crescendo and decrescendo. The time is equally divided, the time signature is 4/4 and stable, and each dynamic fluctuation repeats corresponding to one measure. Six different instrument lines are divided into two groups as 3-3. They form a periodic structure with successive inclusions at equal distances. After a short time, flutes support the timbre with the components of the same spectrum, but the duration of the pitches is slightly longer than four beats (See figure



4.22).

Figure 4.22 : First system, beginning of the excerpt 4, rehearsal mark 17, from Modulations (1978) by Gérard Grisey.

While brass instruments maintain this structure periodically, the 9th and 10th partials of the spectrum the F#4 and G#4 pitches played by the flutes go out of the spectrum and the harmonicity starts to get slightly distorted. Simultaneously, the duration of dynamic fluctuations begins to lengthen after each attack. As the clarinet and bassoon are likewise included with the use of aperiodic and inharmonic pitches, the initial rhythmic, dynamic and timbral homogeneity are slowly distorted. The 9th and 10th partials (F#4 and G#4) played by the woodwinds fall to an exact quarter-tone low and duration between pitches are shortened falling into inharmonic spectra. Pitches outside the spectrum are marked in a square (See figure 4.23).

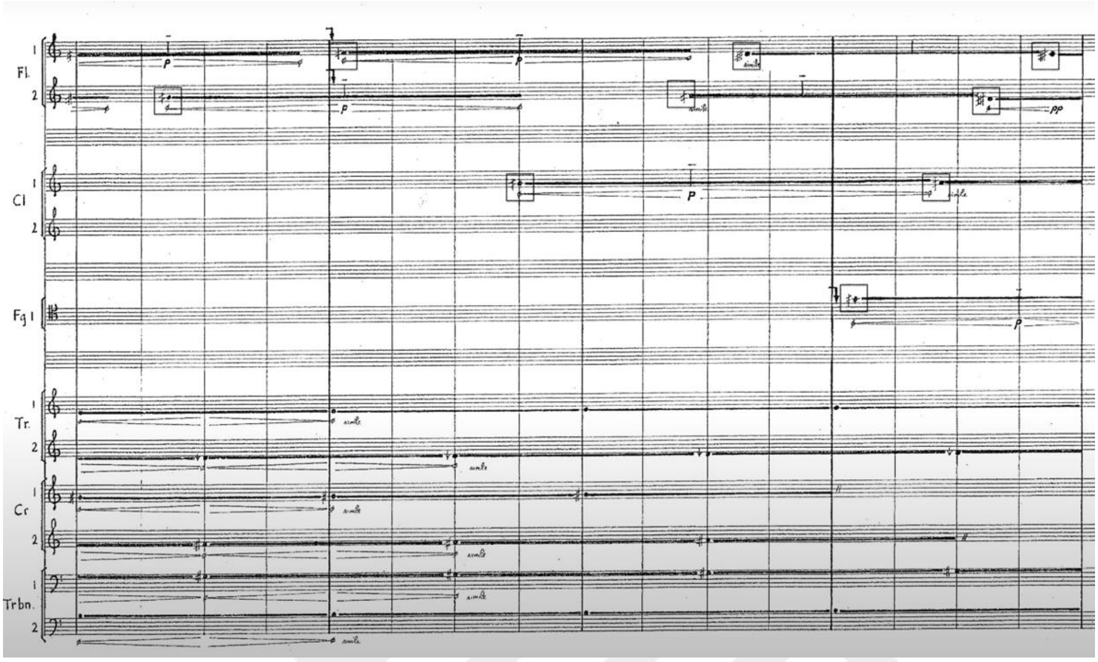


Figure 4.23 : Excerpt 4, second system,winds enter with inharmonic pitches aperiodically, from Modulations (1978) by Gérard Grisey.

The brass section which progresses periodically towards rehearsal mark 18 and preserves the spectrum emphasis fades with the disappearance of the instruments one by one. As a result, the specific overtone partials of the E1 spectrum become completely indistinguishable. Parallel to this, each wind instrument added in a similar way begins with the partials of the spectrum, leaving these partials in a micro-tonal manner over time and moving to the low register by repeating the structure introduced by the flutes in the previous section. Each participating instrument layer introduces itself performing the same cycle, thus a canonic structure emerges, and harmonicity transforms to inharmonicity. The amount of pitch and attack increases both vertically and horizontally, and as density increases, periodicity disappears (See figure 4.24).

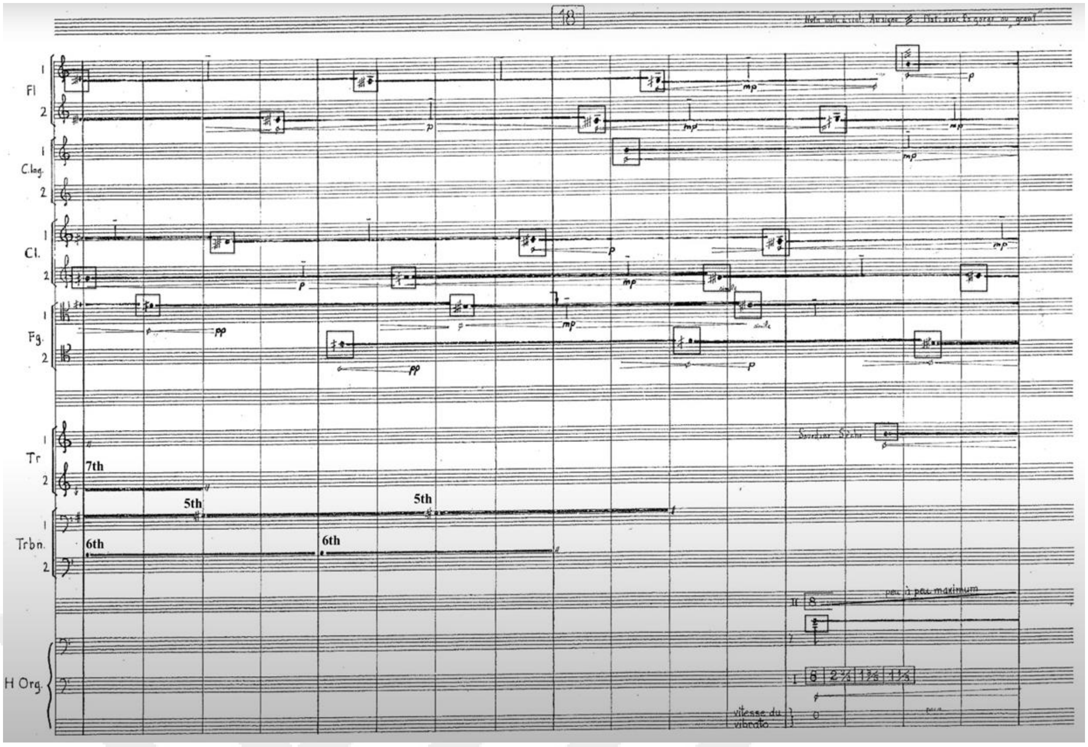


Figure 4.24 : Excerpt 4, third system, reh. mark 18, dominance of inharmonicity and aperiodicity, from Modulations (1978) by Gérard Grisey.

In the second section which begins at rehearsal mark 18 and ends at rehearsal mark 19, periodicity completely disappears rhythmically and dynamically, and parallel to this, dynamics and density start to show an increase. The durations of dynamic fluctuation becomes shorter, and the dynamics increase from p to mf level. Only the trombone remains as a brass instrument and it starts to apply the same cycle. In addition, the hammond organ plays the same canonical line accelerating from ppp, while each included pitch is sustained and added one on top of another, forming a small-scale cluster (See figure 4.25).

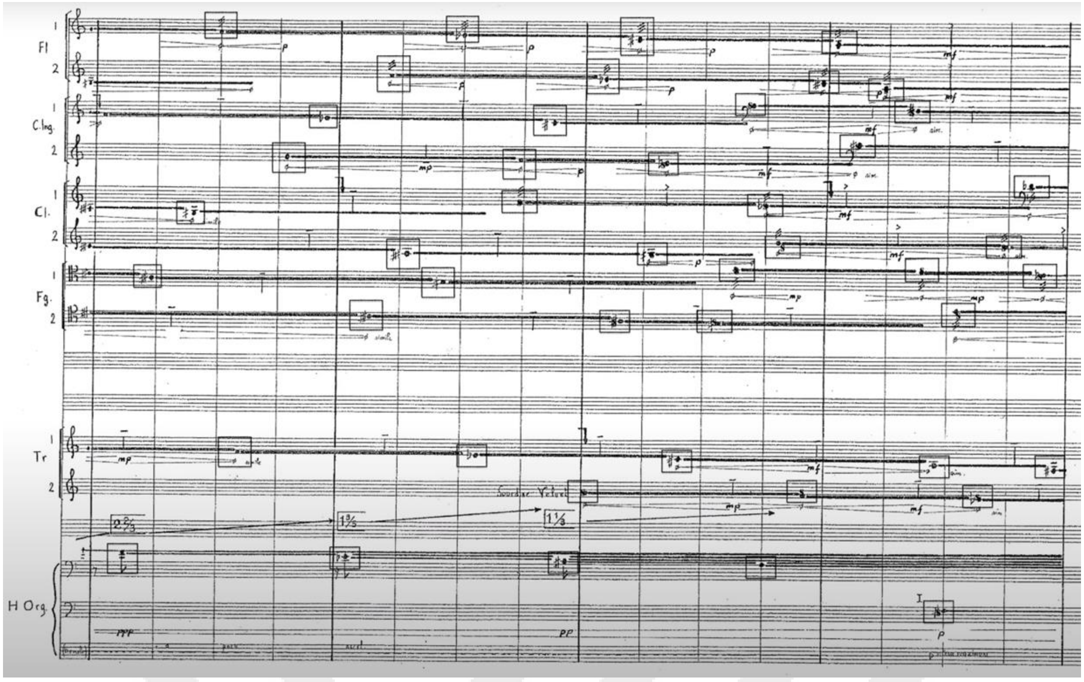


Figure 4.25 : Excerpt 4, fourth system, aperiodic structure which is increasingly dense and accelerated, from Modulations (1978) by Gérard Grisey.

Along with the widening range palette in the last section of the excerpt, the dynamics reach ff in a short time, and the excerpt reaches the part where it is most dense and loud. The second trombone becomes more aggressive with the flutter tongue technique. The Hammond organ, on the other hand, creates a cluster by holding each different pitch of the canonical sequence vertically. The E1 spectrum completely disappears as periodicity transforms to aperiodicity. The tempo is fast and the density is increased (See figure 4.26). Musical tension shows an increasing acceleration until the end of the excerpt with significant manipulations such as increases in loudness and density, and accelerated tempo. In a timbral sense, the transformation of harmonicity into inharmonicity also contributes to a tension increase in addition to aperiodicity.

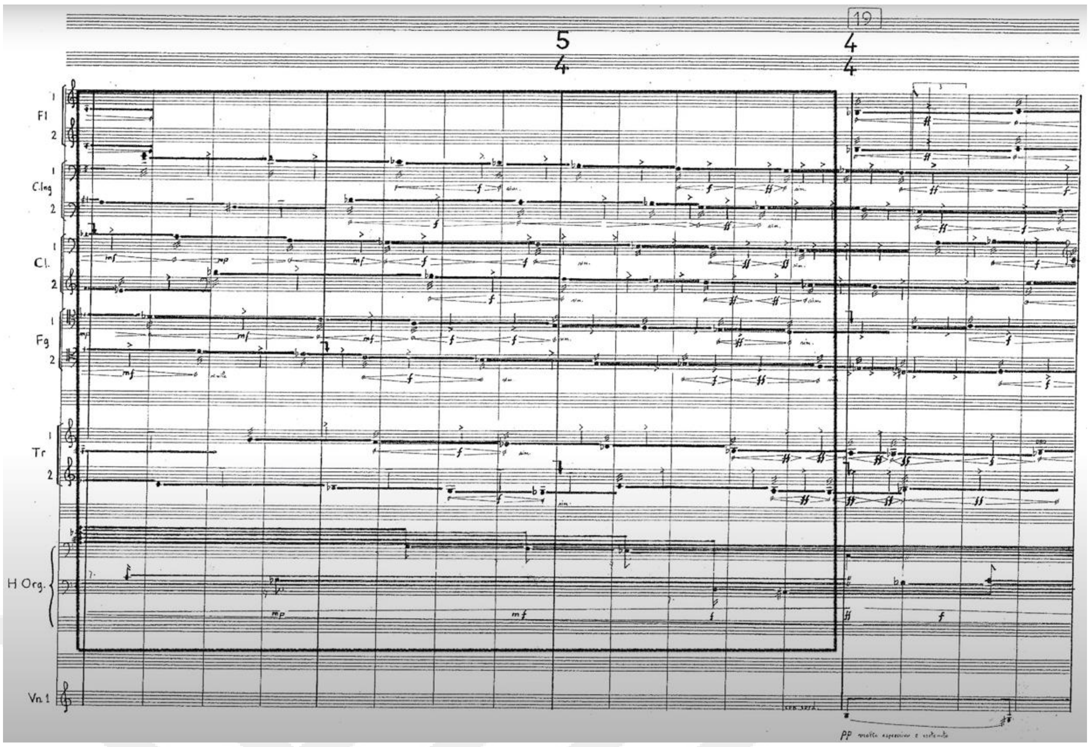


Figure 4.26 : Excerpt 4, last system, dense structure, rehearsal mark 19 from Modulations (1978) by Gérard Grisey.

The scale range is in the margins of G#3 (138 Hz) and G#4 (390 Hz) for most of the excerpt. It expands in the last five measures (See figure 4.27). If we look at the register movements, although most of the instrument lines consist of continuous sequences falling into the low register, its contribution to tension is not that effective compared to other parametric changes. Because this movement continues in a cycle and repeats in short scales successively, there isn't any cumulative movement between high and low registers. However, as seen in the overall range palette in fig. 4.27, there is an expansion towards the end of the excerpt. One could argue that this change also contributes to the increase in tension. Winds gradually depart from the E spectrum and periodic structure following the second section after rehearsal mark 17. In connection with this, tension starts to increase with the loss of harmonicity until rehearsal mark 18 and continues until the end of the section with other parametric changes supporting this, reaching its peak at the end of the excerpt. Timbral change over time based on spectrum components is shown in the image below (See figure 4.28).

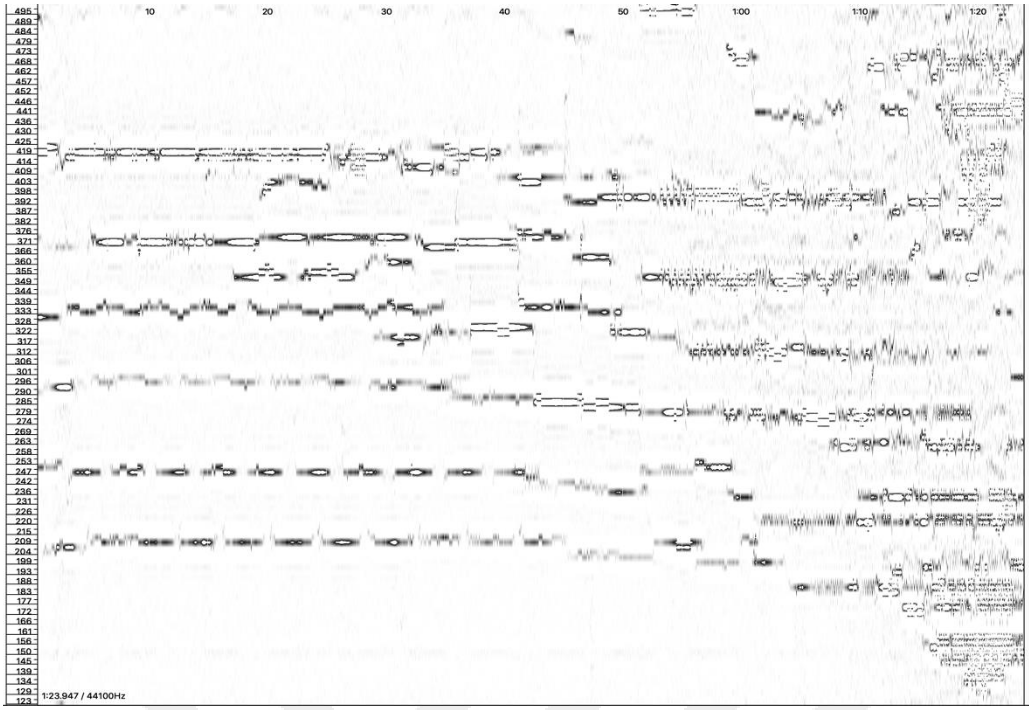


Figure 4.27 : Overall range palette of the excerpt 4, from Modulations (1978) by Gérard Grisey.

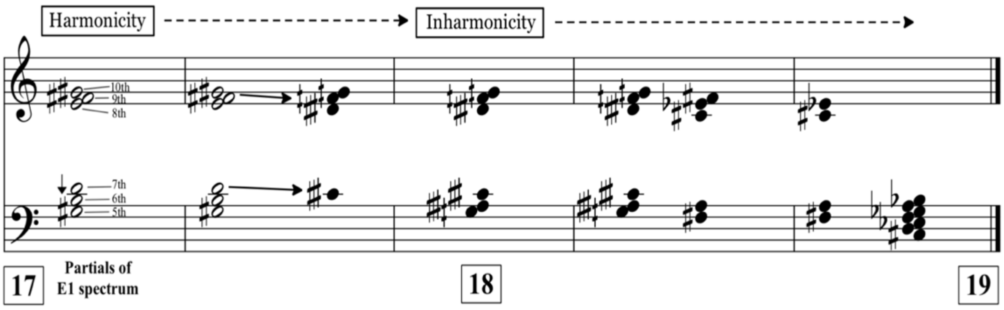
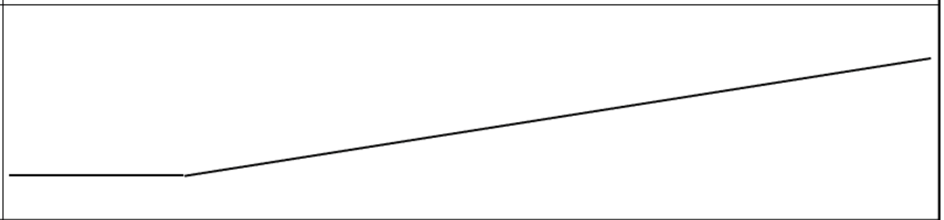


Figure 4.28 : Inharmonicity replaces harmonicity in time, excerpt 4, from Modulations (1978) by Gérard Grisey.

Looking at the texture of the excerpt, it has a homorhythmic feature in the first four measures of 16 seconds starting from rehearsal mark 17. There is a timbral fusion created by the continuous sustained pitches in eight different instrument lines. Therefore, it is possible to say that texture in this section has sound mass characteristics. Since this part has a rhythmic pulse that repeats at equal time intervals, we can consider this part as a homorhythmic sound mass. With the loss of homorhythm and periodicity, sustained pitches become more layered, and the texture's homorhythmic character disappears and evolves into an active sound mass as a result of overlapping lines in a shorter time until the last section. The definition of "active" may be appropriate, since the individual lines are more frequently and constantly in a relationship with each other. Jerome Baillet likens the musical progression in this section of the music to Ligeti because of the successive brick-like process of the instrument groups (Baillet, 2000). Overall visualization of the excerpt is given in the table below (See table 4.5).

Table 4.5 : Overall visualization of the excerpt 4, from Modulations (1978) by Gérard Grisey.

Texture		Static & Homorhythmic Soundmass →				Static Soundmass →											Active Soundmass			
Tension Curve																				
Dynamics		p								mp, repeats* →				mp — mf →				mf — ff →		
Density		24				31				28				46				59		
(attack amount)		6	6	6	6	7	8	8	8	6	7	7	8	7	11	14	14	16	18	25
Time	**Bars**	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	Sec.	16''				16''				16''				16''				13''		
Reh. marks		17									18									19

4.3.5 Excerpt 5, Ethers (1978) by Tristan Murail

Tristan Murail's Ethers was composed in 1978 for ensemble and electronics. The featured instruments are flute, clarinet, trombone, viola, cello, double bass and maracas, with the latter designated as "continuum" and remain as such throughout the majority of the music. The electronic devices are amplification and reverberation, inspired by some electronic music techniques such as echoes, reverberation, phase shifting, sequencers, and frequeny modulation (Url-2). There are no clearly defined segments in the music, but there is an ever-changing sound curve, and the constantly changing tempo causes the sounds to become grainy or extended throughout the section. Murail describes Ethers as a "study of relativity" that involves examining the relationships between speeds and sounds in an unstable environment (Url-3).

The section between rehearsal marks G and H is around 1 minute and 10 seconds. In the beginning, piccolo, trombone, violin, viola, cello, and double bass take stage. All the instruments, except for the trombone, rise rapidly to a higher register with glissando, increasing to fff with crescendo at the beginning of the first measure, and the range widens. As a result, it can be said that the tension increases suddenly. While the trombone plays G1 pitch, the flute rises to F#7. With 32nd tremolos, the rhythmic structure is quite intense (See figure 4.29). The piccolo and trombone maintain a consistent rhythmic pulse emphasizing the chord's highest and lowest pitches, while the strings break the rhythm with gradually increasing aperiodic accents until the end of the second segment. With the changing chord in the third measure of the second segment, the attack times of the piccolo and trombone begin to shorten. Simultaneously, the cello contributes to the dynamic increase by applying crescendo from silence to f with increasing density (See figure 4.30).

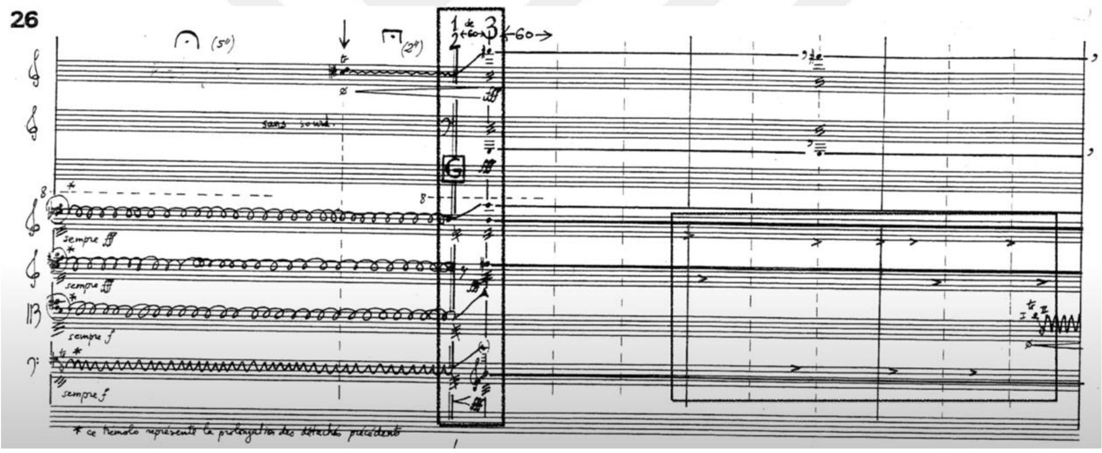


Figure 4.29 : Excerpt 5, rehearsal mark G, beginning of the section from Ethers (1978) by Tristan Murail.

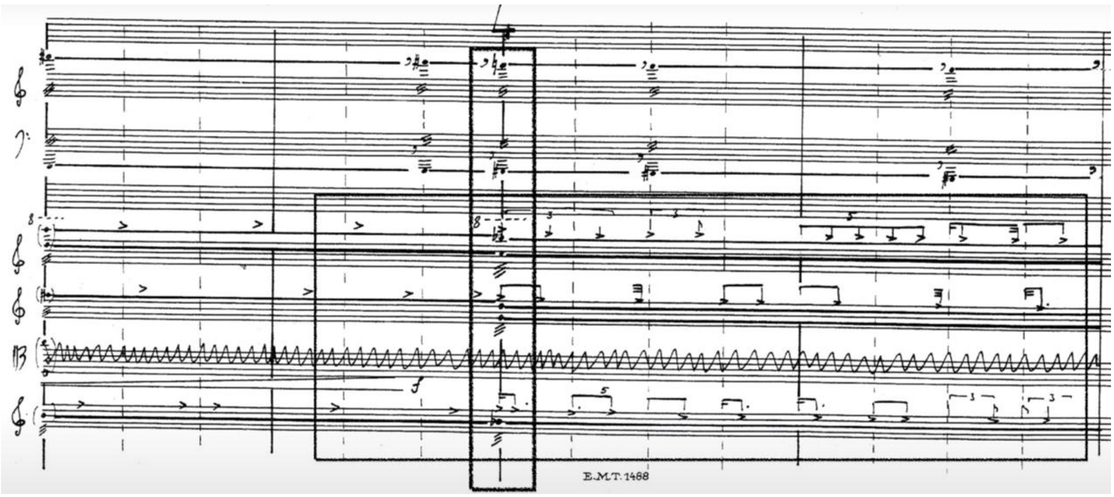


Figure 4.30 : Excerpt 5, second system, continuation of rehearsal mark G, from Ethers (1978) by Tristan Murail.

In the third system, the continuity of the tremolo effect which the strings continuously apply with the increasing amount of accents begins to be filtered in a polyrhythmic structure. Accented beats become more frequent and closer together. The distance between chords starts to be shortened and the scale range continues to narrow as the piccolo and trombone get closer to each other over time. Towards the end of the segment, tremolos are completely filtered out. Along with the tremolos, the accents turn into tenuto's. The dynamic level is also reduced by direct transitions from fff to f, and chord durations become shortened (See figure 4.31). While it is observed that the tension begins to decrease by filtering technique and the rhythmic structure is further simplified in the first two measures up to the fourth segment rehearsal mark H, dynamics are reduced to mf on all instruments. The rhythmical accents on strings disappear completely and are replaced by legatos. Density is also decreased gradually. With the last chord at rehearsal mark H, the vertical harmonic structure disappears and the tempo is slowed down drastically with the rallentando. Density and loudness decrease, tempo slows down and the texture transforms (See figure 4.32).

Figure 4.31 : Excerpt 5, third system, rhythmic change and filtering on accents and tremolos, from Ethers (1978) by Tristan Murail.

Figure 4.32 : Excerpt 5, transition to rehearsal mark H, from Ethers (1978) by Tristan Murail.

Along with the parametric transformation at rehearsal mark H, the tension of the music is reduced significantly as a result of rhythmic simplification, extension in legatos, a reduction in the amount of attacks and pitches per measure, and stretched texture. The dynamic level decreases to pp, and sustained pitches begin to emerge on the cello. The piccolo's and trombone's stable structure disappears, and the polyrhythmic structure dissolves gradually (See figure 4.33).

Regarding the timbre harmony and range, the excerpt begins with a chord consisting of specific partials of the G1 spectrum, beginning with rehearsal mark G. The fundamental pitch, performed on the low register of the trombone, was chosen as G1.

This harmonic structure however, is present only in the first and last chord, with pitches sliding out of the spectrum in those chords in between. Grisey and Murail sometimes apply interpolation to manipulate the initial spectrum by generating intermediate steps (Rose, 1996). In this excerpt, it is possible to say that Murail has followed a similar procedure. The harmonic spectrum generated from G, established at rehearsal mark G, is interpolated in seven steps up to rehearsal mark H and evolves into a harmonically stable area at the end. Simultaneously, the A4 pitch, which corresponds to the 9th component of the G1 spectrum is sustained throughout the interpolation procedure. In comparison to the inharmonic space entered during the interpolation process, the spectrum based on the B2 pitch of the trombone, achieved in the final chord, is more harmonic. Additionally, it is a variant of the G1 harmonic spectrum that was initially introduced. Following that, the harmony continues horizontally and is arpeggiated to the end of the excerpt, with a more narrowband than in the preceding sections. Except for the initial and the last chord, there is no harmonicity. Therefore inharmonicity and harmonicity levels are not as effective as other parameters in the sections where the tension increases or decreases. However, the harmonic spectrum established in rehearsal mark H is maintained throughout the section, raising the harmonicity ratio and thereby contributing to the decrease in tension after rehearsal mark H (See figure 4.34). Additionally, similar to the excerpt from Griseys' Partiels, wedge-shaped harmonies are observed.

Figure 4.33 : Excerpt 5, last system, continuation of rehearsal mark H, from Ethers (1978) by Tristan Murail.

Figure 4.34 : Harmonic structure of the excerpt 5, (whole notes are harmonic, quarter notes are inharmonic pitches), from Ethers (1978) by Tristan Murail.

If we consider the register movements, the clearest one is in the piccolo and trombone. The piccolo falls gradually from G#7 to G#6, while the trombone rises from G1 to B2, and the remaining pitches move to different registers. However, as seen in the harmonic structure, pitch movements are partially similar in the last three chords before rehearsal mark H. Therefore, it is possible to say that the narrowing in this part contributes to the decrease in tension to some extent. The change in the range palette is given in the melodic range spectrogram chart below (See figure 4.35).

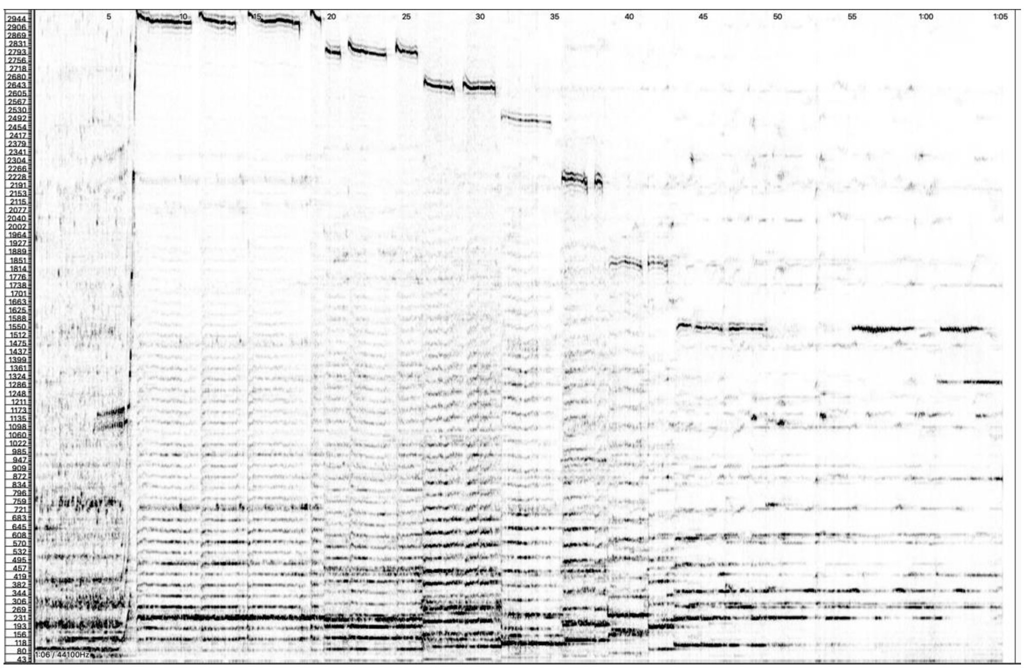
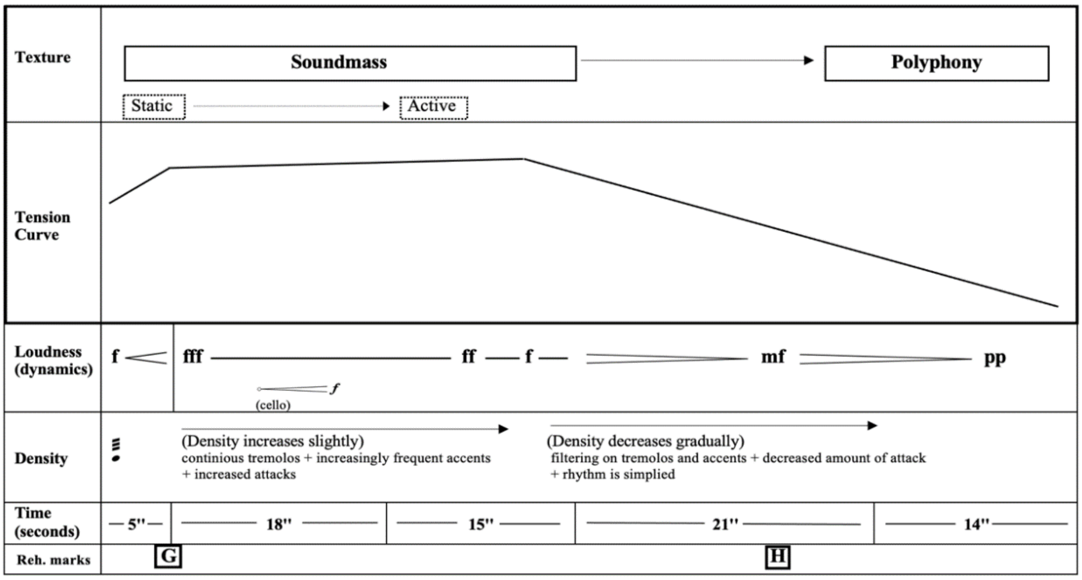


Figure 4.35 : Overall range palette of the excerpt 5, frequency vs time, from Ethers (1978) by Tristan Murail.

If the tension process in the excerpt is briefly summarized, the changes in tempo, filtering in the rhythmic structure and density, changes in dynamics and some register movements stand out as the most important factors. The tension increases with the sudden crescendos and pitch rise at rehearsal mark G, and it is supported by aperiodic accents and the increasing number of attacks, vertically and horizontally, until the end of the G. However, after a short time, tension starts to decrease with sharply reduced dynamics before rehearsal mark H, the filtering in density, the slowing tempo and increased harmonicity level which occurs at rehearsal mark H. This relaxation continues until the end of the excerpt. If we look at texture, the section that starts with G and continues until the third segment can be considered as a static sound mass. With the change in tension level it loses its staticity and evolves into an active form and turns into a polyphonic texture over time. The relationships between individual instrument lines begin to become clear and perceptible. The overall visualization of the excerpt is given in the table below (See table 4.6).

Table 4.6 : Overall visualization of the excerpt 5, from Ethers (1978) by Tristan Murail.



4.3.6 Excerpt 6, Désintégrations (1982) by Tristan Murail

Désintégrations (1982) is a composition by Murail written for 17 instruments and electronics. Electronics consists of computer-synthesized tape. The processes that take place in the tape are also written in the score. One of the main ideas of the piece is to integrate the sounds of electronics and acoustic instruments as much as possible

(Smith, 2000). In music, the tape part often exaggerates the character of the instruments, distorting or strengthening the orchestral effect. In these processes, it is in constant balance with the orchestra. Each section highlights a different spectrum area. The sections contain transitions and evolutions between harmonic and inharmonic spectra. These evolutions are associated with increasing or decreasing agitation (Murail, 1982).

The excerpt from Désintégrations to be analyzed in here, includes sections IX and X. The approximately two-minute process starting from IX to the middle parts of X will be examined. Julian Anderson, in his notes, interprets chapter IX as "chaotic and irregular ring-modulation spectra descend through the ensemble" (Url-4). In section IX, harmonic material is obtained by applying the ring modulation technique twice on two pitch sets: A1 (1/4 higher), F#3 and C#2 (1/4 higher), A2 (1/4 higher). The first stage of this process is shown in the table below (See figure 4.36). The complex harmony of the section was obtained by putting the resulting chords seen in figure 4.36 back into the ring modulation process (Cornicello, 2000). Therefore the section generally consists of a complex sound palette far from harmonicity.

Figure 4.36 : Two sets of pitches combined using ring modulation, first part of the ring modulation process. Adapted from (Cornicello, 2000, p.95).

The first system of the section starts with a dense structure in ff dynamics with the descending movement of tape, flute, clarinet, percussion and piano in a polyrhythmic structure and high register. The tempo is quarter note equals 75 bpm (See figure 4.37). After the third measure of the second system, the dynamics diversify with short transitions on mf-ff scale. But the overall dynamic effect retains its height. This structure is supported by the addition of cello and contrabass in the fifth measure and sustained low-register pitches in the tape part. The range widens and the density starts to increase slightly. In the second system, the dynamics continue to maintain their general level with similar fluctuations. Once the violins and viola are involved with sustained pitches, the strings are also fully activated. In parallel with this, the tape starts to form continuous and elongating clusters in the low register (See Figure 4.38). In addition to the continuing descending complex structure, the bass clarinet, trombone, and horn also begin to form a low dynamic line, similar to the static sustained structure that occurs in the strings and the lowest register of the tape. The structure created by the sustained pitches of tape and strings mostly include fundamental pitch sets form the first process of ring modulation (See figure 4.39).

Figure 4.37 : First system, beginning of the excerpt 6, section IX, from Désintégrations (1982) by Tristan Murail.

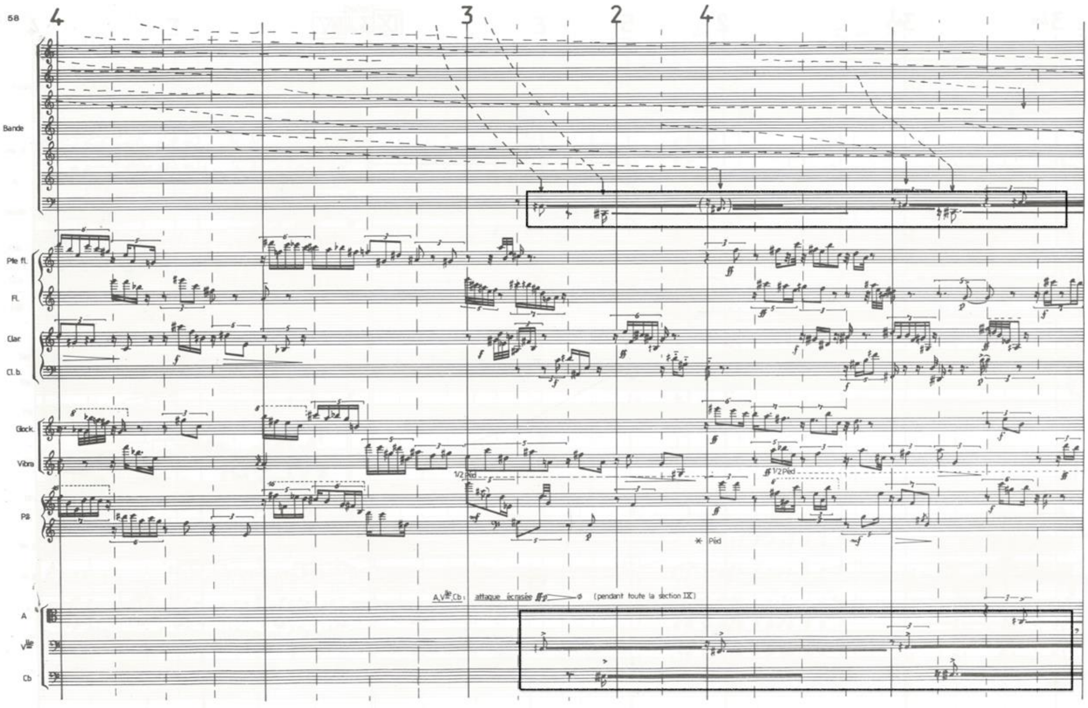


Figure 4.38 : Excerpt 6, second system, sustained pitches introduced by strings and tape, from Désintégrations (1982) by Tristan Murail.

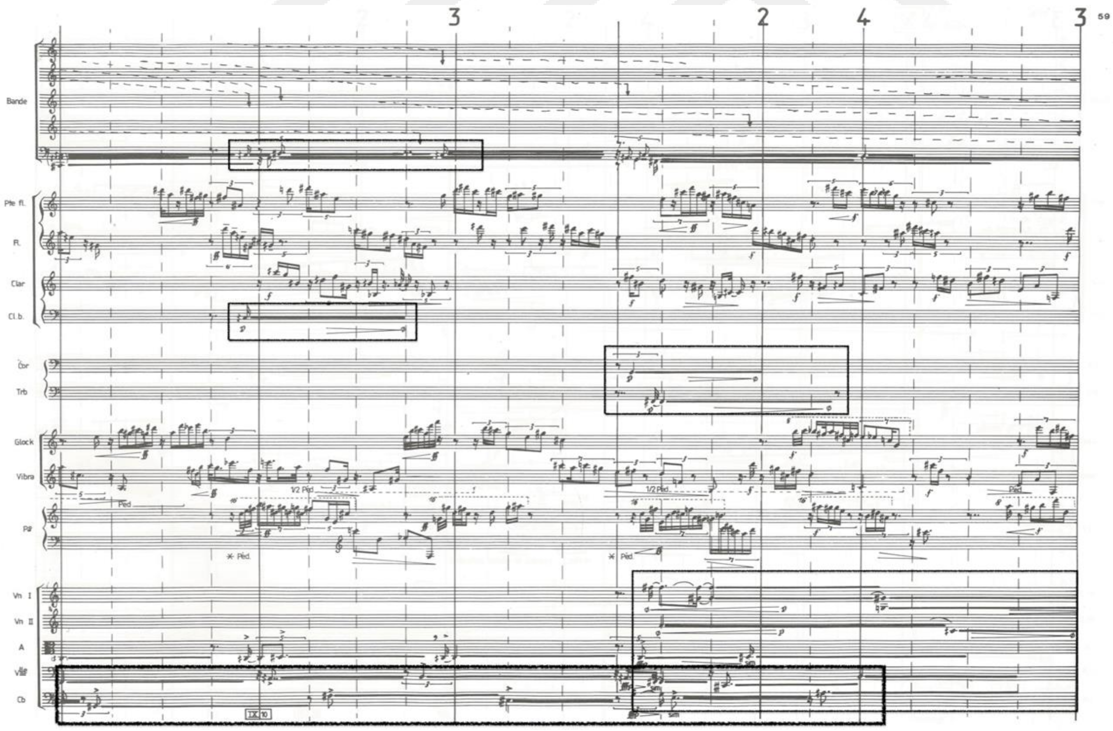


Figure 4.39 : Excerpt 6, third system, increased density and sustained pitches, from Désintégrations (1982) by Tristan Murail.

In the fourth system, the chaotic descending structure gradually enters the filtering process. The structure of sustained pitches starts to come to the fore and the overall dynamic level decreases to mf-mp scale along with it. The pitch fall to low register remains stable. Strings and tape in particular, begin to dominate the range covered by the orchestra. The rhythmic movement and the amount of attacks per measure gradually decrease, which gives the effect of decelerating tempo. Harmonic complexity begins to lose its initial effect, and with all these manipulations, the tension of the music starts to decrease (See figure 4.40).

Figure 4.40 : Excerpt 6, fourth system, gradual decrease loudness and density, from Désintégrations (1982) by Tristan Murail.

In the fifth system connected to section X, the descending polyrhythmic structure is filtered and almost completely disappears. This is replaced by a static structure consisting of prolonged sounds. As the dynamic level continues to decrease, the inharmonic structure also loses its effect. It is seen that the E1 spectrum is prioritized towards section X with reduced density. The emphasis on the E and G# pitches of the trombone and double bass stands out. Throughout the orchestra, the overtone partials of the E1 spectrum gradually begin to appear with sustained pitches. The pitches of E1 harmonic spectrum are marked on the score (See figure 4.41). The evolution towards harmonicity contributes to decreasing tension. The partials of the E1 harmonic spectrum used in section X are given in the figure below (See figure 4.42).

Figure 4.41 : Excerpt 6, fifth system, transition to section X, E1 harmonic spectrum begins to appear, from Désintégrations (1982) by Tristan Murail.

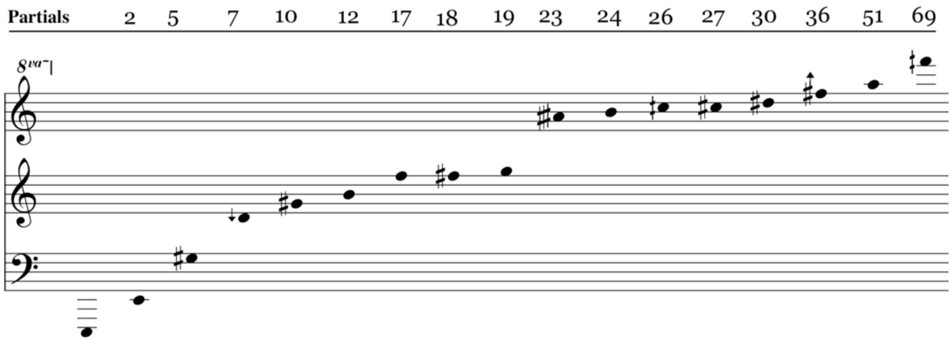


Figure 4.42 : Overtone partials of E1 spectrum used in section X, from Désintégrations (1982) by Tristan Murail.

In the sixth system, which is a continuation of section X, the decreasing density in section IX evolves over time into a structure dominated by harmonicity, consisting mostly of static prolonged sounds. This evolution brings music into a relaxation process. The emphasis on the fundamental E1 pitch is also supported by the tape.

Although the piano and cello recalls the C# and A (1/4 higher) pitches from the pitch sets in the ring modulation process used in section IX, the harmonic spectrum dominates section X. Global change is dominant. The dynamic level is generally low. Some of the clarinets, flutes and strings have sffz attacks, but they fade out without the dominance of the general structure being interrupted. In addition to this, the tempo is slowed down from 75 to 60 beats per minute with the rallentando. With the separation of the piano from the orchestra in the final system, the music evolves into a complete static structure consisting of slow and sustained pitches in a stable harmonic spectrum. The diminuendo on the strings also contribute to the dynamic reduction. The last two systems in the section X are given in the images below and the partials of E1 harmonic spectrum are marked on the score (See figures 4.43 and 4.44).

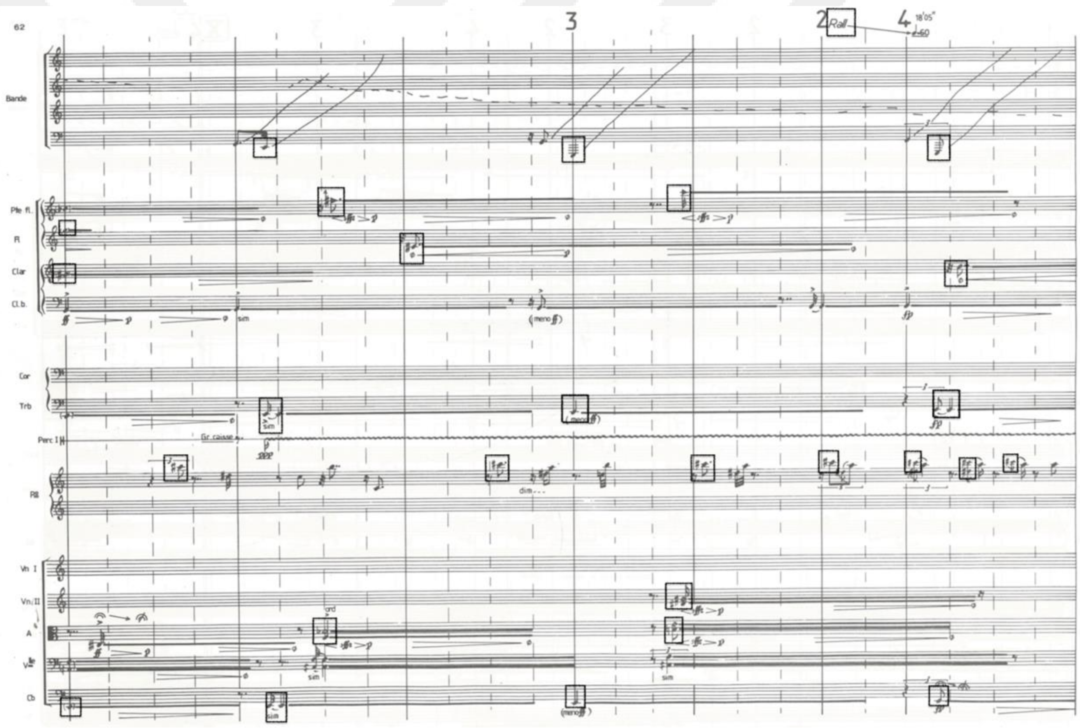


Figure 4.43 : Excerpt 6, section X, sixth system, continuation of harmonicity and static structure, from Désintégrations (1982) by Tristan Murail.

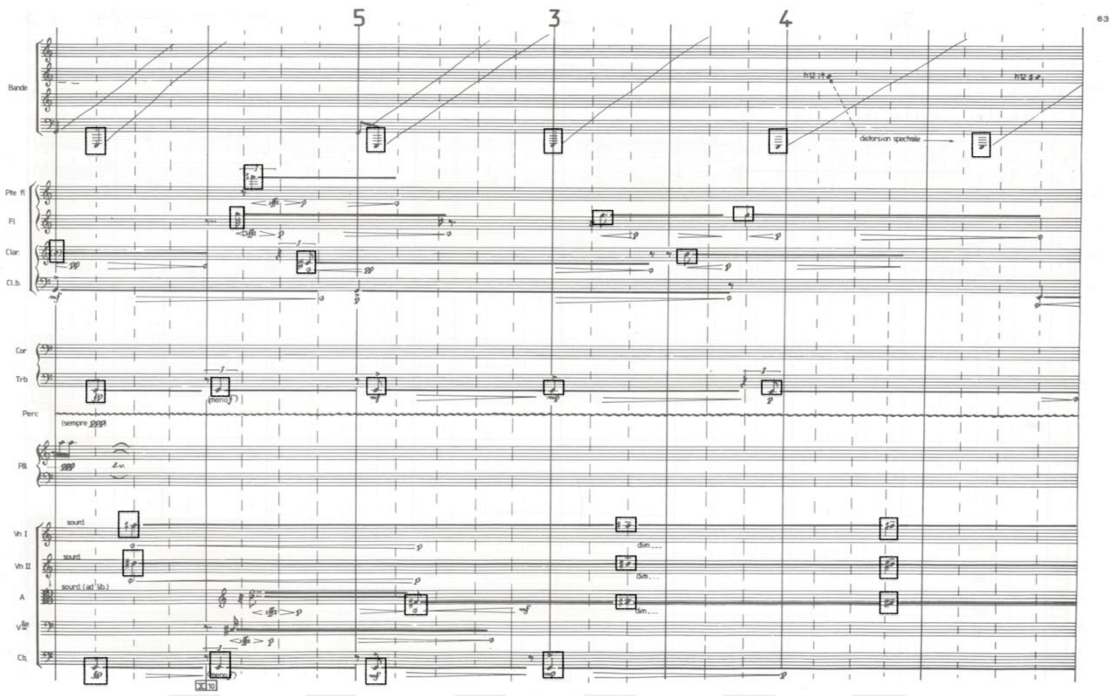


Figure 4.44 : Section X, seventh system, end of the excerpt 6, from Désintégrations (1982) by Tristan Murail.

In summary, the polyrhythmic, complex, inharmonic, dense and dynamically high music which started in section IX is stressed with strings, and clusters on tape included in the second and third segments. Loudness and density increase slightly while tension is slightly increased. Starting from the fourth segment, harmonicity begins to emerge with decreasing density and dynamics towards section X, and the tension begins to relax and reaches its lowest level until the end of the excerpt. In this process, it can be said that, together with the change in other parameters, the continuous ascending movement of the orchestra towards the low register is one of the factors affecting the decrease in tension. The range palette of the excerpt is given in the figure below (See figure 4.45).

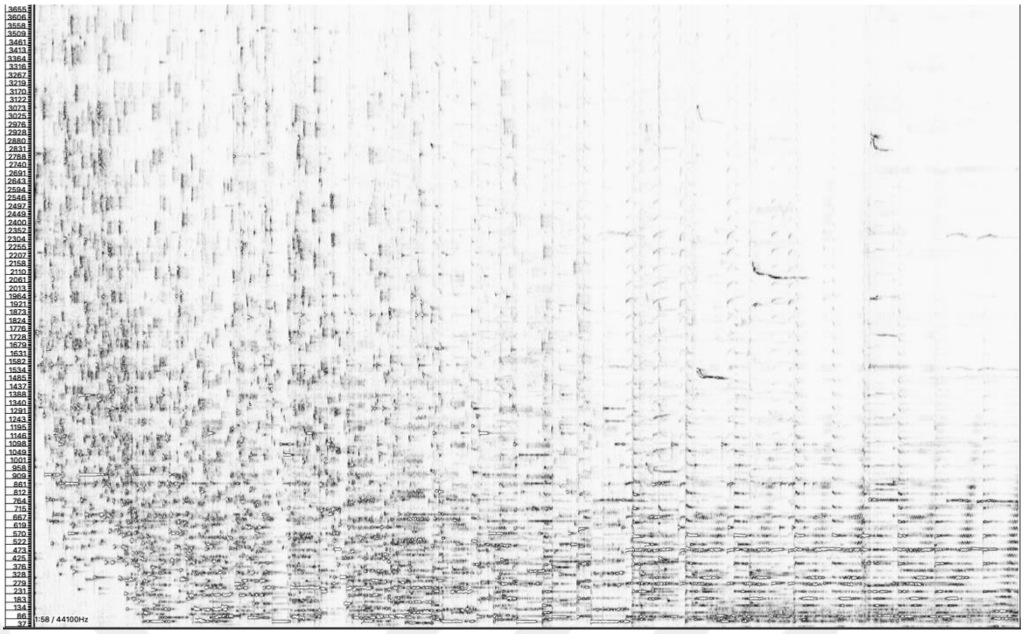
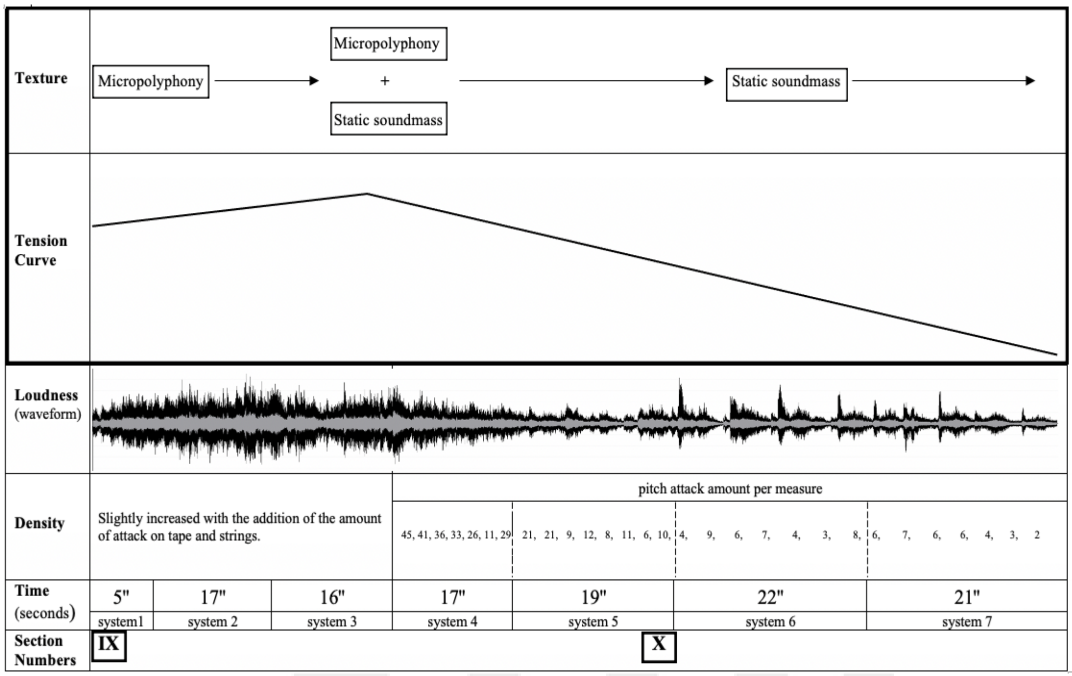


Figure 4.45 : Overall range palette of the excerpt 6, from Désintégrations (1982) by Tristan Murail.

In this process, the texture is also affected and enters into a change. In section IX, the texture has micropolyphonic features. Fast, polyrhythmic and continuous motion masks the distinct sensation of individual lines, resulting in a global fusion. For this reason, it has a similar feature to micropolyphony. In the second and third segments where the tension is slightly increased, the texture is layered with the addition of strings and tape with sustained pitches. The static sound mass created by tape and strings continues in a layered manner with micropolyphony. With the decrease in tension towards section X, the micropolyphonic texture gradually disappears from this layered form, given way to a static sound mass. In the area where the tension releases, the layered texture is simplified by losing its micropolyphonic feature and evolving into a static sound mass. The overall visualization of the excerpt is given in the table below (See table 4.7). In this excerpt, the loudness is shown in waveform in table 4.7 for the purpose of clearly visualizing the global change, since the dynamics are constantly changing at the micro scale.

Table 4.7 : Overall visualization of the excerpt 6, from Désintégrations (1982) by Tristan Murail.



4.3.7 Excerpt 7, Pour L'Image (1987) by Philippe Hurel

In addition to the analyzed sections of the music by Murail and Grisey representing the early period of French spectral music, an excerpt from a piece by a second generation composer Philippe Hurel, titled as Pour L' Image, will also be analyzed briefly. The piece composed for flute, oboe, clarinet, saxophone, horn, trumpet, trombone, percussion, violin, viola, cello and double bass. The excerpt that will be examined consists of approximately 45 seconds from rehearsal mark B through C.

At the beginning of the excerpt, pitched percussion fades out and the polyrhythmic structure of the winds are left alone. Each instrument line maintains a different scale pattern in different rhythmic divisions by creating a polyrhythm at low dynamics. Hereby, winds create a fusion by repeating a specific sequence in a constantly changing rhythmic structure. The tempo is fixed at 60 bpm in 4/4 meter. Starting from rehearsal mark B, this polyrhythmic structure begins to become more frequent in every measure. The pitch amount per measure is gradually increased and the note durations are shortened. With this increase, double bass and cello in the low register are added one by one to the orchestra with sustained pitches (See figure 4.46). In the second segment, the polyrhythmic structure in winds accelerates as the beats completely turn into 32nds and the individual instrument lines become more indistinguishable. The music accelerates as a whole. Strings and brasses also begin to form a static set of sounds including sustained pitches at the same time. Each instrument line enters with low dynamics and at the end of the second segment the entire orchestra rises dynamically by applying crescendo (See figure 4.47). Two separate layers are formed in the texture: one of them is a polyrhythmic fast structure formed by winds, and the other is a static sustained structure consisting of brass and strings.

Figure 4.46 : Beginning of the excerpt 7, rehearsal mark B, polyrhythmic structure, from Pour L'Image (1987) by Philippe Hurel.

Figure 4.47 : Excerpt 7, second system, accelerated tempo, increased density and the addition of static structure, from Pour L'Image (1987) by Philippe Hurel.

In the third system, the increase in dynamics continues. The tempo accelerates even more as a result of the fast tremolos added to the strings. Density and loudness continue to increase. The continued wind lines of 32nd notes are transformed at the last beat of the last measure. In the last system, the C section, the music reaches the ff level in terms of dynamics. At the same time, density reaches its peak with the entire orchestra entering into a state of orchestral synthesis consisting of prolonged sounds. Sound mass texture is revealed (See figures 4.48 and 4.49).

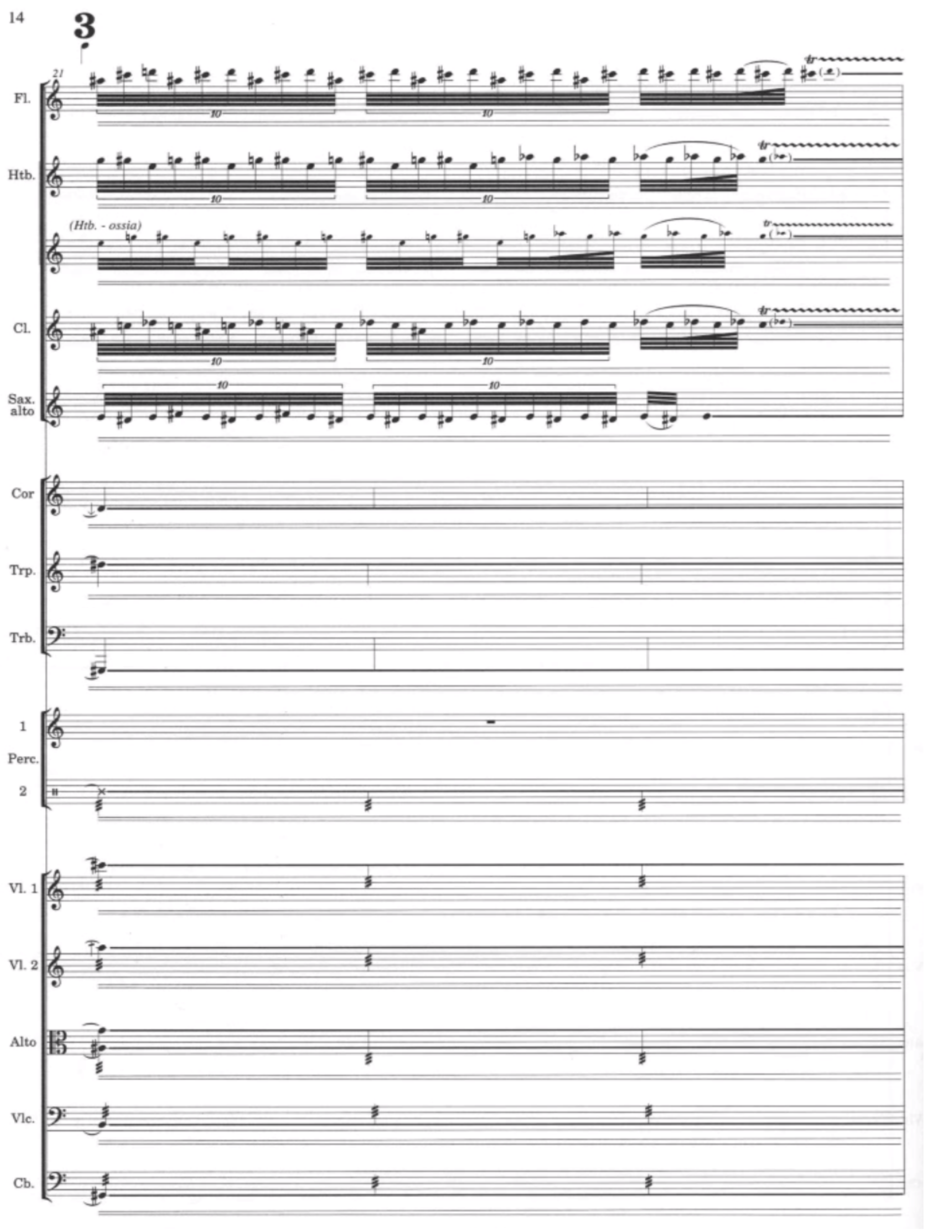


Figure 4.48 : Excerpt 7, third system, continuation of increased tension, from Pour L'Image (1987) by Philippe Hurel.

Figure 4.49 : Excerpt 7, last system, rehearsal mark C, sound mass, from Pour L'Image (1987) by Philippe Hurel.

Tension shows a steady increase over time from rehearsal mark B to C. At the beginning of the excerpt, the range expands in a short time. The range which widens with the introduction of strings and brass right after the B section, maintains the G#1 - D6 scale until the end of the section. A general pitch movement in the same direction is not observed. Movement in the range is generally minimal. Looking at the harmony table, the specific partials of the harmonic spectrum of a fundamental frequency are not emphasized. Immediately after rehearsal mark B, the timbre formed by brass, percussion and strings becomes more evident. The harmony, which is simple at first, becomes irregular after the 4th measure with the increase of microtones of different degrees and the increase of complexity (See figure 4.50). It can be said that this change in timbre, along with the widening range, also contributes to the increased tension.

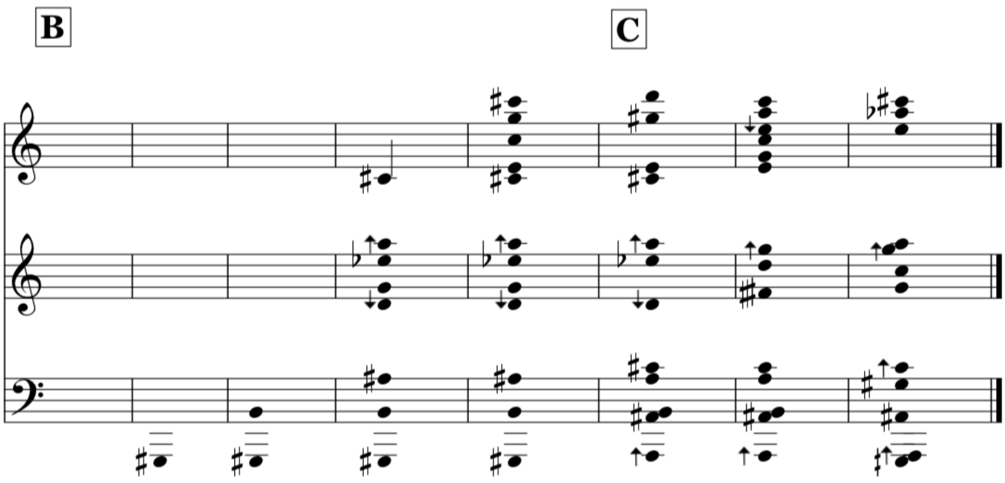
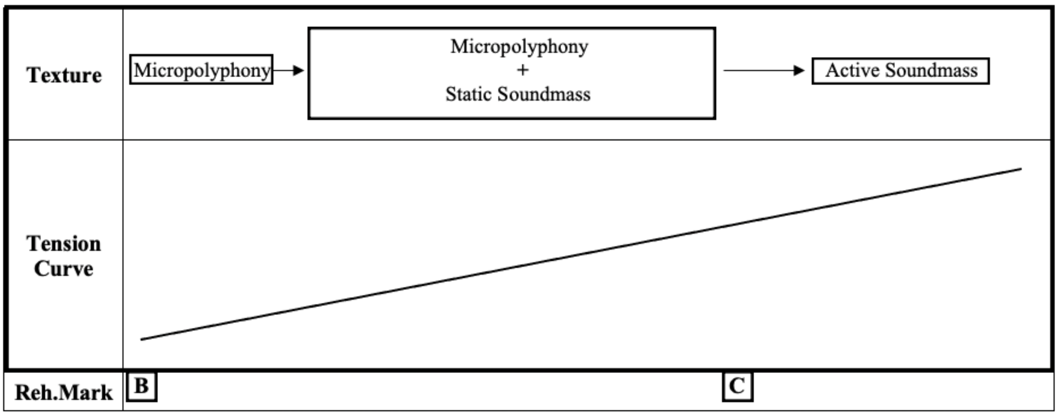


Figure 4.50 : Harmonic structure created by brasses and strings, from Pour L'Image (1987) by Philippe Hurel.

While the tension constantly increases throughout the excerpt, the texture of the music also changes. The polyrhythmic and progressively accelerating structure, formed by the winds entering in rehearsal mark B, has micropolyphonic feature in terms of texture. Individual lines intertwined in rapid and different rhythmic divisions together create a global blurred sound, thus perceptibility between individual lines is poor. Static sound mass texture created by strings and brasses is added to this texture, with each line creating a static structure with sustained pitches added one on top of another over time. A layered texture combined of micropolyphony and static sound mass is achieved. Later, the polyrhythmic structure of the winds disappear, and they turn into prolonged pitches consisting of trills. Thus, the layered texture disappears and the texture of the entire orchestra becomes a sound mass. It is possible to say that the texture also loses its static character due to short-term changes in each line after rehearsal mark C. Texture and tension graph is given in the table below (See table 4.8).

Table 4.8 : Overall visualization of the excerpt 7, tension curve and changes in texture, from Pour L'Image (1987) by Philippe Hurel.



5. CONCLUSIONS AND FURTHER DISCUSSIONS

As stated in the introduction chapter, the purpose of this study is to shed light on the relationship between texture and tension in early French spectral music, as well as to determine the texture changes associated with increasing and decreasing tension. First of all, the brief history of the music is reviewed. The period's characteristics and approach, composers, composition techniques and inspirations are explained. In the following chapter, definitions of texture are discussed and its conventional forms in the literature are demonstrated with musical excerpts. Monophony, homophony, polyphony, and heterophony are characterized as four common texture types. Afterwards, some significant developments and new forms of texture from the early 20th century, when significant innovations and transformations in the history of music occurred, are addressed chronologically under various headings such as new textural approaches in the music of Debussy and Ravel, the pioneering composers of the impressionism movement that emerged in France, the concept of klangfarbenmelodie, a timbral dimension that Arnold Schoenberg brought to the melody component, Cowell's tone clusters in his piano music, the sound mass textures of Penderecki, Ligeti and Xenakis, Ligeti's invention of micropolyphony, and the definition of timbre and its use in texture. After covering the diversity of texture and different forms in textural evolution, the study continues with a discussion about texture in French spectral music. The various texture types and shapes found in French spectral music like static sound mass, micropolyphony and their layered arrays are demonstrated through excerpts from the music by the major composers of the period, Gérard Grisey, Tristan Murail, and late generation composers Philippe Hurel and Kaija Saariaho. All these studies and demonstrations clarify the determinations pertaining to texture in the analysis chapter of the thesis.

The definitions and applications of musical tension, its place in the Western music theory system and its relationship with the concepts of consonance, dissonance and cadence, along with musical parameters such as harmony, melody, pitch movements, dynamics, and tempo are discussed followed by cognitive studies on tension and a number of approaches emphasizing the multidimensionality of tension and its subjectivity. The tension and release processes in French spectral music and some composers' approaches are discussed, as well as the implications of certain concepts like as inharmonicity and roughness, both of which are related to timbre in the context of French spectral music. All of these factors help in the determination of the parameters to be applied in the tension analysis of the musical excerpts, and clarifies the inferences to be drawn about the regions of increasing and decreasing tension.

The focus of the study is early French spectral music. For this reason, the analyses applied include musical excerpts from the prominent early compositions by Gérard Grisey and Tristan Murail, who are the pioneers and most well-known composers of the period. These selected excerpts are chosen based on possible tension curves and the variety of texture types. Thus, the findings provide insight about the music of the period. The musical excerpts are analyzed through the data gathered from the score, composers' notes, quotations from literature, spectrograms generated using the computer software Sonic Visualizer, transcriptions, tables and score examples. As the result of these analyses, it is possible to obtain some determinations by reaching the texture types and tension curves. The findings are listed below:

1. The textures identified as a result of the analyses include sound mass, micropolyphony, polyphony, and two-layer textures generated by sound mass and micropolyphony. As opposed to the typical micropolyphony, another type of micropolyphony is observed as stretched and slowed structures. The sound mass textures emerge both as static and active structures.
2. Textural changes are seen in all processes involving an increase or decrease in tension. Textures frequently evolve into new texture types. Textures that do not evolve into separate types, on the other hand get transformed within themselves. These transformations occurre as sound mass texture types evolving into homorhythmic, static, and active forms, while micropolyphony mutates into slower and stretched forms. Apart from these findings, sharper transitions from sound mass to both micropolyphony and polyphony are found frequently.
3. In the processes where tension increases, we can observe an acceleration and thickening of micropolyphonic textures. Moreover, this alteration is strongly

correlated with the increasing density. Additionally, it is observed that micropolyphonic textures gradually become layered with static sound masses transforming into double-layered textures structured in combination with sound masses in the regions of increased tension. The evolution of the double-layered textures may be interrupted as the tension increases. While the increase continues, the double-layered textures formed by micropolyphony and sound mass can evolve into single-layered sound mass textures. Micropolyphony, with the exception of its brief appearance in excerpt 1, is found to function as a micro-scale layer of the texture of music in general.

4. When not layered with micropolyphony, the sound mass texture is always altered and evolves from static structure to an active one in the regions where the tension increases. In such cases where it has a stable rhythmic structure, it is also possible to state that this stable rhythmic structure transforms into an unstable and aperiodic structure as tension increases. In the textures where sound mass is layered with micropolyphony, the sound mass texture can remain solitary and take static or active forms in the regions of increased tension. In the excerpts examined, the texture of the music stands out with its sound mass characteristics compared to other textures, especially in the processes when the tension increases.

5. In the processes where the tension decreases, the sound mass texture either evolves from the active to the static state, or it separates from the double-layered structure created with micropolyphony and maintains its own static character. Besides that, we can clearly observe that the sound mass texture evolves from an active state with increasing tension to polyphony with decreasing tension. The mass structure generated by the prolonged pitches of the individual instrument lines are evolved into a polyphonic texture in which a contrapuntal interaction between the lines can be observed as the pitches get shortened and transform into an active structure moving in various directions. Micropolyphonic and polyphonic textures are either stretched or slowed down in the process of decreasing tension, or both stretched and slowed down. These textural alterations are found to be strongly associated with the reduction in density.

6. In order to determine the tension process, we analyze the parameters such as loudness, density, range, harmonicity and inharmonicity level. It is observed that several of these parameters become prominent during the textural transformation process of music. For instance, the density parameter is critical in distinguishing texture types. There are many cases where tempo does not literally change. The pitch and attack amount per measure, and the reduction and increase in the spacing between the pitches and attacks are all considered significant components in the shape of texture. Density can be considered the most effective parameter, especially in stretched and tightened micropolyphonic and polyphonic textures. In addition to this, deceleration and acceleration in tempo can be related to vertical and horizontal changes in the number of attacks and pitches. It has been determined that movement changes affected by increase in tension, such as static, active, stretching, tightening, and slowing, are more closely related to changes in density than to other parameters.

This study provides a deeper perspective on the mechanisms forming the relationship between the texture of the music and the tension process in the early French spectral music. The conclusions drawn from this study rely on various research projects, the analyses of various approaches, composer's perspectives on texture and tension, parametric analyses, and transcriptions on the score. As a result of the applied analyses, the parameters directing tension and texture are clearly observed, and as a result, it is possible to speak about obvious interrelations between texture and tension. Although the conclusions drawn as a result of the applied parametric analyses provide extremely precise and concrete inferences about the texture and tension processes in the studied repertoire, the existence of the subjective and psychoacoustic dimensions of the concept of tension complicates making generalizations.

Further research into the subject may focus on a set of large-scale experiments that approach the subject as a cognitive perspective of tension perception in the context of spectral music. Further research might also focus on the textural movements, texture patterns and tension curves in the style of specific composers of French spectral music such as Gérard Grisey and Tristan Murail, and classification based on their music can be presented. Another area of research might be the parametric analysis of transition areas between textures in French spectral music.

The thesis is concluded with an overall assessment of the applied analyses and suggestions for future researches.

REFERENCES

Anderson, J. (2000). A provisional history of spectral music. *Contemporary Music Review*, *19*(2), 7-22. https://doi.org/10.1080/07494460000640231

Anderson, J., & Saariaho, K. (1992). Seductive Solitary. Julian Anderson Introduces the Work of Kaija Saariaho. *The Musical Times*, *133*(1798), 616-619. Musical Times Publications Ltd. https://doi.org/10.2307/1002509

Arrell, C. (2008). The Music of Sound: An Analysis of Partiels by Gérard Grisey. *Spectral World Music, Proceedings of the Istanbul Spectral Music Conference*. pp. 318-332. Istanbul: Pan Yayıncılık, 2008.

Baillet, J. (2000). *Gérard Grisey Fondements d'une écriture*. France: L'Harmattan Inc.

Benward, B., & Saker, M (2009). *Music in Theory and Practice* (8th ed., Vol. 1). New York, NY: McGraw-Hill.

Berry, W. (1976). *Structural Functions in Music*. Cliffs, N.J: Dover Publications, Inc. Englewood Cliffs.

Besharse, K. E. (2011). *The Role of Texture in French Spectral Music*. Urbana, Illinois: Proquest, UMI Dissertation Publishing.

Bithell, C., Cooke, P., Frobenius, W., & Zemtsovsky, I. (2001). "Polyphony". In Oxford Music Online. Retrieved October 16, 2021, from https://www.oxfordmusiconline.com/grovemusic/view/10.1093/gmo/9781561592630.001.0001/omo-9781561592630-e-0000042927

Boulez, P. (1987). Timbre and composition - timbre and language, *Contemporary Music Review*, *2*(1), 161-171. https://doi.org/10.1080/07494468708567057

Bowen, J. (2010). Tristan Murail's Tellur: A Piece of Spectral Music and an Exploration of Compositional Possibilities for the Classical Guitar, *Nota Bene*: *Canadian Undergraduate Journal of Musicology*, *3*(1), Article 7.

Campbell, M. (2001). "Timbre". In Oxford Music Online. Retrieved December 8, 2021, from https://www.oxfordmusiconline.com/grovemusic/view/10.1093/gmo/9781561592630.001.0001/omo-9781561592630-e-0000027973

Cooke, P. (2001). "Heterophony". In Oxford Music Online. Retrieved October 13, 2021, from https://www.oxfordmusiconline.com/grovemusic/view/10.1093/gmo/9781561592630.001.0001/omo-9781561592630-e-0000012945?rskey=L1nA3p&result=1

Cope, D. (1997). *Techniques of the Contemporary Composer* (1st ed.). USA: Cengage Learning. Schirmer Books.

Cornicello, A. (2000). *Timbral Organization in Tristan Murail's Désingtégrations and Rituals.* (Ph.D. Thesis). Retrieved April 6, 2022, from http://www.anthonycornicello.com/dissertation/Frontmatter.pdf

Cornicello, A. (2016). *French Spectral Music: An Introduction to the Techniques and Processes*. USA: LAMBERT Academic Publishing.

Cramer, A. (2002). Schoenberg's Klangfarbenmelodie: A Principle Of Early Atonal Harmony. *Music Theory Spectrum*, *24*(1), 1–34. Oxford: Oxford University Press on behalf of the Society for Music Theory. https://doi.org/10.1525/mts.2002.24.1.1

Erickson, R. (1975). *Sound structure in music*. Berkeley and Los Angeles: University of California Press.

Farbood, M. M. (2006). *A Quantitative, Parametric Model of Musical Tension.* (Phd Thesis) Massachusetts Institute of Technology. Connecting Repositories. https://core.ac.uk/download/pdf/4403935.pdf

Farbood, M. M. (2008). A Global Model of Musical Tension. *Proceedings of the 10th International Conference on Music Perception and Cognition.* Sapporo, Japan: Sapporo ICMPC.

Farbood, M. M., & Price, K. C. (2017). The contribution of timbre attributes to musical tension. *The Journal of the Acoustical Society of America*, *141*(1), 419-427. https://doi.org/10.1121/1.4973568

Féron, F. X. (2011). The Emergence of Spectra in Gérard Grisey's Compositional Process: From Dérives (1973–74) to Les espaces acoustiques (1974–85), *Contemporary Music Review*, *30*(5), 343-375. https://doi.org/10.1080/07494467.2011.665582

Fineberg, J. (2000). Spectral Music. *Contemporary Music Review*, *19*(2), 1-5. https://doi.org/10.1080/07494460000640221

Fineberg, J. (2000). Guide to the Basic Concepts and Techniques of Spectral Music. *Contemporary Music Review*, *19*(2), 81-113. https://doi.org/10.1080/07494460000640271

Fineberg, J. (2000). Musical Examples. *Contemporary Music Review*, *19*(2), 115-134. https://doi.org/10.1080/07494460000640281

Floros, C. (2014). *György Ligeti: beyond avant-garde and postmodernism*. Internationaler Verlag der Wissenchaften Frankfurt am Maim 2014 (English edition). Frankfurt, Germany: PL Academic Research.

Granot, R. Y. & Eithan, Z. (2011). Musical Tension and the Interaction of Dynamic Auditory Parameters. *Music Perception: An Interdisciplinary Journal*, *28*(3), 219-246. University of California Press. https://doi.org/10.1525/mp.2011.28.3.219

Grey, J. M. (1975). *An Exploration of Musical Timbre*. (Ph.D. Thesis) Center for Computer Research in Music and Acoustics, Stanford University. Stanford, CA. https://ccrma.stanford.edu/files/papers/stanm2.pdf

Griffiths, P. (2010). *Modern Music and After* (3rd ed.). Madison Avenue, New York: Oxford University Press, Inc.

Grisey, G. (1974). *Partiels pour 18 musiciens* [Score]. Ricordi.

Hamberger, C. L. (2012). *The Evolution of Schoenberg's Klangfarbenmelodie: The Importance of Timbre in Modern Music*. (Master Thesis) Electronic Theses and Dissertations for Graduate School. https://etda.libraries.psu.edu/files/final_submissions/8130

Har, A. O. (2019). *"Music as a discourse/music as a state of sound': An interpretation of Gerard Grisey's conceptual framework for spectral musical composition*. Context, (44), 37–50. https://search.informit.org/doi/10.3316/INFORMIT.806248684503105

Havdara, M. & Hlinka, J. (2020). A Dynamical Systems Approach to Spectral Music: Modeling the Role of Roughness and Inharmonicity in Perception of Musical Tension. *Frontiers in Applied Mathematics and Statics, 6*(18). doi: 10.3389/fams.2020.00018

Hyer, B. (2001). "Homophony". In Oxford Music Online. Retrieved October 9, 2021, from https://www.oxfordmusiconline.com/grovemusic/view/10.1093/gmo/9781561592630.001.0001/omo-9781561592630-e-0000013291

Iverson, J. J. (2009). *Historical memory and György Ligeti's sound-mass music* 1958-1968. Austin, TX: The University of Texas Libraries.

Ivanchenko, O. (2015). *Characteristics of Maurice Ravel's compositional language as seen through the texture of his selected piano works and the piano suite" Gaspard de la nuit"*. (DMA Thesis). Miami, FL: University of Miami. Retrieved from https://scholarship.miami.edu/esploro/outputs/doctoral/Characteristics-of-Maurice-Ravels-Compositional-Language/991031447889402976

Jakubowski, J. R. (2020). Embodied Form in Grisey's Prologue: Variation, Opposition, Tension. *Integral (The Journal of Applied Musical Thought).* Vol. 34, pp. 1-23. Retrieved from https://www.esm.rochester.edu/integral/wp-content/uploads/2021/03/Integral_Vol_34_Jakubowski.pdf

Kennedy, M. (2003). "Impressionism". In The Concise Oxford Dictionary of Music. (New edition). Oxford: Oxford University Press.

Koelsch, S. (2012). *Brain and Music* (1st ed.). Oxford, UK: John Wiley & Sons, Ltd.

Kostka, S., & Payne, D. (1995). *Tonal Harmony with an Introduction to Twentieth-Century Music.* (3rd ed.). USA: Baskerville by Music-Book Associates, Inc.

Leeuw, T. D. (1962). Music of the Twentieth Century, *A Study of Its Elements and Structure.* Amsterdam University Press. http://www.jstor.org/stable/j.ctt46n27q

Lelong, G. (2001). "Hurel, Philippe". In Oxford Music Online. Retrieved November 13, 2021, from https://www.oxfordmusiconline.com/grovemusic/view/10.1093/gmo/9781561592630.001.0001/omo-9781561592630-e-0000045480?rskey=BmsUNO

Lerdahl, F., & Krumhansl C. L. (2007). Modeling Tonal Tension. *Music Perception: An Interdisciplinary Journal*, *24*(4), 329-366. University of California Press. https://doi.org/10.1525/mp.2007.24.4.329

Lester, J. (1989). *Analytic Approaches to Twentieth-Century Music*. USA: W.W Norton and Company.

Luque, S. (2009). The Stochastic Synthesis of Iannis Xenakis. *Leonardo Music Journal*, Vol. 19, Our Crowd-Four Composers Pick Composers, pp. 77-84. http://www.jstor.org/stable/40926355

Murail, T. (1982). *Désintégrations pour bande synthétisée et 17 instruments* [Score]. Editions Salabert, Paris.

Murail, T. (2000). After-thoughts. *Contemporary Music Review*, *19*(3), 5-9. https://doi.org/10.1080/07494460000640321

Murail, T. (2005). The revolution of complex sounds. *Contemporary Music Review*, *24*(2-3), 121-135. https://doi.org/10.1080/07494460500154780

Maslowiec, A. (2008). *Sonorism and the Polish Avant-Garde 1958-1966*. (Doctoral Thesis) University of Sydney. Retrieved from https://ses.library.usyd.edu.au/handle/2123/8205

Matossian, N. (1986). *Xenakis*. (1st edition). New York: Armida Publications.

Paraskeva S. & McAdams, S. (1997). Influence of timbre, presence/absence of tonal hierarchy and musical training on the perception of musical tension and relaxation schemas. *Proceedings of the 1997 International Computer Music Conference.* Thessaloniki, Greece: Proc. ICMC.

Pärtlas, Ž. (2016). Theoretical Approaches to Heterophony, *Multipart Music: Theoretical Approaches on the Terminology*, In Res Musica 8, 2016, pp. 44-70. Retrieved from https://resmusica.ee/en/res-musica-8-2016/

Porcos, I. (2017). Spectralism. Spectral composition techniques. *Bulletin of the Transilvania University of Brasov, Series VIII: Performing Arts*, *10*(2), 85-94. Retrieved from http://webbut2.unitbv.ro/Bulletin/Series%20VIII/2017/BULETIN%20I/10_PORCOS.pdf

Pousset, D. (2000). The Works of Kaija Saariaho, Philippe Hurel and Marc André Dalbavie-Stile Concertato, Stile Concitato, Stile Rappresentativo. *Contemporary Music Review*, *19*(3), 67-110. https://doi.org/10.1080/07494460000640371

Pressnitzer, D., & McAdams, S. (2000). Acoustics, Psychoacoustics and Spectral Music. *Contemporary Music Review*, 19, p. 33-59. Retrieved from https://sites.music.mcgill.ca/orchestration/files/2014/10/Pressnitzer_2000_ContMusRev.pdf

Pressnitzer, D., McAdams, S., Winsberg, S. & Fineberg, J. (2000). Perception of musical tension for nontonal orchestral timbres and its relation to psychoacoustic roughness. *Perception & psychophysics*, *62*(1), 66-80. DOI:10.3758/BF03212061

Pugin, T. (2001). The New Intimacy in French Music (II). *Tempo*, New Series, 217, pp. 38-44, 47. Cambridge University Press. https://www.jstor.org/stable/i239143

Randel, D. M. (2003). In The Harvard Dictionary of Music. (4th ed.). Boston, MA: Harvard University Press.

Rollin, R. L. (1979). The Genesis of the Technique of Canonic Sound Mass in Ligeti's "Lontano". *Indiana Theory Review*, *2*(2), 23-33. http://www.jstor.org/stable/24044757

Rose, F. (1996). Introduction to the Pitch Organization of French Spectral Music. *Perspectives of New Music*, Summer, 1996, Vol. 34, No. 2 (Summer, 1996), pp. 6-39. https://doi.org/10.2307/833469

Saariaho, K. (1987). Timbre and harmony: interpolations of timbral structures. *Contemporary Music Review*, pp. 93-133. Harwood Academic Publishers GmbH. https://doi.org/10.1080/07494468708567055

Searby, M. (1997). Ligeti the Postmodernist?. *Tempo*, New Series. No.199, pp. 9-14. Cambridge University Press. https://www.jstor.org/stable/945525

Smalley, D. (1994). Defining Timbre - Refining Timbre. *Contemporary Music Review*, *10*(2), pp. 35-48. https://doi.org/10.1080/07494469400640281

Smith, R. B. (2000). An Interview with Tristan Murail. *Computer Music Journal, 24*(1), 11-19. Massachusetts Institute of Technology. https://doi.org/10.1162/014892600559146

Sonic Visualiser (Version 3.2) [Computer software] Chris Cannam, Christian Landone, and Mark Sandler. London: Centre for Digital Music at Queen Mary, University of London.

Texture. (2001). "Texture". In Oxford Music Online. Retrieved September 4, 2021, from https://www.oxfordmusiconline.com/grovemusic/view/10.1093/gmo/9781561592630.001.0001/omo-9781561592630-e-0000027758

Timbre. (n.d.). In Merriam-Webster's online dictionary. Retrieved November 15, 2021, from https://www.merriam-webster.com/dictionary/

Tubb, Monte. (1987). Textural Constructions in Music. *Journal of Music Theory Pedagogy*, *1*(2), 201–223.

Vines, B. W., Nuzzo, R. L., & Levitin, D. J. (2005). Analyzing Temporal Dynamics in Music : Differential Calculus, Physics, and Functional Data Analysis Techniques. *Music Perception: An Interdisciplinary Journal*, *23*(2), 137-152. University of California Press. https://doi.org/10.1525/mp.2005.23.2.137

Vinton, J. (1974). A Change of Mind. *Music Review*, Vol. XXXV, No. 3-4 (Nov, 1974), p. 307.

Webb, B. E. (1962). *Impressionism in the Piano Music of Claude Debussy*. (Master Thesis) Eastern Illinois University Institutional Repository. Paper 4728. https://thekeep.eiu.edu/theses/4728

Zattra, L. (2018). *Hugues Dufourt, La Musique Spectrale. Une Révolution Épistémologique* (Paris: Éditions Delatour, 2014), ISBN 978-2-7521-

0206-5 (pb). Twentieth-Century Music, Cambridge Core. https://doi.org/10.1017/S1478572218000099

Zeller, M. (2020). Klangfarbenmelodie in 1911: Anton Webern's Op. 9 and 10. *Proceedings of the 2nd International Conference on Timbre,* Thessaloniki, Greece. Retrieved from https://timbre2020.mus.auth.gr/assets/papers/40.Zeller.pdf

Url-1 *<https://brahms.ircam.fr/works/work/8965/>*, date retrieved 23.02.2022.

Url-2 < *https://brahms.ircam.fr/works/work/10691//>*, date retrieved 16.03.2022.

Url-3 < *https://www.tristanmurail.com/en/oeuvre-fiche.php?cotage=TR1488>*, date retrieved 28.03.2022.

Url-4 < https://www.tristanmurail.com/en/oeuvre-fiche.php?cotage=28227>, date retrieved 04.04.2022

CURRICULUM VITAE

PHOTO

Name Surname **:** Deniz Can Barış

EDUCATION **:**

- **B.A.** **:** Istanbul Bilgi University, Music Department

PROFESSIONAL EXPERIENCE:

- Freelance composer, performer and sound designer, 2018 - ongoing

PREMIERED COMPOSITIONS:

- **2019,** "Silhouette" for Ensemble Concept, Brisbane, AUSTRALIA
- **2019,** "Petrichor" for Hezarfen Ensemble, Istanbul, TURKEY
- **2018,** "Ripple" for ARTefacts Ensemble, Istanbul, TURKEY
- **2018,** "Enigma" for Platypus Ensemble, Istanbul, TURKEY