Universidade de Aveiro Departamento de Comunicação e Arte
2010

Petra Bachratá

Interacção Gestual na Música para Instrumentos e Sons Electroacústicos

Gesture Interaction in Music for Instruments and Electroacoustic Sounds

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Tese apresentada à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Doutor em Música, realizada sob a orientação científica do Doutor João Pedro Paiva de Oliveira, Professor Catedrático do Departamento de Comunicação e Arte da Universidade de Aveiro e Doutora Isabel Maria Machado Abranches de Soveral, Professora Auxiliar do Departamento de Comunicação e Arte da Universidade de Aveiro.

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To my dearest parents with love and gratitude

o júri

presidente

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To Raúl for serene breeze... and true colours shining through... a beautiful rainbow...

palavras-chave

Música para instrumentos e sons electroacústicos, música electroacústica, análise, composição, gesto musical, modelos de interacção.

resumo

Esta tese apresenta alguns aspectos em como o fenómeno do gesto musical pode ser compreendido na percepção da interação musical na música para instrumentos e sons electroacústicos. Através de exemplos de análise, classificação e categorização de diferentes relacões gestuais entre instrumentos e sons electroacústicos, pretende-se estabelecer modelos específicos de interacção que podem ser aplicados como método analítico assim como na composição musical. A pesquisa parte de uma variedade de definições sobre gesto musical na música em geral, na música contemporânea e na música electroacústica em particular, para subsequentemente incluir as relações entre dois eventos sonoros com características diferentes - o electroacústico e o instrumental. São essencialmente abordadas as relações entre gestos musicais através da análise de diversas características: altura, ritmo, timbre, dinâmica, características contrapontísticas, espectromorfológicas, semânticas e espaciais. O resultado da pesquisa teórica serviu de suporte à composição de diversas obras, onde estes aspectos são explorados sob o ponto de vista da criação musical.

keywords

Music for instruments and electroaocustic sounds, electroacoustic music, analysis, composition, musical gesture, models of interaction.

abstract

This dissertation presents some aspects how the phenomenon of musical gesture can be understood in the perception of musical interaction in music for instruments and electroacoustic sounds. Through analytical examples, classification and categorization of different kinds of gesture relationships between instruments and electroacoustic sounds, the aim is to establish specific models of interaction that can be applied as analytical method, as well as in composition. This research departs from a variety of previous approaches to gesture in music in general, and more specifically contemporary music and electroacoustic music, in order to include the relations between two sound events with different characteristics - the electroacoustic and the instrumental. This research focuses on relations between musical gestures, through the analysis of several characteristics (pitch, rhythm, timbre, dynamics, contrapuntal, spectromorphologic, semantic and spatial). The result of theoretical research has served as basis for composition of various works, where these aspects are explored from the point of view of musical creation.

A special thanks is expressed to the following publishers for permission to use in this dissertation audio excerpts from the following pieces:

Karlheinz Stockhausen:

Kontakte
© 2010 Stockhausen Foundation for Music, Kürten

All CDs and scores may be ordered directly from the *Stockhausen-Verlag*, Kürten, Germany (www.stockhausen.org)

Denis Smalley:

Clarinet Threads
© 2004 Empreintes DIGITALes, Montréal

Piano Nets
© 2004 Empreintes DIGITALes, Montréal

Other audio and score examples included in this dissertation were generously allowed by the following composers:

Chris Cree Brown

Isabel Soveral

João Pedro Oliveira

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Rajmil Fischman

Raúl Minsburg

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INTRODUCTION

Art is about questioning how things fit together, it's not about making them fit together better.

Brian Ferneyhough

One confession to be made before anything else is to reveal that this research project has been a true adventure for me not only from the theoretical, but also from the practical – compositional perspective. I have received my education as a composer of instrumental music in a musical university with traditional conceptions, where electroacoustic music has been considered at the best “strange”, at the worst ”not music at all”. However, I have been lucky to have a very open-minded professor, who was always supporting his students in widening the horizons by participating in different compositional courses abroad. Moreover, Vladimir Bokes was the type of a pedagogue who had the ability to recognize what had been “hidden” in each of his students and support them with all dedication and fineness in their own path. I am very thankful for his unconventional attitude, friendship and support on the way to become the best that I can be throughout the years of my compositional training.

During my education and training as a composer, although having several possibilities to "taste" electroacoustic music in summer courses in IRCAM or Szombathely, I decided to deal with this type of music more seriously only during the recent five years. The particular interest in electroacoustic music for me has been a natural consequence of constant search for new ways of expression, when traditional instrumental potential, even with wide offer of different extended techniques couldn't anymore encompass my sonorous imagination. Sound possibilities offered by use of electronic means, but even more the completely different nature of sound materials and possibility to create my own sound world became too attractive to be resisted. Here the real challenging story of "me and the computer" began. At this point I would like to express my deep gratefulness to João Pedro Oliveira, whose work as a composer I genuinely appreciate and admire, for his readiness and willingness to explain anything what had to do with principles of electroacoustic music composition, from acoustics, recording techniques, through computer programs for sound synthesis to sound diffusion during the performances. And later for his emotional encouragement and believe in my work as a composer that was always "keeping me on track". The knowledge, experiences and insights together with extended skills and broadened range of compositional abilities that I accumulated over these few years, might not have happened without his stimulating support.

As a composer coming from the background of the instrumental music, in a course of my research I have been dealing with different problems. The complexity involved in the subject of my research on one hand and the diversity of existing bibliographic sources nevertheless touching the subject of my interest only very partially on the other hand, became the main challenge for the initiation of this doctoral project and for the choice of its theoretical basis. In this aspect the ElectroAcoustic Resource Site (EARS) developed by a team of authors around Leigh Landy have been an indispensable aid in searching not only for general information references, but provided also very useful glossary and catalogue of specific bibliographic references in the field of electroacoustic music. It functioned as a foundational framework for different subject studies I have been coming across and dealing with during the evolution and development of this research. Another source I have been frequently turning to for terminology, definitions and psychoacoustic terms in "sound-based music" was the online version of Handbook for Acoustic Ecology by Barry Truax. Thanks to these sources, but not exclusively, I was able to better understand other specific texts treating various subjects in electroacoustic music, understand their terminology and choose the references most relevant for departure of my investigation.

As far as my research in the field of electroacoustic music was developing, studying, reading different works done in the field, attending electroacoustic conferences, festivals and concerts, the need for more in-depth musical and compositional analysis, systematization, classification and categorization of researched subjects, seemed to be always more urgent and showed importance not only for analysis in electroacoustic music, but also for composition and general music theory.

The selection of musical gesture interaction as a theme of my doctoral project was not a choice that came by chance. Since many years ago my music has been evolving and "breathing" gesturally, with strong sense of temporal evolution and mutual impact between events creating different relationships either more continuously or by abrupt changes and moments of surprise, but always leaving kind of a trace from previous event to the next one, perceived in transformations of energetic profiles and exchange of energy between events. The possibility to explore this way of structuring musical material in creation of dramatic musical surfaces and vital dynamic musical discourses through the complex gestural articulations and relationships also by using electronic means or their combination with acoustic instruments became then a natural and inevitable focus of my interest.

The goal of this research project was to analyze different kinds of interactive relationships between musical gestures in music written for instruments and electroacoustic sounds, in order to establish specific models of interaction and its subsequent application to several works I have composed.

The investigation has been divided in two main sections – one essentially theoretical and analytical and another compositional. To start the research I focused on works for instruments and electroacoustic sounds from early times till nowadays, exploring different formations (from solo through ensemble to orchestra) or even tape solo pieces, to establish a coherent corpus to be analyzed. In parallel, I have concentrated on the research of large number of literature and bibliography related to the subject of my study, in order to give theoretical consistency to the work. The period of musical analysis has been divided in two parts. First, more superficial research and analysis, which provided information about the form, structure and different types of gestures in researched pieces. Second, I proceeded to a more in-depth analysis in order to identify specific models of interactive relationships between gestures and group them into categories. Simultaneously, and most importantly, the researched models have been applied under personal perspective to a group of my own compositions. The application of interactive gestural relationships has been generalized not only to my works, which use instrumental and electroacoustic sounds in combination, but also to a pure electroacoustic (acousmatic) work and instrumental pieces without electronics.

The dissertation is presented in two main parts – first theoretical, consisting of four main chapters, and second practical, represented by eight of my compositions.

Chapter I focuses on main problems related with mixed music and electroacoustic music in general and sets up several discussions about role of the score in analysis, different ways of aural analysis and listening strategies, the function of graphic listening score and sonogram during analytical processes; concerns significantly also problem of terminology and need of a common unified language to explain musical facts. Here two main attempts are presented – the concept of Pierre Schaeffer's sound object with its extension into more "semantic" level in Denis Smalley's spectromorphologic theory and the concept of Murray Schafer's soundscape and its continuations in the theory of sonic effect. This chapter touches also the problems of variety of electroacoustic materials, storage formats and their accessibility that in many cases represent a barrier for musicologists and theoreticians to approach electroacoustic works. Finally, new disciplines in sound research, such as psychoacoustics and neurotechnology with their potential for application in listening process as well as analysis are introduced. The chapter is completed by summary of main reasons, which in second half of last century contributed to the turn of the attention to sound, not only in music, but life in general.

Chapter II at first presents music for instruments and electroacoustic sounds and its evolution from the brief historical perspective and delineates some basic issues related with multiple perspectives resulting from combination of two worlds with distinct fundamental principles. Later it confronts two main approaches to interaction between instruments and electronics – one using electroacoustic element in a form of fixed prerecorded medium (tape, CD) and another based on live-electroacoustic sound transformation procedures, realized by computer in real time during the musical performance. One of the important subjects concerned here is phenomenon of technological fetish and problems of identity, some traps that were brought up by the evolution of the technology and its incorporation in the process of musical creation, and that are widely criticized by João Pedro Oliveira in his recent conferences and writings. Further, two main compositional concepts of interaction are discussed - Flo Menezes' morphology of interaction based mainly on spectral interaction, textural similarity/difference and spectral transfers and Trevor Wishart's concept of gestural relationships, based on morphologic characteristics, gestural similarity/difference and organization of gestures according to the horizontal and vertical criteria. The final subchapter focuses on distinction between interaction and interactivity, a term that appeared in music to describe mainly human-computer interaction.

Chapter III after presenting gesture as a general phenomenon that plays an important role almost in all areas of our lives, gesture is examined specifically in domain of music through various perspectives. First as a movement, which is probably the most common definition we find in all the approaches to gesture. From this aspect different relations between gesture and space and gesture and time are discussed within the main theories of electroacoustic and contemporary music (Schaeffer, Chion, Wishart, Smalley, Xenakis). In next part after discussing some specific issues of Nattiez' semiology of musical discourse, precisely the concept of "neutral level", musical gesture is presented in connection to the meaning. The way, how physical (somatic) gestures transform into the musical gestures and the processes involved that lead to interpretation of gestures as meaningful are described in two main concepts developed by David Lidov and Robert Hatten. The important part of this chapter is dedicated to approaches to gesture in electroacoustic music – Smalley's concept of gesture as an energy-motion trajectory with strong relation to causality, Wishart's concept of gesture as gestalt – an articulation of continuum with communicative and expressive potential and concept of semiotic temporal units developed by a team around

François Delalande, which involves all earlier discussed issues (movement in time and meaning). Another important subject considered in this chapter is the concept of gesture and figure, developed by Brian Ferneyhough. It is demonstrated that this concept although primarily thought for the instrumental music, it has potential to be applied in electroacoustic music as well as in the mixed music. Last three subchapters may be understood as summaries from all presented approaches. Connection between gesture and energy although sometimes not directly made, but sufficiently understood from the contexts of various presented perspectives represents important relation that is explored later in the main analytical chapter 4. The impossibility of capturing all the continuities of gestures and gestural aspects in notation is a clear and understandable fact that arises from all the important theories considered here. Final summary aims to present gesture in all its complexity and hierarchical potential, the main attributes that created a basis of departure for analysis of different gesture relationships.

Chapter IV represents the heart of this dissertation – it shifts from all previously outlined perspectives to the context of analysis, and identifies, describes and classifies different models of gesture relationships according to several levels of attention. Each category is then documented by audio examples from pieces for diverse formations from different periods of electroacoustic music existence, including also examples from my own works. Although there are many ways by which the interaction between musical gestures in mixed music can be done, the gesture relationships are approached from following perspectives: from the perspective of elementary musical characteristics, such as pitch/frequency, rhythm/temporal organization, dynamics/loudness and timbre, to find points of contact between gestures of different nature; from the viewpoint of tripartite model of structure[1] to compare gestures as whole gestalts and find the relationships between them, from the perspective of counterpoint to clarify the horizontal and vertical relations between gestures; from the perspective of spectromorphologic-semantic characteristics to unfold the directional and energetic relationships between gestures and finally from the spatial perspective, as more theoretical and schematic approach, because I couldn’t document this category by audio

[1] Tripartite model of structure has been used in various texts of electroacoustic and contemporary music to describe the shape of musical structure or sound. Smalley and Chion refer to onset – continuant – termination, Sonnenschein uses terms attack (onset, growth) – body (steady-state, duration) – decay (fall-off, termination).

examples, but felt importance to mention it, since "music is spread and listened in space".

Second practical part includes eight compositions, from which three are using instrumental sounds in combination with electroacoustic sounds, all focused on interaction between gestures with numerous researched models applied; one is pure electroacoustic piece, and other four compositions are instrumental. Each one treats gesture interaction from different perspective, various concepts had been applied.

Given the ambit of this research, I could not become an expert on all the disciplines the broad subject of my investigation interconnects and I am aware that some of my concepts and perspectives as well as the presented models of gesture interaction, identified and classified here may be a target of debate, as there is always something to be improved, corrected, extended... but this is the "beginning"...

Chapter 1: PROBLEMS IN THE ANALYSIS OF ELECTROACOUSTIC AND MIXED MUSIC.

With all its unsettling uncertainties electroacoustic music provides a catharsis which analysis needs. Like no other music it is the best path to meeting the challenge of understanding the whole of sounding creation.

Denis Smalley

In the evolution of electroacoustic music, as in music in general, each historical period has been influenced by technology, conceptual approach to the sound objects, compositional trends and by musical context, which have led to new concepts to explain musical facts.

Although, since 1950's till nowadays, different analytical approaches applied to electroacoustic music started to show some interesting results, electroacoustic music analysis still remains problematic, because of difficulty to consider for the analysis all the diverse information and sources of documentation which electroacoustic music offers. Still there is no stable and consistent compositional theory, which would reflect and guide the listening process. It is not possible to rely upon hundreds years of analytical thought and methodology, like it is in case of approaching the instrumental music. In the first 30 or 40 years of existence of electroacoustic music, despite of the new attempts by Pierre Schaeffer to develop analytic methods for electroacoustic music, there has been a certain lack of theoretical reactions and analytical concentration on this "new music", in comparison with the large amount of musical works produced in the field since then. The situation has been improving in the late 20th century, however in the beginning of 21st century published analysis and theoretical reflections of electroacoustic music are still rare in comparison with the amount of analytical publications of instrumental music.

The possible problems, which might have caused this state of hibernation in development of standard approaches to electroacoustic music and mixed music in particular have been pointed out already by many authors and may be summarized into these main points: the problem of the **score or its absence**, the problems of **perception,** problem of **terminology and language**, and also the **wide range and diversity of storing formats** for electroacoustic documentation and its **accessibility**.

Leilo Camilleri in the article Electro-acoustic Music: Analysis and Listening Processes wrote:

> The introduction of technology in its various phases of development from the end of the 1940's up to today has brought about not only an enrichment of the sonorous palette, it has also brought about a great deal of theoretical reflection on how to classify the sounds of the works thus created and how to analyze them. Thus, a problem arose, not merely regarding the study of music using technological instruments, but about all sonorous phenomena which cannot be described by means of the lexicon and methodology of existing theories, however advanced they may be.[2]

Denis Smalley in his Spectromorphology emphasizes the importance of terminology in describing the listening experience and analyzing an electroacoustic piece:

> How we are to explain and understand electroacoustic music? Music is not created from nothing. If a group of listeners finds a piece of electroacoustic music 'rewarding', it is because there is some shared experiential basis both inside and behind that music. We need to be able to discuss musical experiences, to describe the features we hear and explain how they work in the context of the music.[3]

All these problems and some others to be included are going to be treated in this chapter to create a foundation for further issues discussed in following chapters.

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[2] Camilleri, Leilo. 1993. "Electro-acoustic Music: Analysis and Listening Processes."*Sonus*. http://www.memex.it/sonus/camilleri.PDF (accessed June 29, 2009)
[3] Smalley, Denis. 1997. "Spectromorphology: explaining sound-shapes." *Organized Sound* 2(2), p 107.

1.1. Problem of score and perception.

In traditional analysis of instrumental music, the score is usually the material of the analysis - the analyst works with the notes, signs and symbols presented in the score. From philosophical point of view, this notation-based analysis relies upon the Cartesian subject-object split, where the musical object (notational representation of musical event – score) can be studied by analyst in a way to reveal its underlying systems, within which its perception lies as 'meaningful'. This approach of identifying a musical system, constructed from relations between and within combination of formal elements (such as intervals, rhythm, timbre, melody, tonality, texture, etc.) assumes the stability of the system at the point of analysis in order to define the rules and codes rather than the acts themselves that use the system.

Some phenomenological approaches[4] to instrumental music don't use the score any more. They think of musical work as an "intentional object":

> The phenomenological approach to musical perception describes the perceptual and experiential structure of psychological processes and the musical events belonging inseparably to the latter by virtue of their intrinsic intentionality.[5]

Approaches to musical perception, based on husserlian phenomenology are focused on the phenomenon of our conscious experience of music itself and transform the subject-object split in an important way – consciousness is always consciousness of something, there is no subject without an object and there are no objects independent of subjects. Due to the notion of intentionality, the subject and object are interdependent; thus the analysis includes observation and description of an experienced object (music) as well as the acts of perception and feeling. Application of phenomenology, as one of the fundamental perspectives in approaching electroacoustic music and building

[4] Ihde, Don. 2007. *Listening and Voice. Phenomenologies of Sound* (second edition). Albany: State University of New York Press.

[5] Pike, Alfred. 1966. The phenomenological Approach to Musical Perception. *Philosophy and Phenomenological Research* 27(2), p 247.

different listening strategies, such as concept of sound object and reduced listening, will be explained later.[6]

In electroacoustic music, there is often no score and if there is a score, as it is in the case of mixed electroacoustic music, it represents only partial aspect of the piece. In this case, the score reveals information mostly about instrumental part, the electroacoustic part is sometimes ignored (the score includes only time lines for synchronization (Figure 1, 2) or is represented by schematic graphical notation (time lines and graphical representation of some sounds and musical events important for synchronization). (Figure 3)

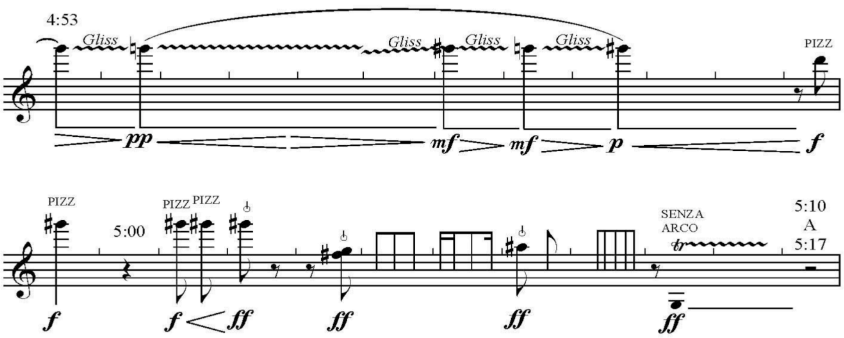

Figure 1. Example from the score of Raúl Minsburg Postales invisibles.[7]
In this score tape part is not notated and the instrumental score includes chronometric divisions in seconds and time indications for synchronization during the performance.

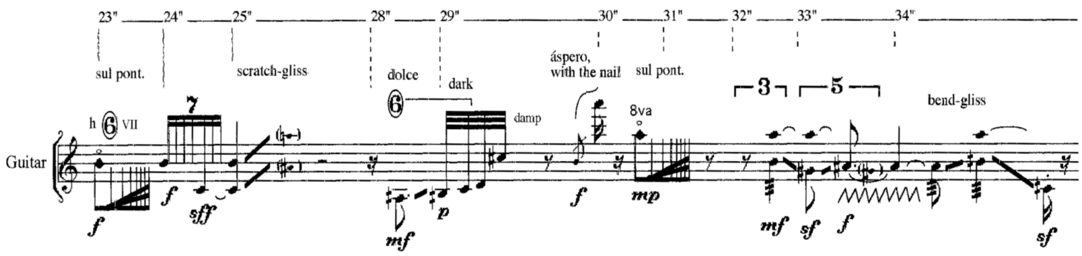

Figure 2. Example from the score of Isabel Soveral Heart.[8]
In this example of a score tape is not notated and the instrumental score includes precise time indications for synchronization with the electroacoustic part.

[6] chapter 1.2. and 1.4.1.
[7] Minsburg, Raúl. 2008. *Postales invisibles*, violin and tape. Unpublished author's manuscript. p.4.
[8] Soveral, Isabel. 2001. *Heart,* guitar and tape. Unpublished author's manuscript., p.9

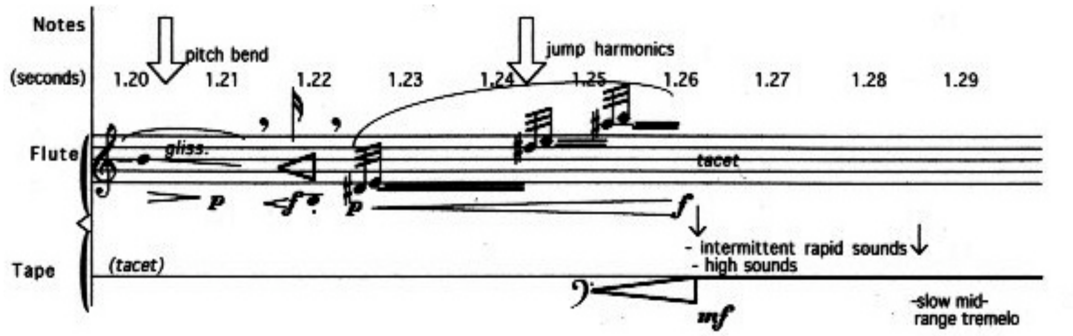

Figure 3. Example from the score of Chris Cree Brown Sound Cylinders.[9]
This score uses except of time indications also some graphic representation (such as the crescendo sound) and description of main characteristics of the electroacoustic sounds (intermittent rapid sounds, high sounds, slow mid-range tremolo).

Some composers use more precise way of notation of the electroacoustic or tape element, using proper pitches, durations and rhythms of the sounds, etc. (Figure 4). One score often contains all these different types of tape notation throughout the piece, depending of the different features and sound characteristics in a part, segment or a movement of the work (Figure 5a, b, c). In all cases, electroacoustic (tape) notation serves more as an instruction for the performer, the score doesn't represent all the information about sounds itself – 'how they sound, or what they are'; the sonic information heard in a musical work doesn't have a complete representation in the score.

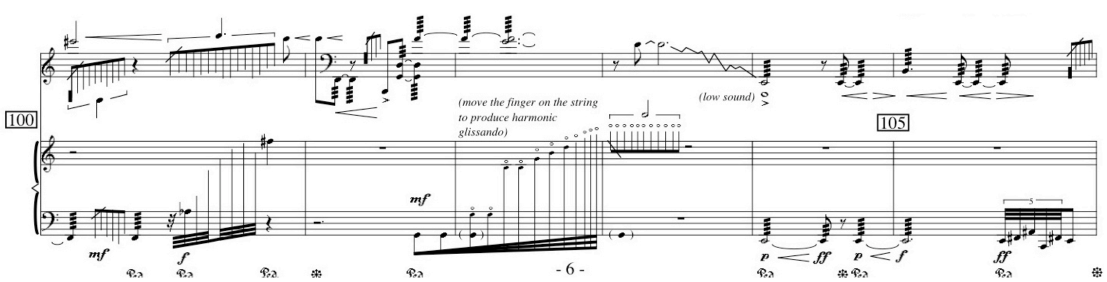

Figure 4. Example from the score of João Pedro Oliveira Maelstrom.[10]
In this example notated tape part includes precise pitches, durations, articulations and dynamics of the electroacoustic sounds.

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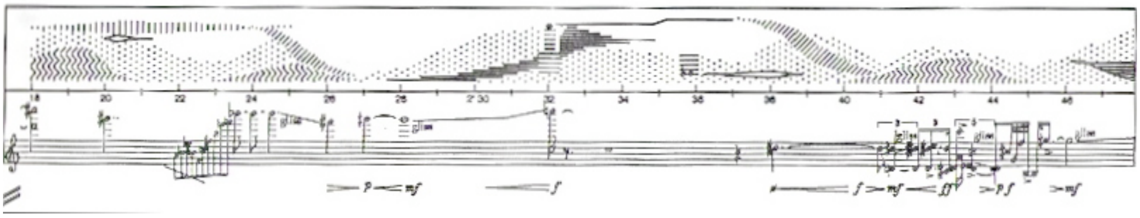
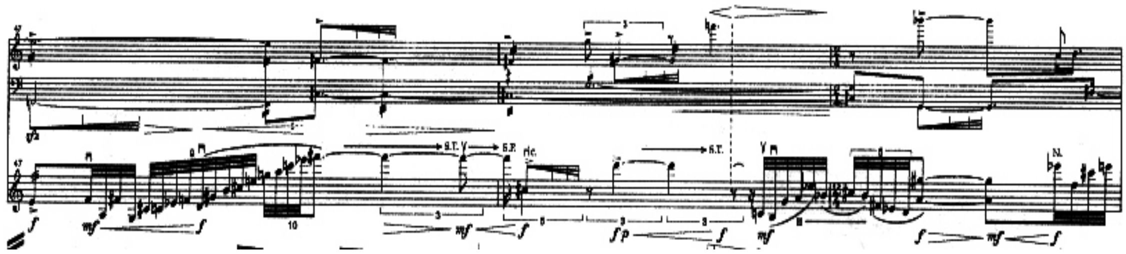
[9] Brown, Chris Cree. 1996-1997. *Sound Cylinders*, flute and tape. Unpublished author's manuscript. p. 3
[10] Oliveira, João Pedro. 2006. *Maelstrom*, cymbalom and tape. Unpublished author's manuscript. p. 6.

a)



b)



c)

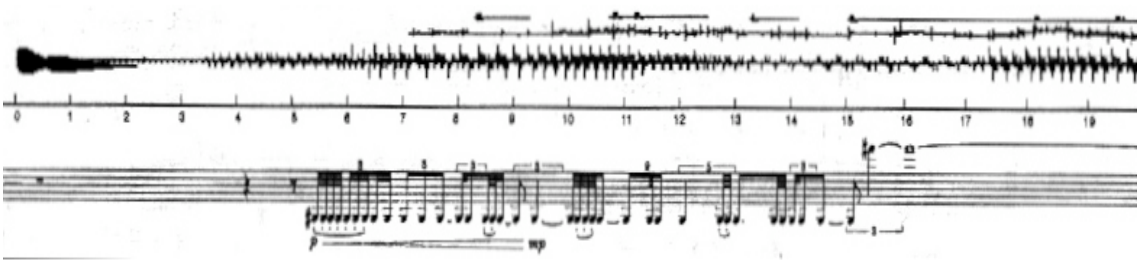
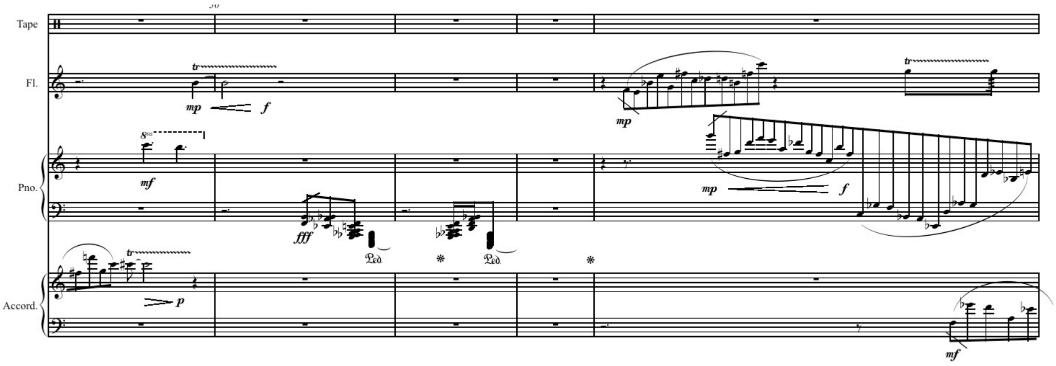


Figure 5a, b, c. Examples from the score of Mario Marcelo Mary Aarhus.[11] This figure presents several types of tape notation in one score. Section a) uses some graphic representation of electroacoustic sounds (density, dynamics and some pitches), in the section b) composer uses precise notation of pitches, rhythms, articulations and dynamics as the electroacoustic part uses the non-transformed violin sounds; and in the section c) electroacoustic part is represented graphically by corresponding sound wave, which has been copied from the sound editing program.

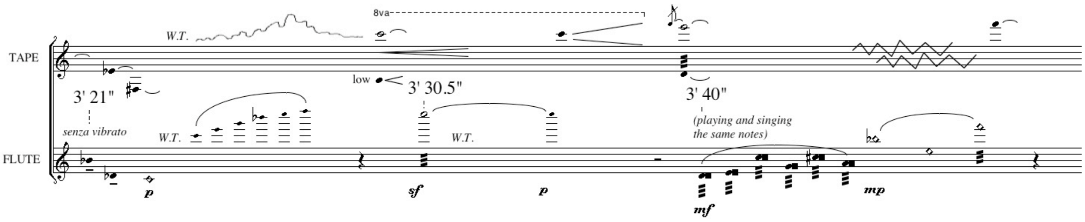
In my own music, I have used several types of tape notation from more simple and approximate to more precise notational and graphic representation of electroacoustic musical structures and gestural articulations (Figure 6a, b, c).

[11] Mary, Mario Marcelo. 2000. *Aarhus*, violin and tape. Unpublished author's manuscript. p. 2, 6 , 8.

a) example from my score Mystic Garden[12]



b) example from my score Luminiscencia[13]



c) example from my score Reflections[14]

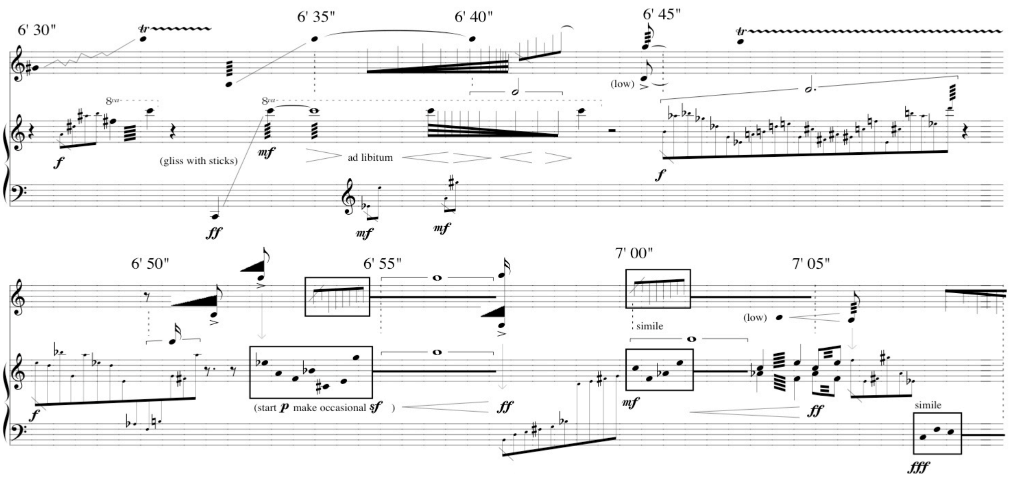


Figure 6. Examples from my own scores.

6a) Tape part is not notated and the time synchronization is done with help of the click-track, 6b) tape notation uses graphic representation of the important sounds to be synchronized during the performance - approximate pitches, articulation, frequency range of sounds (low, etc.) and dynamics, 6c) presents more precise notation of tape with indicated durational values, rhythmic patterns, pitches, dynamics and some morphologic characteristics, such as for example attack-sounds.

12 Bachratá, Petra. 2007. *Mystic Garden*, flute, accordion, piano and tape. Unpublished author's manuscript.

13 Bachratá, Petra. 2006. *Luminiscencia*, flute and tape. Unpublished author's manuscript.

14 Bachratá, Petra. 2005. *Reflections*, marimba and tape. Unpublished author's manuscript.

Composers' awareness of need to discover some ways of graphic representation of electroacoustic sounds didn't appear just in recent years, but has been present since the very beginning of electroacoustic era. Stockhausen in his early pieces, such as for example Kontakte, uses quite precise time signatures together with graphic notation of sound events to better synchronize the performance and give at least some idea about certain characteristics of electroacoustic sounds:

> It was necessary for the composer of electronic music to have found an adequate form of graphic notation, in order to describe all the details of sound production and assembly.[15]

Of course, we have to take this with certain reservation, since it is still impossible, even nowadays, to describe "all the details" of sound production by use of graphic notation. The preservation of musical piece in various forms of abstraction (notes, graphic symbols, etc.) cannot fully communicate the compositional intent. The score is just a representation of some characteristics of the sound, but to understand the piece we need to listen to recognize all the other aspects of music, of the sound, which are not presented in the score (for example its timbral characteristics, morphologic and semantic characteristics, such as temporal sequences, stability, direction, energy, etc.) Thus, to fully understand the music, we have to look beyond visual musical representation and move our attention to a careful listening.

> The visual artifacts are after all, nothing more than a means to harness the intent of some musical abstraction. This practiced balance among representation, compositional intent, and human perception is why music analysis is truly an art about an art.[16]

Taking into account, that score is just a representation of characteristics of the sounds it is the sound of the music itself that should be analyzed. This finding moves the analytical borders to the "listening act". The study of the listening experience and its integration to electroacoustic music analysis requires development of new approaches based on listening.

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[15] Stockhausen, Karlheinz. 1958. "Electronic and Instrumental Music." In: Cox, Christoph and Warner, Daniel eds. 2004. *Audio Culture. Readings in Modern Music*. New York: The Continuum International Publishing Group Inc. p .373.

[16] Simoni, Mary. 2006. *Analytical Methods of Electroacoustic Music*. New York: Routledge. p.1

The sonic manifestation of music is the point of departure for analysis and relevance of the score in its traditional sense is rather vained (however, it still keeps its place in approaching the mixed electroacoustic piece, as it offers sometimes very detail information about the instrumental part).

Camilleri defends that the absence of the score or lack of consolidated notation should not be seen as a handicap, but a strength, because the theoretical analytical model based on the study of the sound and the aural experience of music moves analysis to new dimensions and represents a starting point for modeling of different perceptual and cognitive musical strategies:

> The lack of consolidated notation is not a handicap at all, on the contrary it is a strength. With a rather provocative (but not so very) statement, I would like to say that a theory and an analytical model exclusively focused on the study of the sound text represent a real point of contact between musical theory and the modeling of perceptual and cognitive musical strategies. By possessing these properties, the analysis of electroacoustic music is a field of study full of fascination, even if it is difficult and complex.[17]

1.2. Listening strategies and aural analysis.

We do not listen to music in a fixed, uniform and objective way, neither we understand music similarly. The way we listen and experience electroacoustic music varies from listener to listener, so vary the expectations we may have from our listening. It is also different in what we focus on while listening to music. The research and creative practice in electroacoustic music have emphasized the ways in which we may perceive different music in different manners, and adopt different approaches in our listening. The important aspects of structures perceived in music (morphology or spectromorphology) lead listeners to adopt different strategies in their listening. Frequently, even in a course of a single piece of music, we may apply different listening strategies. The perceptive exploration of a musical work and search for its meaning

[17] Camilleri 1993

depends on each listener *"making the receptive process equally as individual, and valid, as the creative process."*[18]

> For example, we will undoubtedly listen to a fast monophonic sequence of autonomous sonic events in a very different fashion to an immensely dense and slowly evolving granular texture. Similarly, we are likely to listen to narrative in a different manner from a highly abstract musical surface. Since electroacoustic music is a time-based art, our listening may be highly directed by the musical codes and structuring devices of the composer, or we may be left the freedom to listen in more non-directed ways.[19]

In the world where all sounds coexist in a musical context and "everything is possible", aural analysis represents an individual adventurous method - it relies upon the individual and unique listening experience of the person who is exploring the work, for better understanding of musical content and structure, unfolding and identifying not only general aspects but also a specific details of musical work.

One of the most adopted concepts in approaching different aspects of 'aural experience' in electroacoustic music is the method of **Four Modes of Listening (Quatre Ecoutes)**[20] – Listening (Écouter), Perceiving (Ouïr), Hearing (Entendre) and Comprehending (Comprendre), first introduced by Pierre Schaeffer and later developed by Michel Chion and Denis Smalley.

Listening – through the intermediary of sound, aiming to identify the source, the event attached to the sound, the cause; it treats the sound as a sign (index) of this source or event (*causal listening*). We are interested not in the sound itself but in the information it carries (message). For example hearing a car on the street, we are interested if it goes too fast and wonder about the consequences of fast driving, we may recognize what type of a car it is, etc. In listening someone approaching, we wonder

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[18] Rudy, Paul. 2003. *Spectro-morphological Diatonicism: Unlocking Style and Tonality in the Works of Denis Smalley Through Aural Analysis*. http://cec.concordia.ca/econtact/Analyses/index.html (accessed February 18, 2010)

[19] *EARS: ElectroAcoustic Resource Site* 2002. http://www.ears.dmu.ac.uk/ (accessed October 14, 2009)

[20] Quatre Écoutes, by Pierre Schaeffer from Chion, Michel. 1995. *Guide to Sound Objects. Pierre Schaeffer and Musical Research*. English translation of the version from 1983 by John Dack and Christine North downloaded from ElectroAcoustic Resource Site. http://www.ears.dmu.ac.uk

who it is, why the person goes fast or slow, what mood he possibly has, etc. This mode is centered on the object of our attention.

Perceiving – the most elementary level of perception, to perceive by the ear, to be struck by sounds; we perceive things without trying to listen or understand them. There is no intention to listen, but we "can't avoid it" (passive reception), for example sudden explosion or screaming on the street. This mode is centered on the subject (our reaction on the sound).

Hearing – showing an intention to listen (listening), selectively choosing from what we hear (perceiving) that what particularly interests us (appreciating, enjoyment). We ignore the messages sounds might contain or contexts of event and consider only the sound (its dynamic shape, changes in timbre, melodicity, etc.)

Comprehending – understanding a meaning, values, by treating the sound like a sign, referring to this meaning as a function of a language or a code (*semantic listening*). From observations and examinations of different criteria, we might be able to create a complex of signs and meanings from which the musical work results.

For Schaeffer, these four modes of listening arise from crossing over of two dualism which are found in every perceptual activity: the *Abstract/Concrete* and *Objective/Subjective* (confrontation between the object of perception and the activity of the perceiving consciousness) and can be arranged in a four quadrant table, with four sections numbered from one to four (Figure 7).

We see that the four listening modes involve two sets of comparisons: vertically – between abstract and concrete, and horizontally – between objective and subjective. The bottom quadrants 2 and 3 focuses on the subject – person, who is perceiving, the top quadrants 4 and 1 focus on the object of perception. The left quadrants 4 and 3 represent the abstract sectors: the process of listening, with 'hearing' (involves the selection of certain qualities of sound), turns with 'comprehending' towards the comprehension of a meaning through abstract values, a code, etc. The right quadrants 1 and 2 represent the two concrete sectors: listening, with 'perceiving' (raw perception of sound) that turns with 'listening' towards the recognition of the real-world source of the sound and its agent, through the indications given by the sound.

(3) & (4) ABSTRACT	(1) & (2) CONCRETE	
because the object is stripped down to qualities which describe perception (3) or constitute a language, express a meaning (4).	because the causal references (1) and the raw sound data (2) are an inexhaustible concrete given.	
(4) COMPREHENDING A meaning conveyed by SIGNS.	(1) LISTENING Events, causes, of which the sound is an INDEX.	(1) & (4) OBJECTIVE because we turn towards the object of perception.
(3) HEARING selected sound object by means of selective perception.	(2) PERCEIVING raw sound objects by means of raw perception.	(2) & (3) SUBJECTIVE because we turn towards the activity of the perceiving subject.

Figure 7. Quatre Écoutes[21]

From these four modes of listening it is evident that listening process relies in decision of the listener – "how" he/she will listen or "what" he will focus on while listening to sounds or music. Therefore, there will be differences between ordinary and specialist listening or between natural and cultural listening. Chion also refers to that:

> Every listener can specialize in one of the four poles which arise from this dualism tension, but always in relation to the three others… no specialist can in fact dispense with 'going round' the whole cycle of quadrants (1 → 2 → 3 → 4) several times, because no-one can escape from his own subjectivity when dealing with a supposedly (abstract) objective meaning or (concrete) event, or from the (abstract) logical deciphering of a (concrete) event inexplicable in itself, and hence from the uncertainties and the progressive learning process of perception. (…)

[21] Chion, Michel. 1995. *Guide to Sound Objects. Pierre Schaeffer and Musical Research*. English translation of the version from 1983 by John Dack and Christine North. printed from ElectroAcoustic Resource Site. http://www.ears.dmu.ac.uk, p.21.

> For example, the sound of galloping: ordinary listening hears it as the galloping of horses, but different specialized listenings hear it differently; the acoustician seeks to determine the nature of the physical signal, the Native American Indian hears 'the possible danger of an approaching enemy', and the musician hears 'rhythmic groupings'.[22]

Ordinary listening[23] focuses on causality of the sound, origins and meaning of sound (quadrant 1 and 4 – *listening* and *comprehending*), but does not reflect the sound itself (quadrant 2 and 3 – *perceiving* and *hearing*) or how the sound functions.

Specialist listening [24] is concentrated on a particular way of listening.

Natural listening[25] is the most common tendency of listening, when we aim to gain information about an event through its sound and is expressed in the question: "What is it? Who is it? What's happening?" and corresponds to quadrant 1 (*listening*).

Cultural listening [26] on the other hand turns away from the sound event and the information it reveals about its source and uses it as a way to comprehend a message, a meaning, value. It corresponds to quadrant 4 (*comprehending*).

According to traditional listening in instrumental music, the important aspect of recognition of the sounds was the identification of the source of the sound together with the visual representation of the sound and many of the sounds that we thought we have heard we just "have seen" (either in the score - we just imagined we heard them, because they were present in the score, or on the stage - musician playing the instrumental sound). For example, with extended instrumental techniques, but not only in this situation, sometimes it is hard to identify the instrument just from listening (even more if there is a combination of instruments playing extended techniques and all sounds are blended), but as we saw the musician playing certain instrument on the stage or we saw the notated sound in the score, for example violin and flute playing such technique together, we 'heard' violin and flute playing that technique. If we didn't have the visual reference, we might not know that we heard violin and flute in that moment.

[22] Ibid., p.22 , p.25
[23] Ibid., p.25
[24] Ibid.
[25] Ibid., p.26
[26] Ibid.

We would just hear a sound with its unique characteristics – in its own "magic" – its morphology.

Reduced listening[27] has been first introduced by Pierre Schaeffer and is related with concept of sound object.[28] In case of reduced listening, we are listening to sound objects forgetting their source and we are just interested in the sounds for themselves, for what they are (phenomenological reduction). We dissociate our hearing from the visual representation or in case of electroacoustic music from the identification of the source of the sound or the meaning and that opens new ways of listening. We listen sound forms just with the goal to hear them better (in their substance, materiality and perceivable dimensions) – better in order to be able to describe them through analysis of our perception of them. As we can see from previous, reduced listening or listening to the sounds as "sound objects" has its place not only in listening to electroacoustic works but may be beneficial also in instrumental music, as well as in "mixed" music.

Naturally, we are instinctively drawn to listen by our curiosity about the causes (causal listening) and meanings (semantic listening), so reduced listening represents an antinatural way of listening and needs to be practiced. We have to practice to intentionally and "artificially" remove the habitual references (causes, sources and meanings) from listening, in order to unfold the potency of our perception, study and clarify phenomena in sound through how we hear them.

Chion refers to these aspects, when he writes:

> However reduced the listening to the sound object for itself is, we cannot detach its two sides one from another, and the attachments it retains to the two aims which usually go beyond the object: "What's going on?" and "What does it mean?" (...) but we can change our direction of interest, without wholly disrupting the basic intention which determines the structure: if we cease to listen to an event mediated by sound, we nevertheless continue to listen to the sound as a sound event.[29]

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[27] Reduced listening is the attitude, which consists in listening to the sound for its own sake, as a sound object by removing its real or supposed source and the meaning it may convey. In reduced listening our listening intention targets the event, which the sound object is itself (and not to which it refers) and the values, which it carries in itself (and not the ones it suggests). Reduced listening and the sound object are correlates of each other, they define each other mutually and respectively as perceptual activity and object of perception. (Chion 1983, english translation 1995)
[28] Concept of sound object is explained in the chapter 1.4.
[29] Chion. 1995, p.31

As we can imagine, this concept can be successfully used not only for sound analysis, but also for composition.

Figure 8 shows summary of different listening intentions, as they were presented in Schaeffer's concepts.

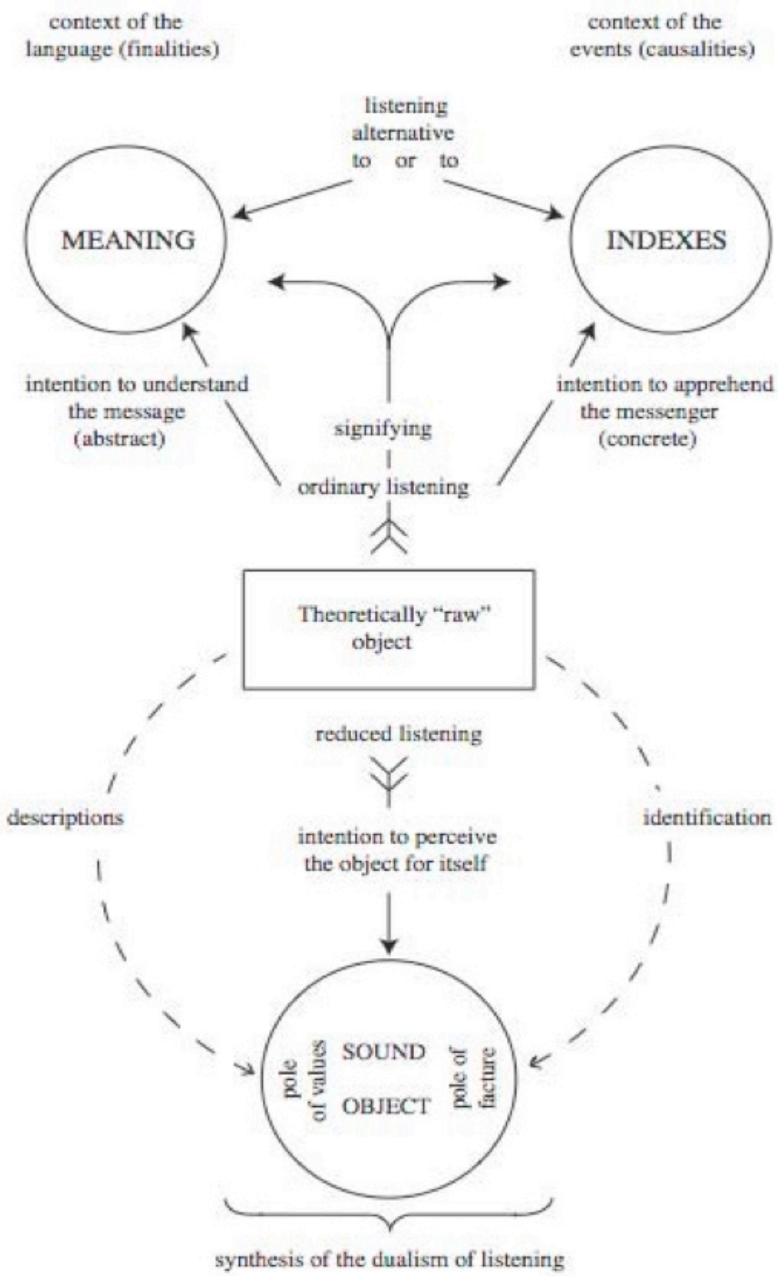

Figure 8. Table of listening intentions[30]

[30] Chion 1995, p.193

Denis Smalley extends Schaefferian modes further, according to the concepts of Schachtel's autocentricity and alocentricity[31] (depending whether the perceptual activities are centered on a subject or an object), to three following modes:[32]

Indicative – concentrated on the object, considers sound as a message, can be actively or passively apprehended. It corresponds to Schaeffer's mode 1 (listening) – treating sound as a message, gaining information about actions and events in environment.

Reflexive – autocentric - concentrated on the subject, based on the basic emotional responses to the object of perception. Object and the emotion are not separated. Although this mode may be active or passive, it has stronger tendency towards the passivity. We don't have intention to explore the object, just subjectively respond to it.

Interactive – allocentric, involves an active relation of the subject to the object, to explore continuously its qualities and structures. This interactive relationship requires effort and will. The mode corresponds to Schaeffer's mode 3 (hearing) and 4 (comprehending). It includes structural hearing, aesthetic attitudes towards the sounds and the music, and concept of reduced listening.

Sonnenschein adds to the main causal, semantic and reduced modes of listening another one, which he introduces as ***referential listening***,[33] related to the listening to music in films (but not exclusively)**.** This way of listening consists of being aware of context of the sound, linking not only to the source but mainly to the emotional and dramatic meaning. This may be performed on an instinctive or universal level for all

[31] Schachtel, Ernest G. 1959. *Metamorphosis: On the Conflict of Human Development and the Psychology of Creativity* (paperback reprint 2001) New York: The Analytic Press. Schachtel designates two basic modes of perceptual relatedness between perceiver and environment. *Autocentric mode* is subject-centered, there is little or no objectification and the emphasis is on how and what the person feels - subjective reactions on the stimuli (the basic responses and feelings - pleasure and unpleasure feelings). It a primitive perception based on needs and is associated with the first reactions of the newborn with the world. On the contrary, *alocentric mode* is object-centered there is objectification and the emphasis is on what the object is like, there is either no relation or less pronounced relation between sensory qualities and pleasure-unpleasure feelings, it means that such feelings are not relevant in this case. In a sense it is not based on the needs of the individual. This mode involves an active and selective process of focalization on an object to distinguish later its properties.

[32] Smalley, Denis. 1992. "The Listening Imagination: Listening in the Electroacoustic Era." In: Paynter, T.H. John, Orton, Richard and Seymor, Peter eds. *Companion to Contemporary Musical Thought*. London, New York: Routledge. 518-520.

[33] Sonnenschein, David. 2001. *Sound Design - The Expressive Power of Music, Voice and Sound Effects in Cinema*. Studio City: Michael Wiese Productions. p.78.

humans, culturally specific to a certain society or period, or within the borders of the sound coding of a specific film.

François Delalande realized after analyzing different classical, contemporary and electroacoustic pieces that there are not infinite ways of listening to music and the actual listening may be regarded as a choice or alternative between different listening behaviours that are perhaps also not unlimited. Listener may be able to engage in more than one of these behaviours but not simultaneously. Thus, the use of the concept of listening behaviours ("conduites de réception") shows the polymorphic aspect of reception of the musical work. He identifies three main listening behaviours:[34]

Taxonomic listening is listening behaviour, when listener distinguishes from the musical flow morphologic units, qualifies them and becomes aware of the relationships between them at different hierarchical levels. This way of listening is often accompanied by use of descriptive metaphors or graphic listening scores to help to organize the thoughts.

Empathetic listening is centered on the feeling, on the sensation and immediate reactions to these sensations, the listener has during the reception of the musical work. Descriptive metaphors are created also in this case, however their role is not to characterize the morphology of the heard units, but rather designate through constructed general images of the piece the bodily sensation experienced by the listener, and lead to his aesthetic reactions.

Figurativization is the listening behaviour towards the narrative discourse of the work. Listener searches for movements, traces of life, for contextual function. Through evoked scenarios and imagined narrativity, he depicts the successive phases of tensions and relaxation that make the work progress (principles of ambiguity between real and abstract).

[34] Delalande, François. 1995. "Meaning and Behaviour paterns: The Creation of meaning in Interpreting and Listening to Music." In: E.Tarasti (ed) *Musical Signification, Essays in the semiotic Theory and Analysis in Music*. New York: Mouton de Gruyter. p. 223-224. Roy, Stephane. 2003. *L'analyse des musiques électroacoustiques: Modèles et propositions*. Paris: L'Harmattan. p.83-86. Landy, Leigh. 2007. *Understanding the Art of Sound Organization*. Cambridge: MIT Press.p. 94.

There is still another type of perception when dealing with pure electroacoustic (acousmatic) music that is called ***transmodal perception***,[35] or sometimes called also multimodal perception. This means, that during listening to acousmatic music we may receive information not only through one sensory mode (the acoustic), but through other senses as well (visual, touch). For example sense of texture is experienced through vision or touch, sound making involves also touch and proprioception - our perceptual awareness of position of our own body or parts of our body in space. Movements of sounds and their distribution in space as well as spectral motion are related to our own experience of physical movement. Rhythm is also multimodaly perceived not only aurally, but also through its corporeal basis and relations to body movement (proprioception).

In summary, listening is an open process, characterized by multiplicity of strategies that may alternate in time. It may be involuntary - passive act, when we don't pay attention to what we "hear" neither try to understand it (no intention) or a voluntary - intentional act, as it is in case of listening to music, when we listen with attention and will to apprehend and understand the sound and music. Our focus may be directed to the meaning (semantic listening) or to the source of the sound (causal listening). We may explore music just for itself, by intentionally removing its references - causes and meanings (reduced listening).[36] Our attention may move freely between the technical aspects of recording quality, extra-musical references, performance nuances or to more specific musical characteristics, shapes of the sounds or the overall shape of the work or even to our bodily sensation and feelings during listening to the music, or just some specific passage or sound of the piece. During repeated listenings or even in a course of listening to one musical work, we may switch between different modes of perception or listening strategies, depending what is the momental focus of our attention or what information we want to grasp from the sound of music.

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[35] Smalley, Denis. 2007. "Space-form and the acousmatic image." *Organized Sound* 12(1): p. 39-40.

[36] Smalley introduces also another mode of listening, related with the field of expertise in electroacoustic techniques. *Technological listening* means perceiving the technology or technique behind the music rather than the music itself, perhaps to such an extent that true musical meaning is blocked. This term is based in an aesthetic orientation that technology should ideally have transparency in electroaocustic music making and listening. (ElectroAcoustic Resource Site 2002)

Of course, the shift to aural analysis or to the approach based upon the sound was very radical change and might feel a bit insecure compared to the highly developed tools of traditional analysis, based on the work with the musical score. Insecurity and lack of verified analytical tools together with the wide and heterogeneous sources of documentation which electroacoustic music offers, might have lead to the long years lasting skepticism, helplessness or ignoration of these techniques by analysts, theoreticians, musicologists, etc. However, attempts to elaborate different perceptual modes and listening strategies were an important step not only to understand the listening process as a whole but also through understanding how our perception functions establish new ways of musical expression through composition and creation of new musical works.

1.3. Score in analysis. Listening score and sonogram. Subjective versus objective.

The focus on music as a sound liberates the development of new approaches. Listening becomes fundamental not only for analytic investigation of electroacoustic music, but also an emphasis in act of composition. Composer stands in front of the new universe of endless sound possibilities and the way how to work with these new possibilities, how to arrange sounds, combine them, transform them, relate them or how to interact the new electroacoustic sound world with the instrumental, appears a basic problem to solve in the creative process. The listener, for understanding the new sound world, needs to develop new ways and strategies of listening. The last decades of research showed that it is possible to develop these strategies to support the hearing experience of a piece of music in various ways and proved also that listening is also very effective basis for analytical investigation.

One of the ways of how this may be achieved is through developing **a listening score**,[37] a form of visual representation of the aural experience of the piece. In analysis, this type of score plays a different role from a traditional score. This score is not a

[37] Stones, Alan. 2000. *The Analysis of Mixed Electroacoustic Music: Kaija Saariaho's Verblendungen, a case study*. http://www.alanstones.net/analysis/analysis.html (accessed September 15, 2009)

source of analytic investigation, but a tool in the process of analysis. Through repeated listening to a recording of the piece, it is drawn what is heard and so the ‘drawn picture’ refers to certain structural features and aspects of the piece.

The approach of developing a listening score (graphic score) has been used already in past, mostly to analyze pure electroacoustic pieces. Tom Williams in analysis of electroaocustic tape piece Vox V by Trevor Wishart, writes:

> In order to come to a deeper analytical understanding of this piece it has been necessary to take it out of the time, to capture the phenomenological ‘now’ by giving some kind of visual representation of the piece over time. The graphic scoring of the work is different to a conventional Western music score in that it only allows us to survey the music not to construct it. In that sense ‘map’ is a more appropriate term: a map’s sole purpose is to guide us through an area. Furthermore, unlike conventional, acoustic composition, where the composer begins from the score and consequently writes his/her music out of time, which determines, by this note by note dissection, certain intellectual activities, the electroaocustician is working within a sonic continuum – the evanescence that is sound itself. (…) I have attempted to give a graphic representation, a mapping of events with the scaling of time on the horizontal axis. This mapping is a guide to the ordering of events and the type of gestures found therein. It is an extension of the Wishart’s diffusion score but now giving more detail. The graphic visualization of the sounds and their morphosis is an attempt to impart the gestalt. To show how the gestures move and evolve through time.[38]

Figure 9 shows the graphic score of the tape piece mentioned above, made by Williams. On horizontal axis, representing the time scale (development of musical events in time), we can see different characteristics of the piece – appearance of voiced (multiple voices, ululation, baby sound) and unvoiced sounds (breath), vocalized sounds (phonemes, consonants), animal sounds (horse, bees and crows), natural sounds (thunder, rain, wind) or their traces and transformations, etc. The listening score also reveals information about crescendos and decrescendos and spatial distribution of the sounds (analyst uses R (right), L (left) with arrows). The analyst applies also the technique of listening at slower speed to unfold information about sound sources. By listening to the recording at slower speed, he arrives to interesting observations, that the

[38] Williams, Tom. 1993. “VOX V by Trevor Wishart. The Analysis of an Electroacoustic Tape Piece.” *Journal of Electroacoustic Music* 7, p.7

bell and gun sound have been derived from a human voice through processing and stretching techniques. From this initial graphic representation of 'what has been heard in the piece', Williams derives detailed analysis of the piece, its structure and form.

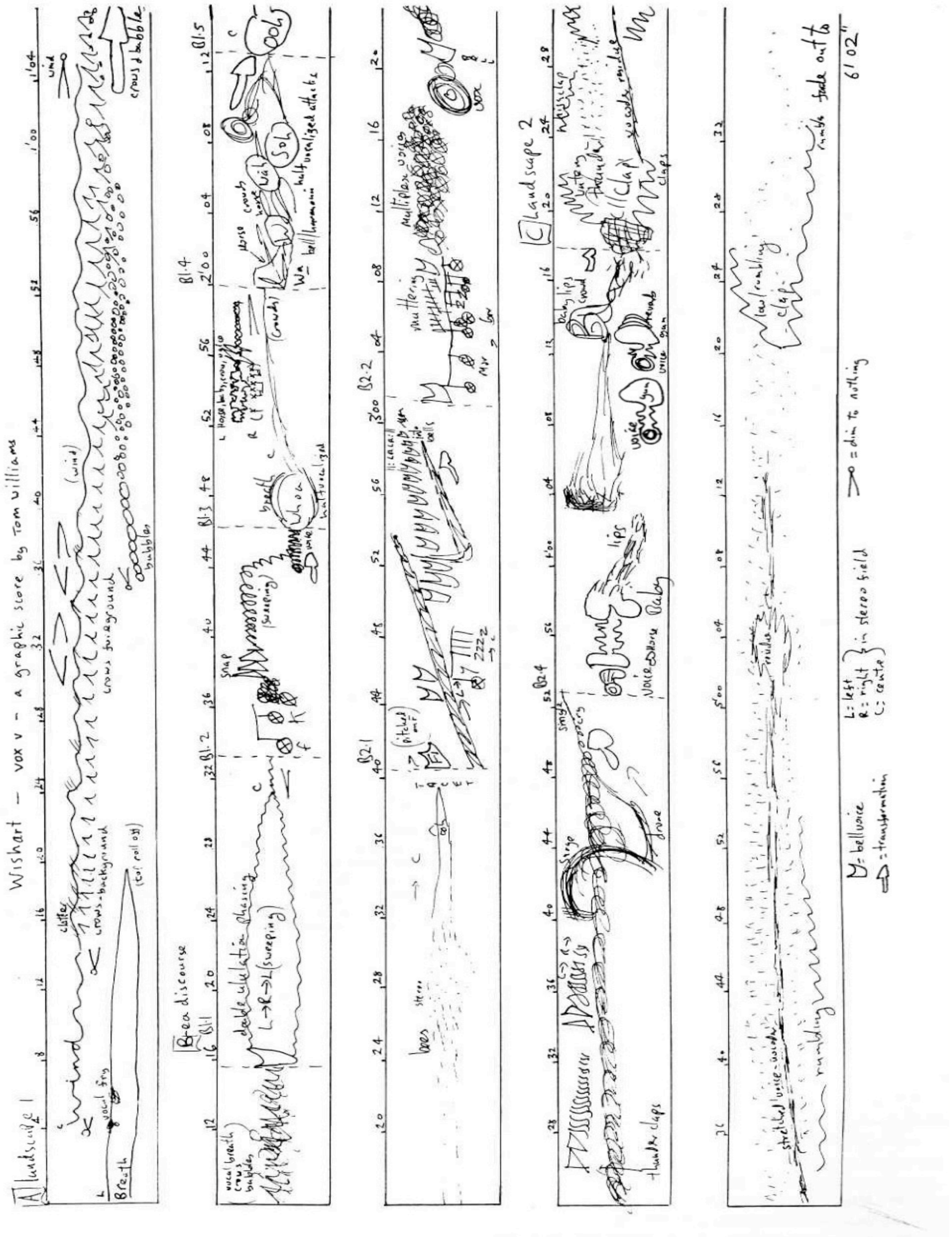


Figure 9. Graphic score of Wishart's Vox V, by Tom Williams[39]

[39] Ibid., p.12

This method, based upon the personal and unique experience of the listener - analyst and representing (more or less) 'subjective sonic view' of the piece in 'visual translation' allows a non-linguistic symbolic presentation of 'what is heard'. As may be imagined, this process also depends of skills of each listener-analyst to concentrate on different formal and structural characteristics of the piece and ability to transform them into a schematic picture, to capture as much information as possible from listening. Depending on how many times the piece is listened to, the drawing may get always more detailed and probably also quite different from the initial one. During first listening the analyst will probably focus more on the general form, main segments and structures of the piece, while during the next listening he will try to gather the information about the more detailed characteristics of the piece. Comparing these 'listening' scores from different stages of listening, he/she will gain very 'valuable' information about the piece, such as distribution of different sounds, their grouping, attacks, decays, emphasis on pitch or noise, dominance of high or low pitch, gesture-carried or texture-carried structures, presence or absence of pulsation, repetitions, rhythm, hierarchical organization of material, level of interaction between instrumental and electroacoustic sounds – presence of fusion and contrast, etc.[40]

This was an example how the method of creating a listening score, as a visual representation of heard experience, might be useful in unfolding different aspects and features, forms, structures and morphologies in analysis of an electroacoustic work.[41]

On the contrary, another approach which also touches the score problem but in a very different way has been developed. Computer spectrum analysis, based on the mathematical technique of Fourier analysis is used to produce **sonogram or spectrogram**. Sonogram, as a trace of the frequencies present in the sound of the piece versus time, enables the viewer to see general features of the sound, such as the onset of notes or phonemes, formant peaks or major transitions and is important to get the general image of the whole work, as well as detailed view of its inner structures and

[40] Stones 2000

[41] A number of other authors used this tool in order to describe aspects of essentially aural music:
Lewis, A. 1983a, 1983b. "Motion and Analysis of Electro-Acoustic Music: Denis Smalley's Vortex (I), (II)". *Electro-Acoustic Music*, 3 (3), 3 (4).
Lewis, A. 1998. "Francis Dhomont's Novars." *Journal of New Music Research* 27 (1-2): 67-83.
Couprie, P. 2004. "Graphical representation: an analytical and publication tool for electroacoustic music" *Organized Sound* 9 (1):109-113.

relationships between sounds. The role of sonogram can be compared to the function of the score in traditional analysis – gaining the information from what is "seen". This alternative approach is not based on listening but on scientific process and it provides more objective view of the sound of the piece. Although spectrogram can be helpful in analysis to point to specific properties of sound over time (harmonic background, pitch groups, timbral transformations, etc.), it is sometimes very far from the act of listening (being "too objective"), and needs to be complemented by other methods and approaches. We need to confront the information revealed by sonogram with our perception of the musical work. Smalley also refers to these aspects:

> … sonogram is not a representation of the music as perceived by a human ear – in a sense it is too objective. Its shapes therefore have to be interpreted and reduced to perceptual essentials… Someone has to decide what retain and discard from the representation, and more particularly, try and determine how much detail is pertinent to the alert listener. For the analyst this question of degree of detail is a problem since recordings (CDs) allow one to listen repeatedly to the briefest passages in a work, discovering much more detail than it is possible to hear in the course of normal music flow. How much is too much, and how much is not enough? There is no objective method of achieving a visual spectromorphological representation, and the analyst hopefully becomes only too aware of subjective decision-making and alternative 'readings'. This is as it should be.[42]

Following figures (Figure 10) presents an example from the analysis of João Pedro Oliveira's Íris, by Paul Rudy.[43] Sonogram has been used as a complementing method to help to explain timbral transformations and sound interpolations between the instrumental and electroacoustic sounds. The string glissando and its visual representation on the sonogram represent the rainbow, a fundamental concept of this composition.

[42] Smalley, Denis. 1997. "Spectromorphology: explaining sound-shapes." *Organized Sound* 2(2), p.108.
[43] Rudy, Paul. 2005. "Interpolating Electroacoustic Sounds in an Acoustic Context: Analysing Timbre, Time and Pitch in Íris by João Pedro Oliveira." *Journal SEAMUS* 18 (2): 2-11.

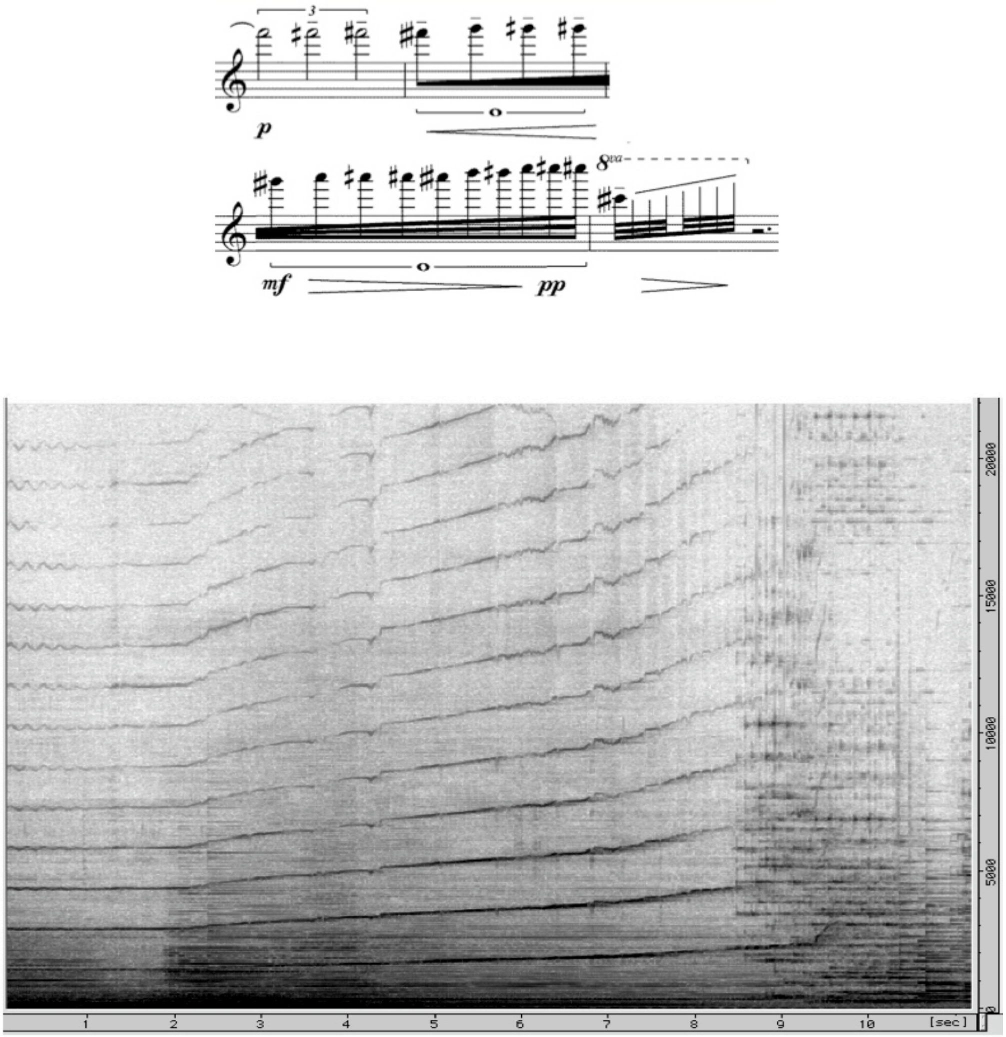


Figure 10. Segment from João Pedro Oliveira's score of Íris (violin) with its corresponding sonogram, by Paul Rudy[44]

In another example (Figure 11) Rudy identifies from sonogram other visual features, as metaphors of the rainbow: *"glissandi in both directions present in the ensemble and tape parts suggest the curvature of the rainbow, and also add to the blur of discrete pitches… In this case, pure string glissandi are used (the cello glissando is plainly visible from 4-8 seconds on the sonogram)…"*[45] For better illustration, we added corresponding part of the score to the sonogram, made by Rudy.

[44] Ibid., p.10
[45] Ibid., p.9

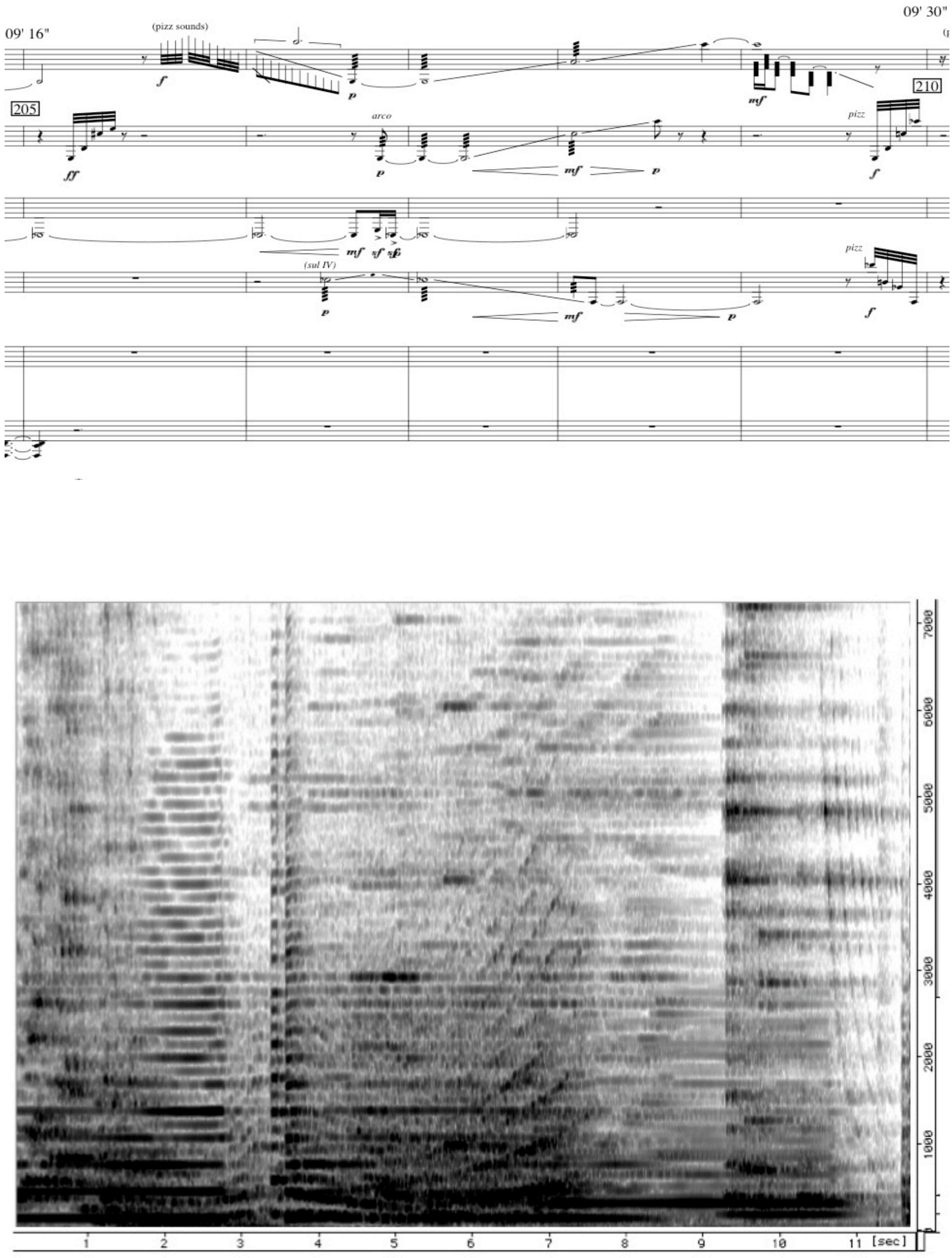


Figure 11. Excerpt from the score of Íris and corresponding sonogram, by Paul Rudy[46]

[46] Ibid. p.9. with example added form the score João Pedro Oliveira. 2000. Íris, violin, clarinet, cello, piano and tape. Unpublished composer's manuscript.

Sometimes, we may observe discrepancy between ‘visually interesting’ and ‘aurally interesting’, when visually interesting and very recognizable features of the sonogram might overpower the idea of the sound itself. These observations have been documented by an example from the Norman Adams’ analysis of Richard James’ piece, using sonogram (Figure 12). In this particular case according to author, the visually interesting part – the face corresponds to *“least coherent sounds*”, while the less visually interesting part corresponds to *“most coherent sounds”*. It is clear, that composer first drew the face on the sonogram and then synthesized the sounds. The visual idea of having the face in the sonogram played more important role than the sound itself. Composer accepted the aural solution corresponding to the face, whatever this result would have been.

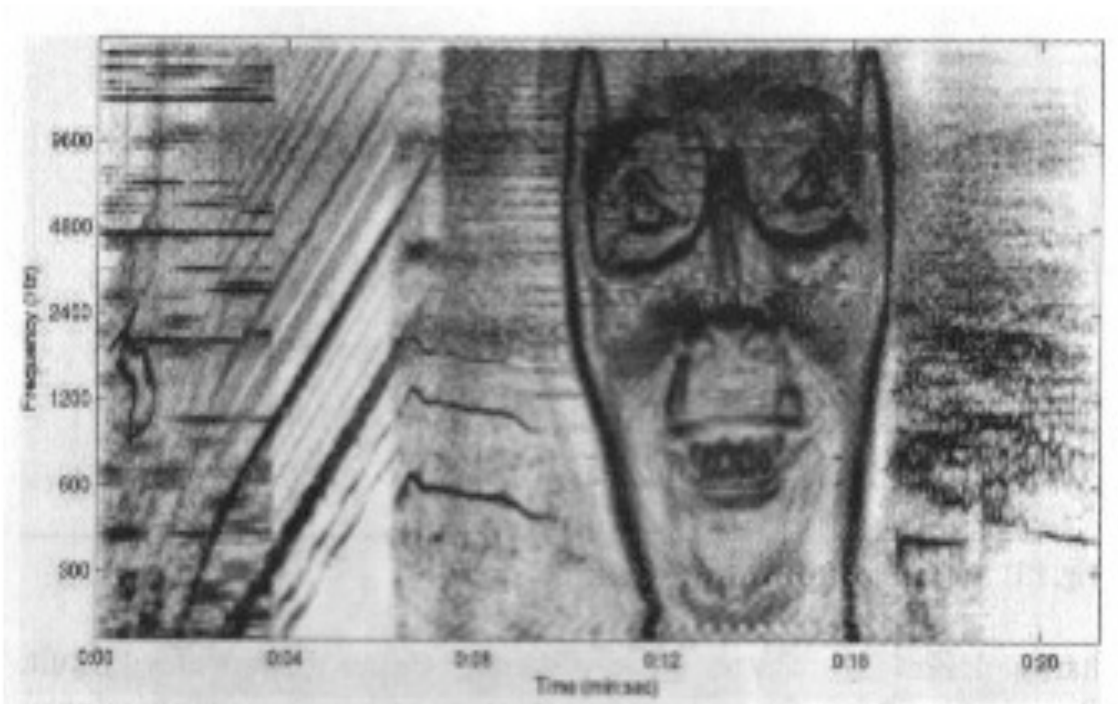


Figure 12. Spectrogram of a segment of Richard James’ piece “ΔM_i^{-1} =...”, by Norman Adams[47]

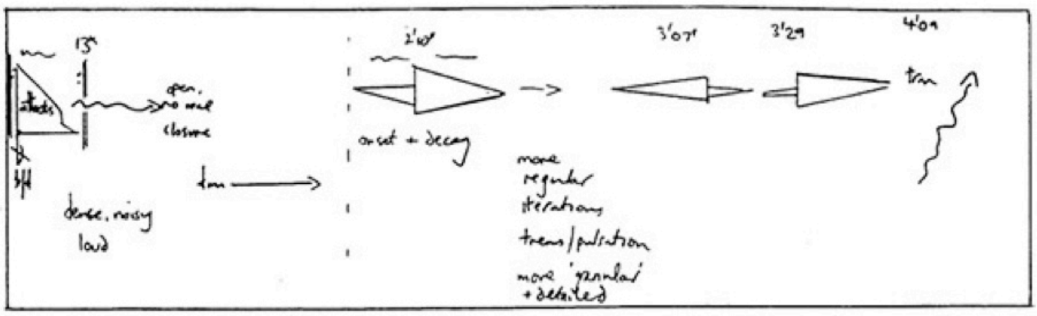
[47] Adams, Norman. 2006. “Visualization of Musical Signals.” In: Simoni, Mary (ed.) *Analytical Methods of Electroacoustic Music*. New York: Routledge. p.26.

Computer spectrum analysis has during years passed through different innovations and the recent **acousmographe** already allows besides creating a spectrogram, also manually add graphical symbolic representation of any selected segment of analyzed piece. It represents a tool for visualization and annotation, combining both, the spectrogram and the listening graphic score.

Last decades the mentioned approaches and their cooperation have been applied in analysis of mixed pieces. Composer and sound designer Alan Stones uses in case study analysis of Kaija Saariaho's Verblendungen[48] combination of listening score (Figure 13a, b), orchestral score and sonogram (Figure 13c) and provides very detailed analysis of this complex mixed orchestral work.

> Each of the three score objects used in this study (orchestral, graphic and sonogram) can tell us something about a mixed electroacoustic work. The orchestral score allows us a detailed picture of the instrumental role within the work. The graphic score creates an outline of the whole and forces, through the process of its making, a clear view of how the work is heard. The sonogram shows us both a general image of the whole, allowing a structural overview, as well as allowing us to uncover much detail of the internal structures and relationships of particular sounds. However, it is in their combined usage that these scores provide us with a much fuller picture of a work's structure, in creation of a multi-dimensional analytical space in which we can explore the piece.[49]

a) excerpt of "first" listening score



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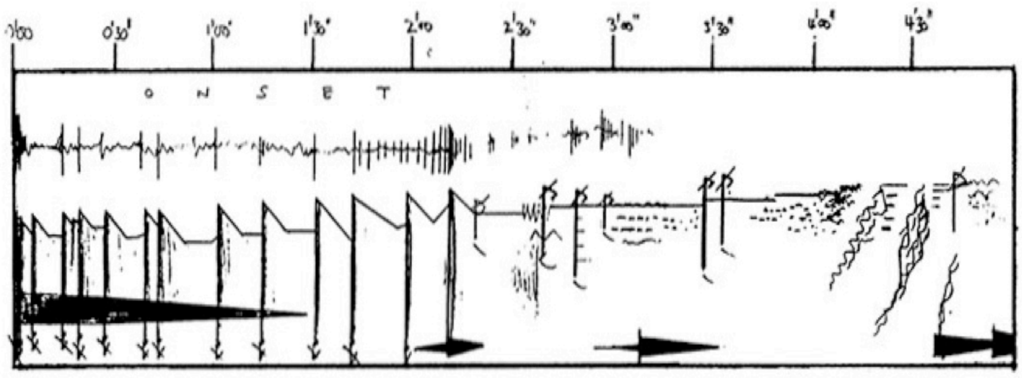
[48] Stones 2000.
[49] Ibid.

b) excerpt of listening score overview



c) excerpt of sonogram

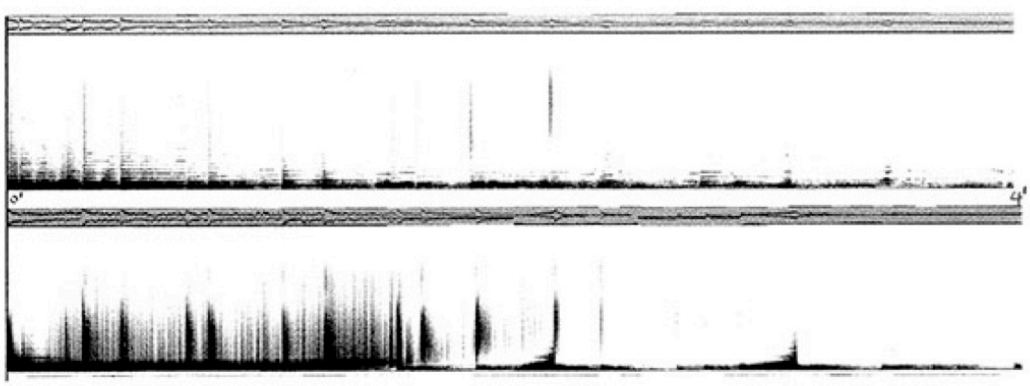


Figure 13. Examples from analysis K. Saariaho's Verblendungen, by Alan Stones[50]

a) Excerpt of first listening score shows some important structural characteristics in several smaller temporal segments (first 4 minutes of the piece), in which the analyst focused on (attacks and decays of sounds, some sound articulations – tremoli, iterations, pulsations, density and loudness).

b) The excerpt of first 4 and half minutes of listening score overview represent the onset phase of the piece where all important material is introduced.

c) The last excerpt is the part of overall sonogram, corresponding to the first 4 minutes of the piece. Upper trace presents the orchestral part and lower trace the tape part. It shows higher spectral density in the beginning (first 2 minutes) of the piece, which decreases significantly in the next 2 minutes.

[50] Ibid.

The use of these 3 different types of 'score' in collaboration, each presenting its own view of the work, helps developing our understanding of an mixed electroacoustic piece and give more complete information of the work. (Figure 14)

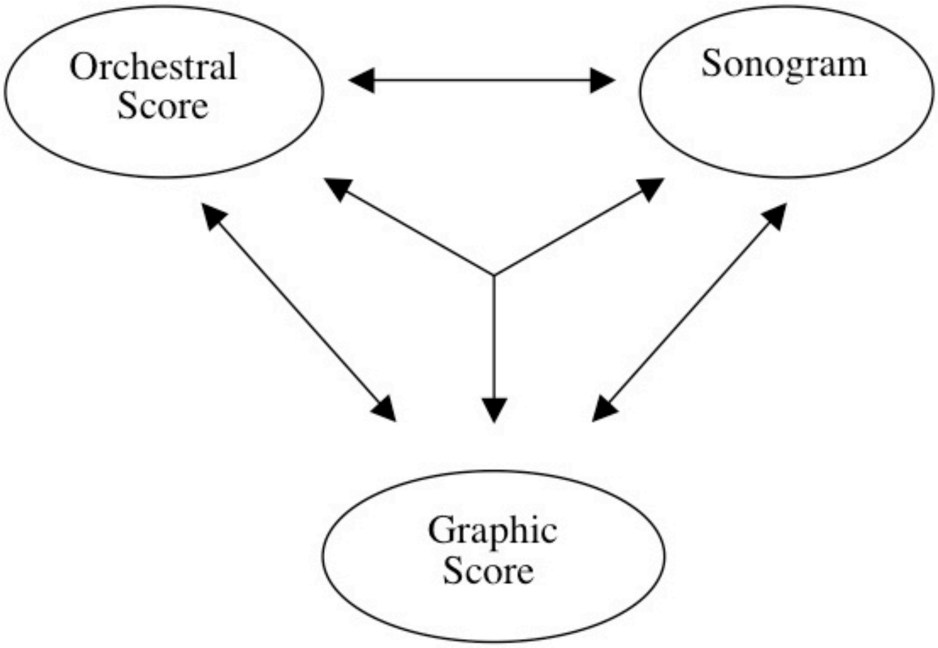


Figure 14. Analytical space created between the three scores, by Alan Stones[51]

According to Stones:

> The centre-point in this diagram, where as much information about the work as possible (from the three specific viewpoints) is gathered, aims to reflect some of the complexity of our experience of a musical work and to bring this to the process of analysis. The different perspectives that each of these scores affords is not only important for the information each directly reveals about the work, giving us a more rounded view, but also the fact that it forces the appraisal and re-appraisal of materials and ideas about the piece, as information from the different viewpoints is compared and combined. In addition to this and as a recognition of the fact that mixed electroacoustic music crosses over and combines note-based and electroacoustic worlds, is the importance of applying an electroacoustically-framed viewpoint to note-based (orchestral) material, and vice versa.[52]

[51] Ibid.
[52] Ibid.

Smalley also mentions the existence of *"three types of score"*[53] in electroacoustic music, which might contain perceptually relevant information and could be eventually helpful as a support in the analytical process. These three types of score are different from those mentioned above, their primary function is to help to perform the electroacoustic piece. He refers to the *graphic score* (graphic transcription of acousmatic material intended to help performer to orientate himself in the performance), the *realization score* (record of how a work was produced, may include composer's form-plans, etc.) and *diffusion score* (a sketchy, graphic representation of the sounding context produced as an aid for the diffusion of the electroacoustic work in concert), all done by composer. These transcriptive scores may sometimes be used as a listening aid.

Another example of how the mentioned methods may be used in collaboration for analysis of electroacoustic music is a creation of an *interactive study score*.[54] David Hirst, Australian composer and researcher introduced the SIAM framework (Figure 15). The methodology of *segregation* (identification of sonic objects and establishment of factors responsible for identification), *integration* (identification of horizontal relationships - streams of sonic objects functioning as 'pattern units', considering 'trajectories' and 'gestures'; determinations of relationships between pattern units, local organization in time – pulse, beat, accent, rhythm, meter; horizontal integration of pitch, identification of vertical relationships – vertical integration as a cause of timbre creation and variance or in terms of potential psychoacoustic and musical dissonance and consonance), *assimilation* and *meaning* (nature and type of discourse, implication-realization, arousal and meaning on a moment-to-moment basis through the work, global organization in time – sectional or continuous, the relationships between sections – hierarchy) helps to develop an 'interactive study score'. A Flash-based interactive helps to provide dynamic visual representation along with synchronized playback of the recorded work. It helps to display aspects of the frequency spectrum versus time, graphic symbols describing different sound events, text about sound events, start times, duration of events, etc.

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[53] Smalley 1997

[54] Hirst, David. 2005. *Developing an Interactive Study Score for the Analysis of Electro-acoustic Music*. http://www.acma.asn.au/acmc05/acmc05-085-088.pdf (accessed November 30, 2009)

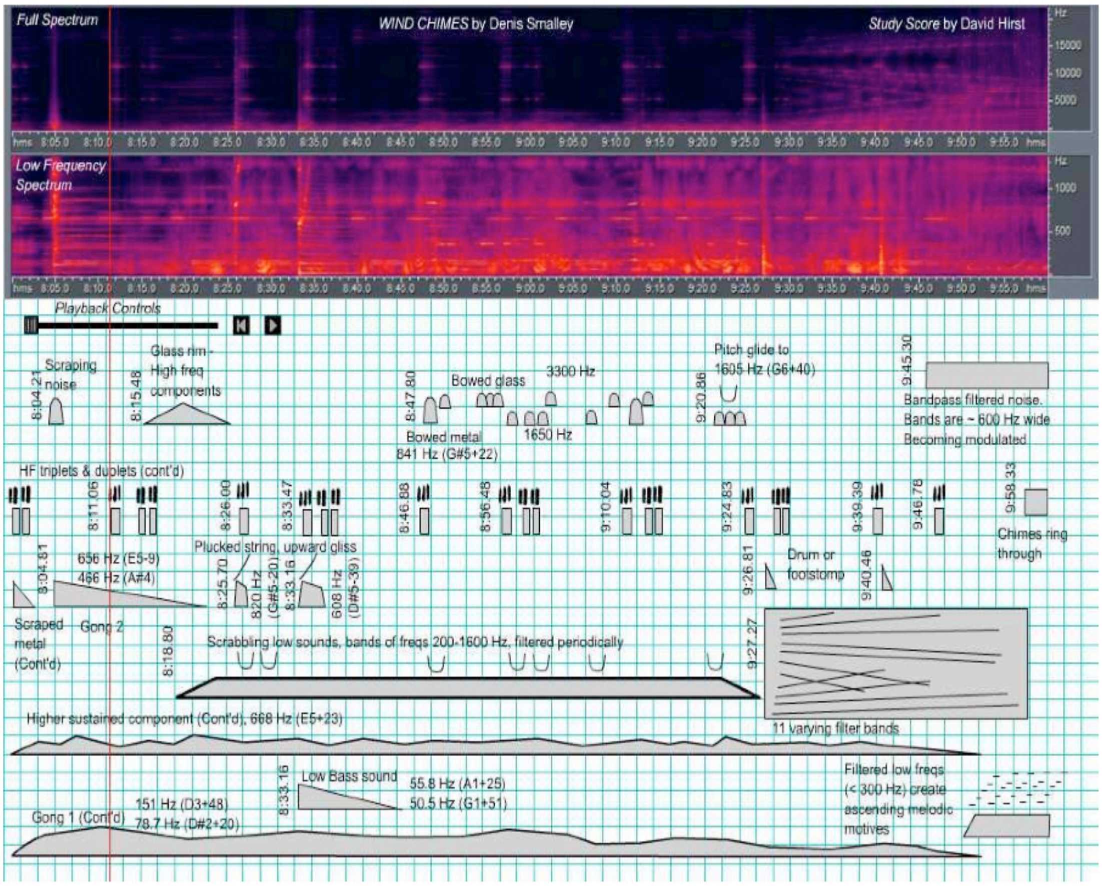

Figure 15. Example from Smalley's Wind Chimes interactive study score, by David Hirst[55]

As the figure 15 shows, the screen is divided into two parts – upper part displays sonogram (representing computer analysis), lower part shows graphic symbols and text (the product of human analysis), the grid background of this graphic part facilitate alignment with time scale of the sonogram. Under the sonogram there is a set of playback controls, which allows moving to particular moments in the sound file and play chosen segments.

Hirst stresses importance of the interactive study score in his conclusion:

> Creation of the study score was quite a long and laborious task, but once it has been created, it does provide some insights and benefits. It is quite

[55] Ibid.

> quick to move from one area to another in the piece (…) this allows some ready comparisons of different parts of the work to expose some of the longer-term formal organization of the work. Screens can also be printed and strung together to get the total picture of the work. One benefit is provided by the Flash authoring environment in that the study score can be widely disseminated over internet – subject to copyright clearance. One aim of the project is to produce hard data that others could use for further analysis. (…) Our representation, that includes significant frequencies, pitch information, and accurate start-times, does allow these values to be used by other researchers in a more quantitative analytical fashion.[56]

In summary, score in electroacoustic music have various functions:

A. The aid for performance of the electroacoustic or mixed piece:

1. In music combining live instruments and electroacoustic sounds score serves as an aid for performer and synchronization:

- prescription - *instrumental score*
- description - *graphic representation of electroacoustic sounds in score*

2. It may be important for diffusion of the electroacoustic work over complex loudspeaker systems - *diffusion score* (Figure 16). Generally it is a visual representation of a piece, that notates important aural details necessary for the diffusion of the musical work. Time is usually represented on the horizontal axis while the vertial axis is reserved for the spectrum.

3. It can be presented in different forms, plans, records of how a work was produced or how it should be realized and reproduced - *realization score*.

In limited extend all these types of scores may serve also as an aid in the analytical process.

B. The tool in process of analysis:

1. Graphic score created by analyst during listening process - *listening graphic score*.

2. Visual representation of the electroacoustic music by computer spectral analysis - *sonogram*.

[56] Ibid.

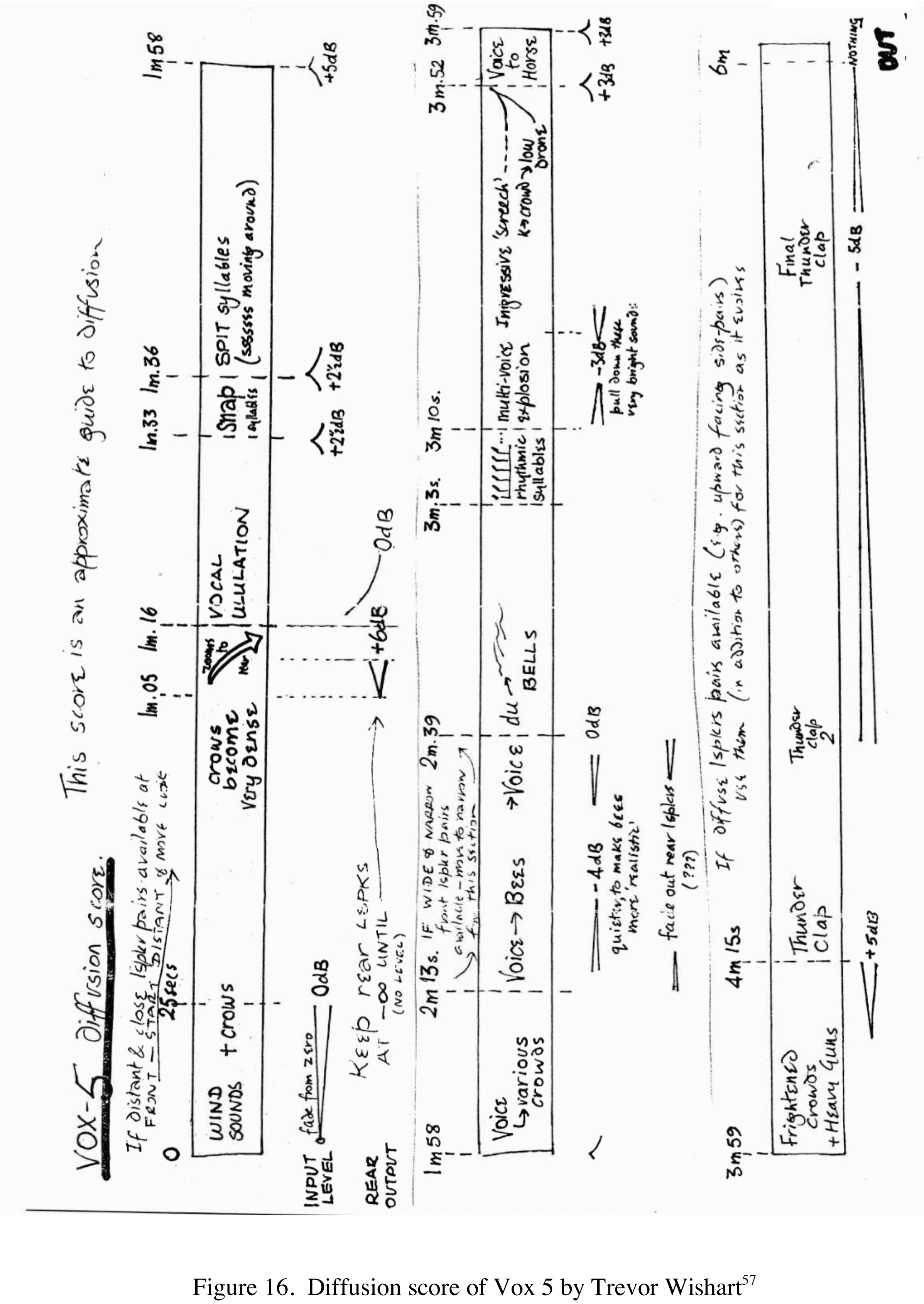

Figure 16. Diffusion score of Vox 5 by Trevor Wishart[57]

[57] Williams 1993

1.4. Terminology and language in electroacoustic music.

One of the problems that need to be considered in the analysis of the electroacoustic music is the problem of **terminology and language**.

> The most important tool for establishing an aesthetic of electroacoustic music is language. We must have words to express and explain what we do as much as we must engage in the doing. Just as we must evaluate and re-evaluate the tools for electroaocustic music, along with the tasks those tools are meant to meet, we must, in our use of language, accept neither a trivial implication nor a broad one without serious reflection of what language does to the thing so represented and vice versa.[58]

1.4.1. Sound object and PROGREMU. Spectromorphology.

In approaching electroacoustic music, most of the traditional tools for analysis become obsolete, disciplines like harmony, counterpoint or instrumentation in the environment of electroacoustic music are inappropriate. The need of new vocabulary for the discussion of sound and music has been recognized already in early 1960s by Pierre Schaeffer. In his famous study Traité des objets musicaux, he developed **typomorphology** and introduced a lexicon of descriptive terms to talk about sound. He broke up the academic classifications of music and sound and created a new theory with the crucial concept of "**sound object**" (L'objet sonore). The term sound object[59] refers to:

> ... every sound phenomenon and event perceived as a whole, as a coherent entity and heard by means of reduced listening which targets it for itself, independently of its origin and its meaning. It is a correlate of reduced listening: it doesn't exist "in itself" but by means of a specific foundational intention. It is a sound unit perceived in its material, its inherent texture, its own qualities and perceptual dimensions. On the other hand, it represents a global perception, which remains identical

[58] Keane, David. 1986. "At the Threshold of an Aesthetic." In: Emmerson, Simon (ed.) *Language of Electroacoustic Music*. London: MacMillan Press. p.118

[59] To avoid confusions concerning the notion of sound object, it should be noted that "sound object is not the sound body, nor the physical signal, it is not recorded fragment, nor a notated symbol on the score, it is also not a state of mind", it remains the same across different listening modes. (Chion 1995)

> through different hearings; an organized unit, which can be compared to a 'gestalt' in the meaning of the psychology of form.[60]

In Schaeffer's Program de la Recherche Musicale (PROGREMU),[61] sound objects are studied in 5 interdependent stages: typology, morphology, characterology, analysis and synthesis (Figure 17).

Typology[62] is divided into two procedures: *identification* - isolation of sound objects and cutting them into sound units and *classification* - establishment of basic characteristic types of sound objects, such as instantaneous (impulsive), continuous and iterative; arranging them in families, such as balanced objects (they have a central privileged place), redundant objects (not original enough) and eccentric objects (too original and irregular).

Morphology[63] includes *description* of detailed characteristics of the sound objects, distinguishing 7 morphological criteria (distinctive features or properties of the perceived sound object): *mass, harmonic timbre, dynamic, grain, allure, melodic profile and profile of mass,* which are examined one by one and reorganized into four classes of criteria - criterion of material (mass, harmonic timbre), criterion of sustainment (grain, allure), criterion of form (dynamic) and criterion of variation (melodic profile and mass profile). Typomorphology represents the most detailed two stages of PROGREMU.

Once the sound objects are isolated and classified by typology, described and studied separately by morphology, they can be grouped further to *genres* according to **characterology**[64] and evaluated in the musical perceptive field by **analysis**[65] in order to assess their capacities to emerge as musical *values*, their potential for musical structures.

The last stage of the program is **synthesis**[66] of musical objects derived from the criteria. This is the ultimate aim of the program for composer – to use all revealed information to synthesize new sound objects. While typology, morphology and characterology aim to identify and describe 'the sonorous', analysis and synthesis attempt to make 'transition from sound to the musical'.

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[60] ElectroAcoustic Resource Site 2002
[61] Schaeffer Pierre. 1966. *Traité des Objets Musicaux* (nouvelle édition 1977). Paris: Éditions du Seuil.
[62] Chion 1995. p.108
[63] Ibid., p.110
[64] Ibid., p.113
[65] Ibid., p.115
[66] Ibid.

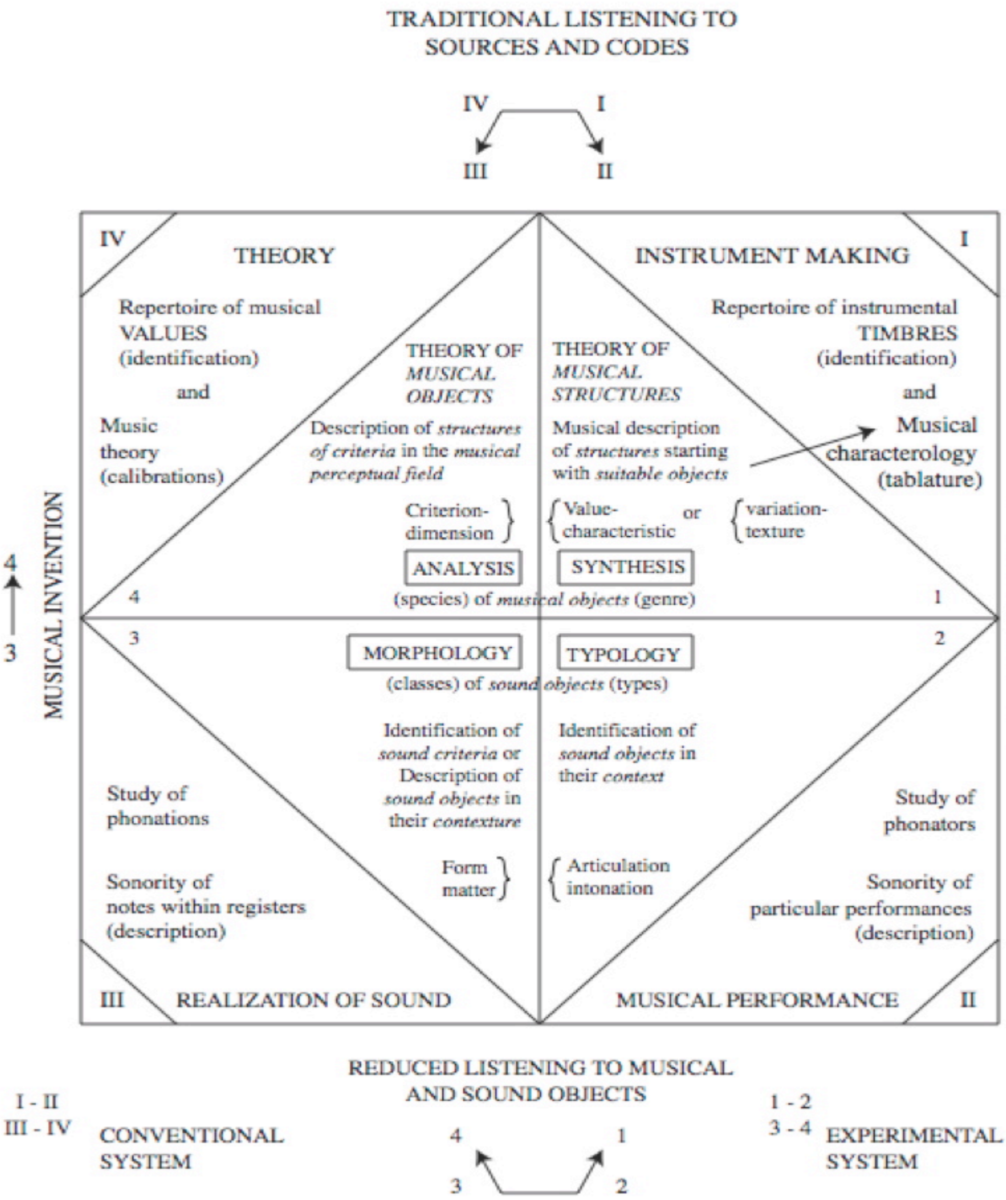

Figure 17. Schaeffer's Programme de la recherche musicale PROGREMU[67]

One of the important Schaeffer's considerations deals with *three plans of reference*,[68] through which the sound objects are described and classified due to their characteristics: *melodic or texture plan* (evolution of pitch in time), *dynamic or form plan* (variation of intensity in time) and *harmonic or timbral plan* (relationship between

[67] Ibid., p.194
[68] Schaeffer 1966, Chion 1983, 1995

the previous parameters and their spectral components). Each of these plans of reference presents diverse systems of classification according to the melodic, dynamic or timbral type of movement.[69]

According to Schaeffer's theory, concept of morphological criteria is essential for building a general music theory of the sound world. It is necessary to give up using the traditional musical values, which are no more relevant (they are concerned only with particular Western classical music and with traditional system of notes, without them they lose their meaning) and replace them by new concepts that can be used in order to describe the complex sounds of electroacoustic world.

> If we abandon traditional musical identification, we must find something to replace it, in the all and sundry of sound, for we can no longer be sure of anything: neither timbres nor values.[70]

For example, when there are several sound objects, we should talk instead of their common values (f.e. pitch) about criteria (f.e. criteria of mass), as a more general term than a value. Criterion of mass is a generalization of the concept of pitch and includes also sounds where pitch is not precisely identifiable by the ear. This criterion involves also perception of colour and thickness and no longer perception of degrees and intervals. Thus, mass is a "crossroads-concept", it represents a meeting point for two modes of apprehending the "pitch-field", the "traditional" and "the electroacoustic". We can very well imagine the significance and adequacy of the concept of mass in describing not only the complex sounds of electroacoustic music but also the instrumental clusters, where the perception of cluster can't be reduced just to a sum of the perceptions of its component pitches.

The complex relationships and various distinctions resulting from various stages of PROGREMU are demonstrated in the following figure (Figure 18).

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[69] see chapter 4.1.

[70] Schaeffer 1966. *"si l'on abandonne l'identification musicale traditionelle, il faut en retrouver une autre, dans le tout-venant du sonore, car rien ne nous est plus garanti: ni timbres, ni valeurs".*

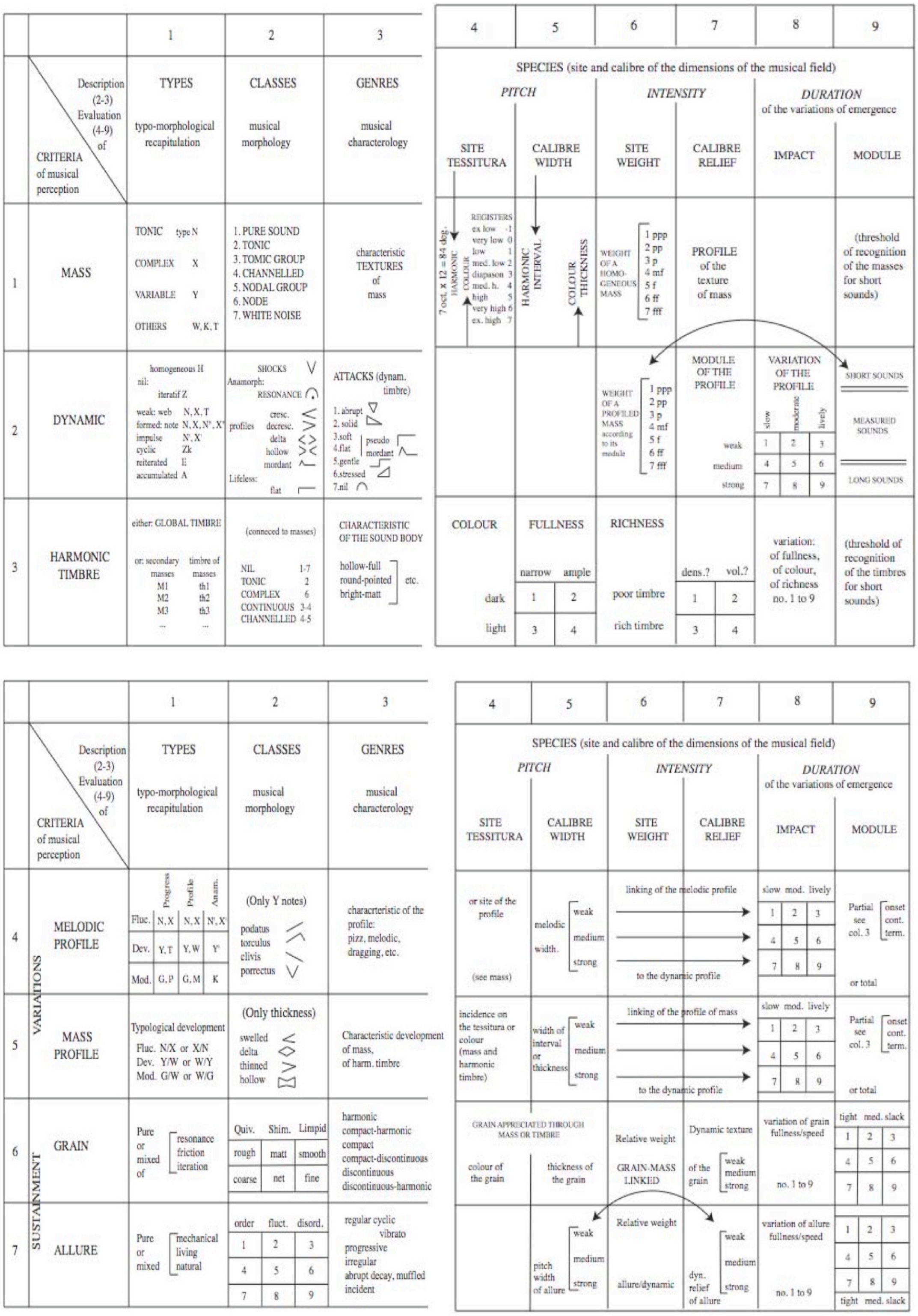

Figure 18. Summary diagram of Schaeffer's Theory of Musical Objects[71]

[71] Chion 1995, p.197-200

The constant urge for "common unified" language and terminology to describe electroacoustic music and its relations continued and occupied the musical researchers and musical thought in general, till now. The previous Schaeffer's attempts were successfully extended and re-formulated by Smalley's **Spectromorphology**,[72] which have been more widely adopted as one of the main approaches to analysis in electroacoustic music, nowadays.

> I have developed the concepts and terminology of spectromorphology as tools for describing and analyzing listening experience. The two parts of the term refer to the interaction between sound spectra (spectro-) and the ways they change and are shaped through time (-morphology). The spectro- cannot exist without the – morphology and vice versa: something has to be shaped, and a shape must have sonic context. Although spectral content and temporal shaping are indissolubly linked, we need conceptually to be able to separate them for discursive purposes- we cannot in the same breath describe what is shaped and the shapes themselves. (…) Spectromorphology is not a compositional theory or method, but a descriptive tool based on aural perception. It is intended to aid listening, and seeks to help explain what can be apprehended in over four decades of electroacoustic repertory. (…) Although spectromorphology is not a compositional theory, it can influence compositional methods since once the composer becomes conscious of concepts and words to diagnose and describe, then compositional thinking can be influenced. (…) Composers need criteria for selecting sound materials and understanding structural relationships. So descriptive and conceptual tools, which classify and relate sounds and structures can be valuable compositional aids.[73]

Smalley extends concepts of Schaeffer to other complex properties, such as motion and space and establishes new kinds of structural hierarchies. Traditional hierarchies of tonal music based on the note, its groupings (note → motive → phrase, etc.) and pulse (defines the density of the movement) are replaced by new hierarchies in electroacoustic music, formed in gestures and textures. These hierarchies are not permanently organized and may be applied in a small or a large scale:

> One might detect three or four levels in one part of a work and fewer or more in another part; one section of a work might comprise a neat

[72] Smalley, Denis. 1986. Spectro-morphology and Structuring Processes. Emerson, Simon, ed. *The Language of Electroacoustic Music*. London: The Macmillan Press Ltd. 61-93.
[73] Smalley 1997, p.107

> hierarchy of small, unit-groupings, while another section might be a much larger, indivisible, higher-level whole.[74]

The theoretical framework of spectromorphology is presented in five principal parts: spectral typology, morphology, motion (motion typology and motion style), structuring processes (low-level/high-level, gesture/texture, surrogacy) and space.[75]

Spectral typology.

Spectral typology[76] defines the note-noise continuum and divides it into three principal elements: ***note*** - subdivided into three categories – *note proper* (absolute pitches, intervalic and chordal combinations), *harmonic spectrum* (specific intervalic organization based on vibrational properties of strings and columns of air, f.e. string instruments, wind instruments) and *inharmonic spectrum* (don't have a specific intervalic organization, f.e. bell, gong or other percussion metalic sounds)[77]; ***node*** (an event having a more complex texture than a single pitch; either band of sound which resists pitch identification, such as cymbal sound, or a compact density in which it is difficult to hear its internal pitch structure, such as note cluster) and ***noise*** (variegated phenomenon, in which it is impossible to hear any internal pitch structure, we perceive it as granular or particle motion, f.e. wind and sea sounds). On the line from note to noise we can observe increasing spectral density and compression. The state where the ear can't decompose spectra into pitches is defined as ***effluvium***. Smalley talks about *pitch-effluvium continuum*, where:

> Listener, confronted by an effluvial state, needs to change focal strategy as aural interest is forced away from charting the pitch behaviour of internal components to follow the momentum of external shaping. Thus, the context changes the level at which the ear can respond to the musical structure.[78]

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[74] Ibid., p.114
[75] Smalley 1986
[76] Ibid., p.65-68
[77] Smalley 1997. In other words, harmonic refers to the frequencies which are integer multiples of the fundamental frequency, their waveform is periodic. Inharmonic refers to the frequencies which are not integer multiples of the fundamental frequency, their waveform is aperiodic. (ElectroAcoustic Resource Site 2002)
[78] Smalley 1986, p.67

Morphology.

Morphology[79] defines three morphological archetypes of instrumental sounds – ***attack-impulse***, ***attack-decay*** and ***graduated continuant***, which are linked with three temporal phases ***– onset, continuant*** and ***termination***. ***Attack-impulse*** is a sound with sudden onset which is immediately terminated - onset is on the same time a termination (onset = termination, f.e. single detached note)**.** ***Attack-decay*** is a sound whose sudden onset is extended by a resonance, which decays towards termination (onset + termination, f.e. plucked string or bell sound) either quickly – *closed attack-decay* or gradually – *open attack-decay*. ***Graduated continuant*** is a sound represented by an onset which is graduated and maintained in a continuant phase and can close in graduated termination (onset + continuant + termination, f.e. sustained sounds). From these central archetypes various models of temporal articulations may be generated – morphological models or "*variants*". These variants may be created by manipulating the durations and spectral energy of the three temporal phases (f.e. compressing the onset and termination phase → swelled graduated continuant, reversing the onset phase → reversed attack-decay; linear onsets and decays → linear attack-decay, linear graduated continuant; increasing the spectral energy towards termination – termination acts as an onset → reversed attack-decay leading to new attack-decay). Morphologies are also not just isolated objects. Since the sounds in electroacoustic works are often dynamic objects, morphologies may create hybrids and merge in "*morphological strings*", which are composed of two or more morphological archetypes or models. This is observed also in instrumental music, where different morphological archetypes are combined, superimposed and blended into each other. Morphological strings may be created by cross-fading, interpolating, or compressing distances between different morphological models. For example different stages may be generated by compressing distance between attack-impulse archetypes: separated attack-impulses → iteration (linked attack-impulses are perceived as unified object) → grain (the impulses have lost the separate entity) → effluvium or effluvial state (not possible to identify any granular characteristics). The *attack-effluvium continuum* represents a "morphological" counterpart of pitch-effluvium continuum from spectral typology. Dealing with this continuum ear has to move its attention from components (which are no more

[79] Ibid., p.68-73

determinable) to the morphologies which shape the structural motion – *"the level at which the ear can respond to the musical structure is changed"*[80]

Motion.

If we consider that the music is "motion in time", we may easily imagine different types of motion. Spectromorphology recognizes wide range of motion types (real or imagined), where the motion (spectral and dynamic shaping) is created without actual movement in space.

Motion typology[81] defines six basic categories of motion type, each one divided into various subcategories: ***linear*** (motion related to simple linear principle); ***curvilinear*** (motion deflected off its course – changing its angle or direction); ***unidirectional*** (motion in one direction) – ascent, plane, descent; ***bi-directional*** and ***eccentric/multi-directional*** (motions in two and more directions, motion that creates expectation and have a sense of direction; these motions have both gestural and textural tendencies) - agglomeration/dissipation, dilation/contraction, divergence/convergence, exogeny/endogeny; ***reciprocal*** (motion in one direction is balanced by a return movement) – parabola, oscillation, undulation***, centric/cyclic*** (motion related to a central point by recycling) – rotation, spiral, spin, vortex, pericentricity, centrifugal motion.

Motion categories have a great importance since they can be applied on variety of structural levels – from single sound object to the large structures or sections of a musical work (f.e. motion category may be related with the external contouring of a gesture as well as with the internal behaviour of a texture).

Motion style[82] characterizes internal progress of motion typology and refers to the internal motion of spectral texture. It recognized four basic continua: ***synchrony/asynchrony, continuity/discontinuity, conjunction/disjunction and periodicity/aperiodicity*** and three typical categories of internal motion***: flocked motion*** (individual components behave in a coherent group or groups, the ear follows the flock rather than its components)***, streamed motion*** (concurrent flow of motions which maintain their separate identity) and ***contorted motion*** (the relationships of components

[80] Ibid., p.72
[81] Ibid., p.73-77
[82] Ibid., p.77-80

are so tied, that they have to be considered as a whole), which can be made up of single morphological type (*monomorphological motion style*) or various morphologies (*polymorphological motion style*).[83]

According to stability of internal motion of spectral texture Smalley further distinguishes four basic ***stable pitch-space settings***: ***canopied setting*** (related to high pitch area), ***rooted setting*** (related to the low pitch area; in more traditional sense it may be related with the fundamental tone from which the spectral motion grows), ***pitch-space frame*** (formed by both canopy and root together) and ***centred/pivoted setting*** (refers to the central point or pivot, around which musical events take place).

Structuring processes.[84]

According to Smalley's spectromorphology, ***gesture*** and ***texture*** represent two fundamental structuring strategies associated with multilevel focus and the experience of the temporal unfolding of structure. Gesture is *"concerned with action directed away from a previous goal or towards a new goal*"[85] – presses forward, while texture "*is concerned with internal behaviour patterning*"[86] – marks time. Gesture has to do with trajectory, is concerned with application of energy and its consequences and is linked to causality, while texture is contemplating, self-propagating and its energy is directed inwards. Gesture is carried by external shape, while texture is turned to internal activity. Where gesture encourages higher-level focus, texture encourages lower-level focus. The mechanisms whereby musical gesture and texture are linked to their sources may be explained by ***surrogacy***.[87] Smalley has introduced this term to describe the levels and degrees to which a listener perceptually relates to real or imagined physical and gestural sources within acousmatic listening situation.

Space.

Smalley recognizes five dimensions of **space**[88]: ***spectral space***, ***temporal space*** (time as space), ***resonance***, ***spatial articulation*** (in composition) and ***transference of***

[83] Ibid., p.77
[84] Ibid., p.80
[85] Ibid, p.82
[86] Ibid.
[87] Smalley 1997, p.112, Smalley 1986, p.82
[88] Smalley 1986, p.89-92

spatial articulation (into listening environments). The first three are common for all music, the next two are specific for electroacoustic music. Resonance represents an *inner space*, which is determinating the spectral morphologies and by manipulating these spaces we can create new morphologies. Spatial articulation represents an *outer space*, where sound structures interact with their acoustic environment – reverberation. Transference is related with listening process, when music is diffused - transferred via loudspeakers into acoustic space.

Descriptive terminology and concepts, introduced by Smalley, represent a structured framework for describtion and analysis of listening experience. They helped to eliminate the initial fears and insecurities of basing analysis on perception, and brought about a way to common level of communication in electroacoustic music ("to be able to communicate what is 'that' what we hear").

Spectromorphological approach enables the analysis of the electroacoustic work through the use of fundamental functions, such as description, segmentation and relationship building, helps us to describe what we hear, to differentiate between sound objects, materials or processes, and to be able to compare them and find relations between them. This method implies a segmentation of a piece of music into basic units of construction, and to the identification of different materials of which the piece is built, morphological models and processes, and provides a foundation for understanding structural relations and behaviours between these units and materials, as *"experienced in the temporal flux of the music"*.[89]

Spectromorphology presents a very useful perspective of finding contacts between structural description and structural function – we can project models described by morphology into structural functions, f.e. three temporal phases – onset-continuant-termination may be expanded into high level structural functions, grouped according to their common features and expectation patterns. As stated by Smalley,

> structural functions are concerned with expectation, during listening we attempt to predict the directionality implied in spectral change. We might ask ourselves, for example, where a gesture might be leading, whether the texture is going to continue behaving in the same way, whether

[89] Ibid.

change is likely to be concerned with gradual merging or sudden interuption, etc.[90]

Therefore, onsets may reflect different degrees of abruptness and function as downbeat, attack, emergence or departure. Continuants may be more independent (statement), look forward to the termination (transition, passage), or backwards to the onset (prolongation, maintenance). Terminations may vary in the feeling of completion and function as a weak termination without much purpose (dissapearance), or have a strong relaxing function (resolution, release) or express structural goals achieved (arrival, plan).

In accordance with Smalley, attribution of functions is a complex cognitive process, it is more intuitive - intuitive expectation of psychological time, incomplete - we may change our minds in a course of listening or in repeated listening and ambiguous - when a context may have different simultaneous functions.[91]

Spectromorphology is also flexible approach, its concepts and ideas can be applied in any level of the musical structure, depending of our focus of attention, for example three temporal phases may be applied to a note, object, gesture, texture or motion type or growth process, motion categories may refer to single sound objects or to large sections of a piece, as well as to gesture or the texture, etc. It has its important place not only in analysis of electroacoustic music dealing with the complex sound world but also in approaching some of the contemporary instrumental music, where score itself can't adequately represent the perceptual qualities of the music, as it is for example in case of stochastic music or spectral music.

One should be aware, that the application of the spectromorphological concepts and terms is limited by competences of each listener or analyst, the structure of each

[90] Smalley 1997

[91] We would like to add, that changes of our minds in attribution of functions in the course of listening to a piece of music is a natural process and it is related not only with spectromorphological thinking but with the general principles of perception. We don't know what will come later (although we may have some expectations), so we evaluate a "moment" or a sound event in a moment we hear it. For example, in a known Bregman's theory of auditory streaming and Gestalt psychology – principles of figure and the ground may have very ambiguous functions. We experience many musical works where we first attribute functions of a figure and the ground to sounds of heard part of a piece, later with introduction of a new sound, the previous functions ("roles" may change) and what was before a figure may become a ground, because the new introduced sound has much stronger "figural potential" then the previous one), so in comparison with the new figural sound, the previous figure and previous ground will both have the same function of the ground, etc.

one's perceptual-cognitive abilities and requires adoption of these terms to our language through long time practice.

1.4.2. Soundscape and sonic effect.

Complementing Schaeffer's approach at the end of 1960s R. Murray Schafer, Canadian composer and theorist, introduces another fundamental tool for sound analysis, the new concept of '**soundscape**' as a fundamental mode for description and analysis of urban sounds. His writings about the new soundscape drew attention to the importance of the acoustic environment in everyday life.[92]

> The term does not simply refer to a "sound environment", but to what is perceptible as an aesthetic unit in a sound milieu. Shapes can be analyzed because they seem to be integrated into a composition with very selective criteria… If we would use the linguistic analogy, the soundscape corresponds to the whole structure of a text, while the sound object corresponds to the first level of composition – words and syntagmas.[93]

The emphasis in a concept of soundscape (sonic environment) is on the way it is perceived and understood by the individual, or by a society. The term soundscape may refer not only to an actual natural environment but also to abstract artificial environment such as musical composition. Soundscape is dependent on the relationship between individual and environment; and discipline, which is studying this relationship, is called acoustic ecology. Creation, improvement and modeling of such environments are matters of soundscape design. Soundscape analysis is based on perceptual and cognitive attributes such as foreground, background, contour, rhythm, silence, density, space and volume.

In the past 20 years this approach have been followed by Jean-François Augoyard and his team in Cresson and resulted in development of another useful concept of the "**sonic effect**"[94], designed to analyze the experience of everyday sounds

[92] Schafer, R. Murray. 1968. *The New Soundscape*. Ontario: Arcana Editions. Schafer, R. Murray. 1977. *The Tuning of the World*. Toronto: McClelland&Stewart.
[93] Augoyard, Jean-François and Torgue, Henry eds. 2005. *Sonic Experience. A guide to Everyday Sounds*. Québec: McGill-Queen's University Press., p.7
[94] Ibid.

in the contexts of architectural and urban sources, and creation of a sonic guide *Sonic Experience*, which defines and analyses 82 of these effects. The work includes numerous descriptive terms, discusses the physical qualities of acoustic phenomena and focuses on the effects, which sounds have on the listener.

> Sonic Experience is an alphabetical sourcebook of eighty-two sonic effects. Spanning musicology, electro-acoustic composition, architecture, urban studies, communication, phenomenology, social theory, physics, and psychology, Sonic Experience integrates information about the physical spaces in which sounds occur with cultural contexts and individual auditory experience. These unique accounts of terms such as "echo", "anticipation", "vibrato" and "wha-wha" enrich our understanding of what it is to listen and the role sounds plays in relating us to our environment.[95]

Sonic experience classifies 16 *major sonic effects* and 66 *minor sonic effects,* which are divided in 5 categories:[96]

elementary effects – related with the sound material itself (pitch, intensity, timbre, attack, duration, release, shape of the signal) – mode of the propagation of the sound (f.e. filtration, distortion, resonance, reverberation);

composition effects – defined by specific characteristics describing either the synchronic or the diachronic dimension of the context and depend on spatio-temporal flow of the propagation (f.e. masking, release, cut out, drone, telephone);

effects linked to perceptive organization – mainly due to perceptive and mnemonic organization of individuals placed in a concrete situation and they are located through the expression or perception of listeners (f.e. erasure, synecdoche, remanence, anticipation, metamorphosis);

psychomotor effects – imply the existence of sound action of the listener or the scheme in which perception and motor function interact (f.e. chain, niche, attraction, phonotonie) and

semantic effects – use the difference in meaning between a given context and its emerging signification (f.e. delocalization, imitation).[97]

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[95] Ibid.
[96] Ibid.
[97] Ibid.

As the authors point out, sonic effect is paradigmatic, but should not be understood as a full concept in its strict sense. The survey of objects it refers to remains open. Sonic effect allows a general discourse about sounds, but cannot dispense with examples. It doesn't define things in a closed way, but gives some indication of their nature and status, characterizes the modal or instrumental dimensions of sound and provides a context and common sense for physical and human dimensions of sound.

1.5. Electroacoustic material.

The analytical approaches to electroacoustic music can consider the sound material of a musical piece either just as *pure sound* (and refer to it as a sound objects) or base their study on the knowledge of the *technological environment* used to generate the sound in the piece. As mentioned in the beginning of this chapter, electroacoustic music is a large heterogeneous musical world, where electroacoustic piece can be created by wide range of technological tools, and stored in various formats and forms. From this fact arises another problem for analysis – knowledge and consideration of all this **variety of stored formats** (recordings of an acoustic performance on analogue tape, DAT, CD, digital formats on hard disks, digital and operational data, composed patches, symbolic notations of the score, diffusion scores, documentation of composition process – compositional ideas, production of the sounds and structures, planning documents, explanatory notes, instructions for performances, etc.) and their **accessibility**. The accessibility of documentation especially in case of music using live electronics still remains problematic (complex production and set ups, problems of compatibility and software accessibility, problems of authors rights, etc.)

Some of these subjects have already been discussed in different electroacoustic conferences. Laura Zattra talked in EMS conference about the critical editing of computer music. In her opinion preservation, restoration and critical editing of music are becoming one of the main concerns in electroacoustic music. Although there are very different forms of preservation of computer music in comparison to the traditional western music,

> ... it can already happen that a CD is illegible, a program language is obsolete, computer data used to produce a piece twenty or thirty years ago are no more available.[98]

She suggests that some disciplines as philology of music should start to consider these problems and for critical edition of computer music she proposes a methodology divided into several stages: collections of information about the musical works, their history, etc.; complete recension of extant sources – written sources (musical scores and articles dedicated to the piece), audio sources, digital sources, mental texts and oral witnesses; accurate description of these sources (description of the articles, origin of the scores, information about condition of the tape, text from booklets to CDs, etc.); systematic collation (comparison of these sources collected during the second stage and the source criticism); restitution of the text (withe the aim to make critical investigation of the musical piece in its tradition, restoring its history, innovations and changes during its transmission and reception). The result of this final stage would be critical notes arisen from comparisons of different sources.[99]

In another article Laura Zattra talks about necessity of cooperation between musicologists, analysts and scientist to share their different competences and stresses the fundamental importance of future studies in their interdisciplinary character. She sets up various concepts an analyst should consider before starting any analytical process (preservation of musical heritage for permitting the re-synthesis or preservation of performance praxis; seeking for graphical scores to help listeners in comprehension of electroacoustic music, tracing automatic score to help musicologists in the examination of structural dimensions of the musical piece; determining automatic classification of electroacoustic music, etc.)[100]

Hannah Bosma presented her research about documentation and publication of electroacoustic compositions at NEAR (Electroacoustic Repertoirecenter in Netherlands), where she distinguished different forms of documentation from basic ones

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[98] Zattra, Laura. 2006. *The Critical Editing of Computer Music*. EMS: Electroacousic Music Studies Network, Beijing. http://www.ems-network.org/spip.php?article236 (accessed August 15, 2009)
[99] Ibid.
[100] Zattra, Laura. 2005. *Analysis and analyses of electroacoustic music*. In: Sound and Music Computing Proceedings, Salerno. http://www.smc-conference.net/smc05/papers/LauraZattra/LZanalysis.pdf (accessed August 15, 2009)

such as scores, recordings, copies of tape to extended documentation, such as computer data files, drawings, photographs and texts about the performances, etc.[101]

Discussion and talking about various subjects mentioned above might help analysts, musicologists and theoreticians to become more aware of problems electroacoustic music analysis involves. Then with this knowledge they will be able to choose the suitable and appropriate documentation material in approaching any piece of the repertoire of electroacoustic music in analysis. Obviously, electroacoustic music equipment, tools, with their potentials and limitations, influence the typology of sound, the compositional process, as well as listening. Analyst may consider these aspects in order to understand the compositional and perceptive problems of the work, even if he is not necessarily interested in the process of technical realization of the sound.

1.6. New disciplines in sound research.

Understanding of our motivations for hearing and listening and its mechanisms ("how" we hear and "what" we hear) is fundamental for the electroacoustic music research and creative practice and has been developed through the new disciplines, such as **psychoacoustics** and **psychocognition**. Technological and conceptual innovations allowed to explore how auditory information is encoded in the brain, how it is distributed and processed.

Psychoacoustics is essentially study of the perception of sound - how we listen, what are our psychological responses and what is the physiological impact of music and sound on the human nervous system – how the brain interprets the physical sounds. Some of the traditional psychoacoustic involve the perception of pitch, loudness, volume and timbre. The traditional research also focused mainly on the exploration of speech and the psychological effects of musicotherapy. Current concerns involve higher level concepts such as auditory percepts, streaming, and auditory scene analysis and also focus on the sound as a vibration. There is an important difference between

[101] Bosma, Hannah. 2005. *Documentation and publication of electroacoustic compositions at NEAR*. EMS: Electroacoustic Music Studies Network Montreal.
http://www.ems-network.org/spip.php?article172 (accessed August 15, 2009)

psychological and neurological perception. We should distinguish between memory-based psychological reaction which sounds associated with certain situation or emotional state from past induce, and the physiological - neurological response to sounds. The primary effect of sounds is neurological – the sounds trigger active listening response and tonify the auditory mechanisms, including the muscles in the middle ear. This results in more accurate perceiving of sounds and improvement of speech and communication. Recently, some results of these disciplines show an importance also in the analysis and new perspectives to approach the electroacoustic music.[102]

Christopher Biggs in his research Timbre Identification and the Perceptual Reconciliation of Live Instruments and Electronics[103] suggest a model for the interaction of research in psychoacoustics and musical experimentation in the area of mixed music.

> The mixture of instrumental and electronic performance forces provides an intriguing musical landscape for the incorporation of compositional techniques derived from psychoacoustic information and the development of research questions inspired by musical phenomena. Most significantly, these performing forces create a patently syncretic situation – a contradictory perceptual environment: the listener must process and somehow reconcile or meaningfully disassociate the instrumental sounds and the electronic sounds that have been superimposed.[104]

He departs from evidences which suggest that *"neuronal activity in the primary auditory cortex represents sounds in terms of auditory objects rather than in terms of invariant acoustic features"* and from definition of timbre-identification as *"the perceptual relation of auditory-objects*[105] *independent of the mechanism of sound*

[102] for further information about psychoacoustic and auditory neuroscience see:
Peretz, Isabelle and Zattore, Robert J. 2005. "Brain Organization for Music Processing." *Annual Review of Psychology 56*: 89-114. http://www.brams.umontreal.ca/plab/downloads/PeretzZatorre2005.pdf (accessed June 20, 2009); Hirsh, Ira J. and Watson, Charles S. 1996. "Auditory Psychophysics and Perception." *Annual Review of Psychology 47*: 461-484.
Webpages: http://www.sfu.ca/sonic-studio/handbook/Psychoacoustics.html
http://www.incrediblehorizons.com/psychoacoustics.html

[103] Biggs, Christopher. 2007. "Timbre Identification and the Perceptual Reconciliation of Live Instruments and Electronics." Doctoral dissertation. Kansas City: University of Missouri and Kansas City.

[104] Ibid., p.3

[105] Auditory object, the fundamental element of auditory world, might be defined as an *"acoustic experience that produces a two-dimensional image with frequency and time dimensions."* Griffith, Timothy D. and Warren, Jason D. 2004. "What is an auditory object? *Nature Reviews/Neuroscience 5*, p.891.

production, apparent agency, or perceived sound source"[106] to recognition of three ways how electronic sounds can timbre-identify with live instruments:

timbre-reproduction (reproduction of the live instrument in the electronics with limited manipulation),

timbre-integration (reproduction of the live instrument in the electronics with extended manipulation; this can result in sounds that are not timbre-identified but the consistent use of sounds derived only from instrument tends to create a sense of reconciliation based on timbre-identification) and

timbre-association (the use of distinct timbres in the electronics that are associated with the live instruments; this would happen in situation when a subset of the information abstracted in the brain about the distinct auditory-objects is the same or related).[107] He documents his statements and suggestions by various examples from mixed electroacoustic works.

Most recent developments of technologies, particularly neurotechnology, may bring important innovations and results in nowadays analysis. Sound reaching the eardrum induces a complex cascade of mechanical, chemical, and neural events in the auditory pathway and results in a percept. Auditory cognitive neuroscience studies how this is happening. Musical sounds and all other sounds share most of the processing stages throughout the auditory neuraxis, but evidence points to a degree of functional segregation in the processing of music.

Eduardo Miranda proposes the possibility of devising tools for the analysis of electroacoustic music based on neurophysiologic models of our auditory system.[108] These tools would reveal representations that our brain produces at various stages of the auditory pathway, from cochlea to the cortex (cochlea, oliva, thalamus, auditory cortex). He envisages that cochlearnucleigram could provide precise onset information and trace the behaviour of the sounds in horizontal and vertical planes; olivogram would give further information about sound localization through the use of timing information (focus on low frequency sounds) and through the intensity information (focus on high frequency sounds); thalamogram would provide salient sound attributes that would be

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[106] Biggs 2007
[107] Ibid.
[108] Miranda, Eduardo Reck. 2007. *A Neurotechnology Approach to the Analysis of Electroacoustic Music: A proposition*. EMS:Electroacoustic Music Studies Network, Montfort/Leicester. http://cmr.soc.plymouth.ac.uk/publications/ahrc_ict_paper.pdf (accessed June 20, 2009)

deemed more important than others in function of specific contexts or conditions and would reveal the impact of different sensorial modalities on the auditory signal; and auditory corticogram would allow combination of different levels of attention to various sound features and building representations. Finally, the talamocortical control panel would allow us simulate and predict the kinds of representations that would emerge by forging different ontologies and cortical plasticities. Then it may be possible to equip the analysis system with different listening strategies based on exposure to different sound worlds.

1.7. Sound obsession.

At this point, it is important to add, that the new attempts in music and musical research haven't happened just incidentally, but they went hand-to hand with another important changes observed in everyday life. In the second half of 20th century some authors started to point out the fact that the "aural" had been displacing the "visual" as a result of new communication technologies. Marshall McLuhan, a theorist of late 20th century media, in the late 1970s argues:

> ... visual space structure is an artifact of Western civilization created by Greek phonetic literacy. It is a space perceived by the eyes when separated or abstracted from all other senses. As a construct of the mind, it is continuous, which is to say that it is infinite, divisible, extensible, and featureless – what the early Greek geometers referred to as 'physis'. It is also connected (abstract figures with fixed boundaries, linked logically and sequentially but having no visible grounds), homogeneous (uniform everywhere), and static (qualitatively unchangeable). It is like the 'mind's eye' or visual imagination which dominates the thinking of literate Western people, some of whom demand ocular proof for existence itself. Acoustic space structure is the natural space of nature-in-the-raw inhabited by non-literate people. It is like the 'mind's ear' or acoustic imagination that dominates the thinking of pre-literate and post-literate humans alike (rock video has as much acoustic power as a Watusi mating dance). It is both discontinuous and nonhomogeneous. Its resonant and interpenetrating processes are simultaneously related with centres everywhere and boundaries nowhere. Like music, as communications engineer Barrington Nevitt puts it, acoustic space requires neither proof nor explanation but is made manifest through its

> cultural content. Acoustic and visual space structures may be seen as incommensurable, like history and eternity, yet, at the same time, as complementary, like art and science or bioculturalism.[109]

The fascination by sound and obsession for sound research after 1950 was based in two main developments – the world was becoming more urban and noisy and the development of new recording technologies and sound analysis technologies made it easier to "catch and store" the sound, listen to it repeatedly and analyze its components. The development of new machines designed to record, synthesize, manipulate, amplify, analyze and control the sound also allowed the creation of yet unheard sounds and opened the new world of possibilities, hardly imaginable before. The aural phenomena due to these technological expansions gained an important role; sound itself became a focus not only in music, but also in everyday life and various non-musical scientific disciplines.

> The soundscape of the world is changing. Modern man is beginning to inhabit a world with an acoustical environment radically different from any he has hitherto known. These new sounds, which differ in quality and intensity from those of the past, have already alerted researchers to the dangers of the imperialistic spread of more and larger sounds into every corner of man's life. In various parts of the world important research is being undertaken in many independent areas of sonic studies: acoustics, psychoacoustics, otology, audiology, noise abatement practices and procedures, communications and sound recording engineering (electroacoustics and electronic music), aural pattern perception and the structural analysis of speech and music. These researches are related; each is dealing with aspects of the world soundscape, the vast musical composition which is unfolding around us ceaselessly.[110]

All these important changes were reflected in musical research and started inevitable revolutions in the field of music composition, performance and perception. It is interesting to realize how all this is interconnected with the main aspects and problems discussed in previous subchapters:

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[109] McLuhan, Marshall. 1979. "Visual and Acoustic Space." In: Cox, Christoph and Warner, Daniel eds. 2004. *Audio Culture. Readings in Modern Music*. New York: The Continuum International Publishing Group Inc. p.71

[110] Schafer, R. Murray. 1971. "The music of the Environment." In: Cox, Christoph and Warner, Daniel eds. 2004. *Audio Culture. Readings in Modern Music*. New York: The Continuum International Publishing Group Inc. p.29

With the appearance and fast evolution of technologies incorporated in the creative process in music arose a new problem that particularly affected the listener. Throughout centuries the technical evolution of musical instruments has been relatively small in comparison with large number of musical works produced and listener has been adapting his perceptual mechanisms to "process" the information included in music through listening to different musical pieces, though using the same sound source (musical instruments). Musical instrument then represented the main means to obtain musical knowledge. Moreover, traditionally music has been realized only through performance and listener could relate sounds to the visually observed causes (physical gestures of performers).

However, in second half of last century this situation changed drastically and the evolution of instruments used for sound production (computers, synthesizers, etc.) has been enormously fast in relation to the music produced. The wide range of new sounds, which have never been heard before and impossibility to relate them either with known sources or causes may have contributed to certain psychological instability for the listener during listening to music produced by new technological means. He can't anymore rely on the same ways of perception he was used to by recognizing real instruments and visually or aurally identifiable causal actions to produce the sound (recognition of sound sources and causes) and has to develop new mechanism and strategies for perception and understanding this "new sound world" in music.

In the novel context of this modern world some composers, as it was in case of concrete, electroacoustic and spectral music, started the search for original ways of expression by using new sound material, elaborate and organize sounds, or compose their original sounds that have never been heard before. Their attention was concerned with *"renewal of the musical vocabulary"*[111], as the opposition to the attempts of dodecaphony and serialism, establishing "*new musical grammars, without changing the vocabulary*"[112], since these were still using the same sound material produced by traditional musical instruments, and were based on parametric relations, such as pitch,

[111] Risset, Jean-Claude. 2004. "The Liberation of Sound, Art-Science and the Digital Domain: Contacts With Edgard Varèse." *Contemporary Music Review* 23(2). Routledge. p.31
[112] Ibid.

duration, intensity and timbre and believe that the parameters were keeping their characteristics regardless of the ways how they were combined.

The search of new compositional concepts and alternatives in complex electroacoustic music and contemporary music in general, no more related with assumption of parametric independence from the relations among themselves, but concerned with the perceptual processes and complexity of listening, brought up the importance of other strategies in structuring musical material, such as gesture and texture. These new organizational strategies represent the main interest not only in electroacoustic and contemporary instrumental composition but also possible perspectives for current analysis.

Recent years many theoretical writings are dedicated to these two phenomena. Denis Smalley in his spectromorphological theory presents gesture and texture as two fundamental strategies in structuring processes of music. Edson Zampronha considers gesture one of the alternatives for contemporary music composition, because of its situation on the edge between sound materiality and signification. He understands gesture as a natural ground to justify compositional options, when composer through the gestures may introduce significations into the composition and the deconstruction of stereotyped symbolic gestures may bring them closer to the materiality. Thus according to Zampronha:

> Gesture turns out to be an efficient resource through which it is possible to transform what is non-musical into musical inside a work. A work based on this transformation generates a complex plot resulting from the many re-significations it generates in listening, which makes room to a rich dialogue between the work and other works. It becomes then a way by means of which composers can focus listening in this plot that is one of the main important topics for the construction of contemporary musical thought nowadays.[113]

Some authors deal with problem of texture and distinction of diverse textures and the ways we perceive them in music in general (Bregman, Minsburg, Kokoras)[114] or

[113] Zampronha, Edson. 2005. "Gesture In Contemporary Music – On The Edge Between Sound Materiality And Signification." *Transcultural Music Review 9*. http://www.sibetrans.com/trans/trans9/zanpronha.htm (accessed September 5, 2008).

[114] Bregman, Albert S. 1994. *Auditory Scene Analysis: the Perceptual Organization of Sound* (new edition). Cambridge: MIT Press; Minsburg, Raúl. *Percepción de la simultaneidad sonora en música*

how the interaction in mixed electroacoustic music may be created through textural similarities and differences (Menezes)[115].

The main approaches to gesture, which were the theoretical basis for this research will be presented in chapter III.

electroacústica. Unpublished author's writing; Panayiotis A. Kokoras, "Towards a Holophonic Musical Texture". *JMM: The Journal of Music and Meaning* 4, Winter 2007, sec.5.1.1. http://www.musicandmeaning.net/issues/showArticle.php?artID=4.5

[115] The concept of Menezes will be presented in next chapter 2.

Chapter II. INTERACTION IN MUSIC FOR INSTRUMENTS AND ELECTROACOUSTIC SOUNDS.

When composing, the normal course of action is to imagine a sound, sometimes check or adjust it at a piano, then write it down: notate it. Is there any essential difference between such traditional ways of working and the composing of computer synthesized music? At the terminal a sound is also imagined, tried out, adjusted and then saved in program language notation: a very similar procedure.

Jonathan Harvey

2.1. Music for instruments and electroacoustic sounds.

In the evolution of electroacoustic music the dialogue between acoustic instruments and electroacoustic sounds has become an important area of creation that many composers have explored. Music which combines instruments with electroacoustic sounds ("mixed music") attracted and engaged composers almost since the birth of electroacoustic music itself.

Varèse's *Déserts* (1950-54) and Maderna's *Musica su due dimensioni* (1958) are some of the first examples, where instrumental sounds are combined with prerecorded sounds on the analogue tape and represent the first solutions how the two worlds – instrumental and electroacoustic can be combined.

Déserts is written for 15 instruments, percussions and two-channel tape and consist of four instrumental episodes and three tape interludes. In this piece, 'instrumental' and 'electroacoustic' don't sound simultaneously and there is no direct interaction between instrumental and electroacoustic, since the instrumental sections and the tape sections are juxtaposed.

In *Musica su due dimensioni* for flute and tape, the instrumental sounds are in dialogue with the sounds recorded on a tape and the coordination of both elements is done by a technician.

Stockhausen's *Mixtur* (1964) for orchestra (5 orchestral groups – percussion, woodwind, brass, strings – pizzicato and arco subgroup, sine-wave oscillators and ring modulators) and *Mantra* (1970), which uses two ring modulated pianos, set of crotales, wood block and short-wave radio producing morse code, may be considered the first pieces using 'live-electronics'. In these pieces the instrumental sounds enter through microphone inside the amplifier, then they are compressed, filtered and ring modulated and the modulated sounds are played through loudspeakers. Different transformations of the instrumental sounds lead to creation of sounds with new characteristics.

The mentioned works represent first experiments and innovative solutions in the field of mixed music and present its two main approaches: works for instruments and tape, where interpolation of electronic and acoustic-instrumental sound is the musical goal or works where acoustic sounds are modified and transformed in real time.

Nevertheless, some isolated examples of use of non-instrumental and instrumental sounds in one piece appeared even before the first experiments of Pierre Schaeffer's concrete music in late 1950th. For example, John Cage's piece *Imaginary landscapes No. 1* (1939) scored for piano and cymbal uses as non-instrumental source 2 variable speed phonographs.

Since the beginning of electroacoustic music, a large amount of mixed electroacoustic works has been created. With the appearance of digital technologies the analogue tape has been replaced by recording of electroacoustic sounds on the CD and different computer software enabled not only very complex performer-computer interactions during live-performances but also advanced elaboration of sounds (manipulation and transformation of original recorded instrumental sounds, creation of new synthetic sounds, etc.) in the studio conditions. Nowadays musical performances have often a "hybrid" character, in a sense that the electroacoustic part is constituted from both – sounds pre-elaborated in the studio as well as sounds processed in real time. During performances computer can process live instrumental sounds and change their sonic qualities with more simple procedures, such as reverberation, or more complex ones, like use of MAX/MSP patches to process incoming instrumental sounds in different ways, for example by manipulating their pitch or spectrum, etc.

Incorporating sensors on the instrument or performer's body may transfer instrumental and physical gestures into new sounds and sonic gestures. In recent mixed works, performer is given certain freedom to make decisions and choose from several possible actions and so influence and change the course of the performance, many performances have very strong character of improvisation.

Although composers have built connections between the instrumental and the electroacoustic world in many ways, analytically these have far not been explored in the same extent.

In case of mixed electroacoustic music, we have to consider some specific problems. It is often related with multiple perspectives by bringing together two musical worlds with different characteristics, the instrumental and the electroacoustic. One of the special tasks for the listener, analyst or composer, is how it combines these two worlds, each based on different fundamental units, principles and ways of hearing – the instrumental based on the note (score), and the electroacoustic on sound objects (listening strategy).

Another problem, which comes out in case of music that combines instruments with electroacoustics is concerned with source recognition. With instrumental music we are mostly[116] dealing with sounds of which we are able to recognize the source. From the conventional praxis we are used to identify instrumental sounds and reduce instrumental sounds to notes, as basic carriers of information. In analysis of a mixed piece, it is impossible to reduce the electroacoustic element to "notes" and to see better the "units" from which it is constructed; it is beneficial to apply Schaeffer's reduced listening. In certain stage we will need to apply this strategy also on the instrumental element – to move our attention away from recognition of the source of the instrumental sound and how it was produced towards the consideration of the sound structure and shape, to see the sound of the piece 'morphologically'. The basic cells of information will be no more notes but morphologic units of the sound. In the terms of morphology it

[116] but not always. In previous chapter we presented the special situation even in instrumental music, when without visual support (score or the performer playing) we might not be able to clearly identify the source of the sound – the instrument. This is the case of extended playing techniques.

will be then much easier to describe and understand the relations between sounds of different nature.

In summary, we can say that to approach and explore electroacoustic music and particularly mixed electroacoustic piece, a multidimensional (multilevel) analytical perspective is desired. The goal of this approach is to reflect all the complexity of our experience of a musical work and to bring it into the process of analysis. The collaboration of several concepts and perspectives together with flexible utilization of various listening strategies and "cross-application" of the viewpoints from one area to the other (to see electroacoustic part form instrumental point of view – for example recognition of pitch, rhythmic or timbral organization and the instrumental part from perspective of electroacoustic music – for example recognition of morphological units and their special characteristics) helps approaching different aspects of a work and developing an understanding of an electroacoustic piece by giving most complete information about it.

2.2. Interaction between instruments and electroacoustic sounds.

Interaction, generally, is a feature common for many art forms and we might even consider it a characteristic attribute almost of any sphere of the life itself. It may exist at a wide range of levels, from the more-or-less unnoticeable to a fully present and recognized. Online encyclopedias, such as Wikipedia and Merriam-Webster dictionary, define interaction as

> ... mutual or reciprocal action or influence that occurs when two or more objects have an effect upon one another.[117]

The idea of a two-way effect is essential in the concept of interaction.

The phenomenon of interaction between instrumental and electroacoustic sounds became a fundamental point of interest of contemporary music. Rich potential of instrumental music together with endless world of electroacoustic sounds offers to

[117] Wikipedia - http://en.wikipedia.org/wiki/Interaction
Merriam-Webster Dictionary online - http://www.merriam-webster.com/dictionary/interaction

composers abundant structural and expressive possibilities, opportunities which are too good to resist.

If we take two different worlds, one instrumental and the other electroacoustic, we can imagine that there are situations when these worlds are completely separated, they exist as two individual entities. However, this situation in realms of music is more hypothetical, it is hard to imagine any two or more musical events being "completely separated" – without any relation. Smalley supports this fact by stating:

> True independence is not a musical reality. It is rare if not impossible for simultaneously existing events to be unrelated, simply because placing them together in a musical context confers connection upon them. That connection is forged from one of three directions: interaction (relative equality), reaction (relative inequality) and interpolation (most close to independence).[118]

On the other side, there are moments when both of these worlds build one, where one entity cannot exist without the other. Interaction is the moment when these two worlds start to communicate and relate with each other. We can imagine that there are different levels of interaction that can go from the little or almost no identification – *dissociation* to more or less complete identification – *fusion* of the two worlds. To analyze the different forms these two worlds combine and interact will be the main purpose of this research.

In physics interaction is understood as

> transfer of energy between elementary particles or between an elementary particle and a field or between fields, mediated by gauge bosons.[119]

Understanding interaction as a "transfer of energy" is one of the approaches to the interaction and will be explained later on relations between gestures.[120]

One of the main problems approaching the mixed music from a compositional view may be seen in a *very narrow understanding of interaction*. Often it is understood only as one of its extremes – as pure fusion of the two worlds and disregards all the

[118] Smalley 1986, p.88
[119] Princeton University: WordNet – lexical database of English online, http://wordnet.princeton.edu
[120] chapters 3.5. and 4.4.2.

other actions in between on the way to the other pole; or as in the case of "live electronics" interaction is understood *"too literally"*, considering the "real interaction" only the one created in "live-ambience" – live-transformations of the instrumental sounds, and condemning the pieces for instruments and prerecorded sounds (tape) as "non-interactive", which from the listening perspective is not correct either. Both of these approaches to interaction between instruments and electronic sounds have their advantages and disadvantages.

The use of prerecorded electroacoustic sounds, worked in the studio and composed together with the instrumental material during the composition process, opens a wide cosmos of sounds more or less close or distant from each other and enables that electroacoustic sounds may relate so much in concurrent as much non-concurrent ways in comparison to the instrumental sound, since they are not directly dependent of instrumental sources – composer may use as much manipulation of instrumental sound source, as any other concrete or synthetic sound sources. Working in studio conditions provides for composer very effective possibilities for spectral, structural and formal elaboration of sounds and their relationships. The repeated listening offers possibility of corrections and improvements of results. By working simultaneously on the instrumental and electroacoustic material with mentioned "aural checking", composer fully controls the sound interactions and decides in which moments which direction is desired, as none of the sound material, neither instrumental nor electroacoustic, is directly dependent of one another.

However, from the performer's point of view, there is little freedom, as in most cases he has to follow strict temporal axis, to be synchronized with the "tape part". Performances using electroacoustic sounds on fixed media ("tape", CD) may seem to be less "adventurous" or even a bit "sterile" in comparison with "action", brought in some of the performances using live electronics.

Real-time computer controlled transformations are providing interesting and tight direct correlations between instrumental sounds and their electroacoustic transformation. In past they may have offered limited sonic possibilities, as the electroacoustic sound structures were dependent exclusively on instrumental sound and the results of such "live-time" operations were functioning only in a dependency on instrumental sounds – the instrumental sound produced by a performer was transformed in real time into electroacoustic sound by different manipulations assisted by the computer (concurrent way of interaction). With developments of technology, software and compositional tools as for example Max/Msp, Pure Data or jMax, it is possible to integrate during the performance also another procedures, like real-time sound synthesis or possibility to control the reproduction of pre-recorded sounds and enlarge the performance possibilities.

> Recent technological developments allow us to define in real time practically all the aspects of sonic discourse, making possible an interactive relationship between instrumental and electroacoustic sound where both may change in time as a result of a two-sided stimulus-response relation that not only allows but in fact requires freeing of diachronic axis. This concept of interaction, which we may call co-action, is much more flexible as it allows both participants to question and answer each other in different ways during the work.[121]

As these advanced technologies can operate upon almost any form of data, that can be input into the computer, and facilitate interaction with other media, like image or dance, they represent also ideal solution for cross-media work.

However, dependency on technologies may often bring uncomfortable concert situations, in case of their failures, or too much freedom of performance may bring unsatisfying results for composer - when the sonic result is "just not what he expected" or the sounds resulted from the real time operations might bring not very rewarding aural experience for the listener. As Daniel Schachter truly says:

> Technology should not become itself and end, but a key to expand the expressiveness of musical language.[122]

It is a pity, that in musical praxis in electroacoustic music we often witness the opposite situations. Unfortunately, sometimes we can observe theoretical superficiality and lack of compositional technique hidden behind new technological inventions and solutions, attempts of originality (which then end up to be just an "empty originality without a soul") or theatrical technological demonstrations on stage 'live-electronics'

[121] Daniel Schachter. 2007. "Towards New Models for the Construction of Interactive Electroacoustic Music Discourse." *Organised Sound 12*(1), p.71
[122] Ibid., p.68

performances. We have many experiences from concerts and festivals when all these problems are often present – experiences of works where theoretical and compositional consistence is substituted by innovative or pseudo-innovative aspects and tendencies and technological means turn to play more important role than the compositional evolution of the work. In fact, we can see many times in proper program notes of composers that they describe technological procedures and algorithms used in very detail, but the "musical" stays "somewhere suspended". Furthermore, always more often applied technological listening – listening with the goal of gaining information about the technological aspects rather than the music itself, may divorce composers and musicians from any poetic and esthetic aspects of the piece or from the true musical meaning.

João Pedro Oliveira refers to some of these problems in his article Problems of technology: Fetishism, Seduction and Crisis of Identity.[123] He sees incapacity of composer to take decisions in the creative process of structuring and organization of sound material in electroacoustic composition and "seduction" by solutions offered by technological means as one of the main problems that turn focus from creativity to just "*skillful manipulation of tools*". In his important considerations *technological fetish* and *seduction by technological solution* represent major traps that if not being aware of them, may easily lead to loss of composer's identity.

> We believe that only in the moment, when we become aware of the advantages and especially the traps that these technological means bring in themselves, and we manage to overcome them, we have the way to create a personal language, free and with proper identity.[124]

Now, going back to the essence of interaction, importance of perception should overpass the technology and in the moment of listening to the musical work, it should not matter what type of technological equipment or approaches to interaction have been

[123] Oliveira, João Pedro. 2010. *Os problemas da Tecnologia: Fetichismo, Sedução e Crise de Identidade.* Unpublished author's article.

[124] Ibid. *"Pensamos que somente no momento em que tomamos consciência das vantagens e especialmente das armadilhas que estes meios comportam em si, e as conseguimos superar, teremos o caminho para criar uma linguagem pessoal, livre e com identidade própria."*

used, the listener will sense the interaction on its different levels through the structural and morphological relationships, unrestrictedly from the technological means.[125]

Flo Menezes supports this, when he recognizes two crucial aspects of the problem when approaching mixed music:

> Effectiveness of interaction won't ever depend on the fact that electroacoustic sounds are fixed or not on some technological medium with their predeterminated duration, but rather on the elaboration of such an interaction in the actual composition, in agreement with its morphologic possibilities.[126]

He takes the problem further and touches also the problem of 'time', when arguments that 'fixed time' (how is sometimes called the music using tape) will never be understood as 'rigid':

> The listener will perceive much less the existence of time the better the composition is organized; the more elaborated and complex is thus the music.[127]

From this Menezes' perspective, it is clear that it is not the physical support, which is the determinating factor of rigidity or absence of rigidity of musical time, but the form, how composer organizes his structural and expressive elements. And in our opinion this should be the main concern not only in electroacoustic or mixed music but in any music, regardless of the genre.

As we can imagine, interaction in mixed music may function on many levels and not only the direct and most evident influences and relations between the two diverse means (instrumental and electroacoustic) demonstrate its existence, but the indirect and more hidden ones, as well. The relations or connections between musical events or materials of different nature in a piece may range from closer, almost identificating relationships to distant contrasting connections.

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[125] Although, in our opinion, skilled listener may eventually recognize also this technological aspect, for example the similar sonic features of pieces created in Max/MSP due to circulation of the "patches" between composers, etc.
[126] Menezes, Flo. 2002. "For Morphology of Interaction." *Organised Sound* 7(3), p.306
[127] Ibid.

According to Smalley these situations may be created in three ways,[128] concerned with:

relative equality – *interaction*, as cooperation between events or materials represented by confluence or reciprocity;

relative inequality – *reaction,* as causal or competitive relationships between events, involving different degrees of active-passive role-playing; and

relative independence – *interpolation*, interruption or sudden change.

Similarly to Smalley's extreme poles of equality and interpolation, Menezes in his esthetic theory of electroacoustic composition, suggests *fusion* and *contrast*[129]*,* as fundamental principles in the interaction between instrumental writing and electroacoustic resources. He arguments by stating that:

> It is through the old principle of binary opposition, according to which the determinated element is only valued if confronted with its opponent.[130]

For classification of different situations on the way from pure fusion to pure contrast he introduces the term ***morphology of interaction***.[131]

As Menezes suggests, to reach the fusion between the instrumental and electroacoustic writing, it is necessary to have located transfers of spectral characteristics – *spectral transfers*[132] from one sound sphere to the other. The unification-fusion is made by *'absolute similarity'*[133] (for example, instrumental sounds serve for creation and elaboration of electroacoustic sounds in studio, structural transfers can be attained also through colouration (timbre) of the spectra, such as identity related to frequency, space routes, behaviour of melodic and mass profiles, gesture-like constitution of sounds, etc.). For Menezes, it is possible to reach the full range of situations on the way from fusion to the contrast even without a spectral

[128] Smalley 1986, p.88-89
[129] Menezes 2002
[130] Menezes, Flo. 2001. Por uma Morphologia da Interação. Unpublished earlier version on the subject of morphology of interaction. p.5
[131] Menezes 2002, p.311
[132] Ibid.
[133] Ibid.

transfer, and that's by *relative distinction*[134], when all transition possibilities between instrumental and electroacoustic are achieved through numerous transformation procedures and operations of the original instrumental sound material. The use of other than instrumental sound sources may also facilitate the transition from the fused to the contrasted and vice versa. If fusion is made by absolute similarity, then contrast will be anchored in the difference – '*absolute distinction'*[135]. This might be reached in case one of them, the instrumental or the electroacoustic assume the role of the silence (instrumental or electroacoustic solo) or obtain temporary autonomy, even excluding any "momental" relationship to the other sound world. The summary scheme of Menezes' morphology of interaction is presented in Figure 19.

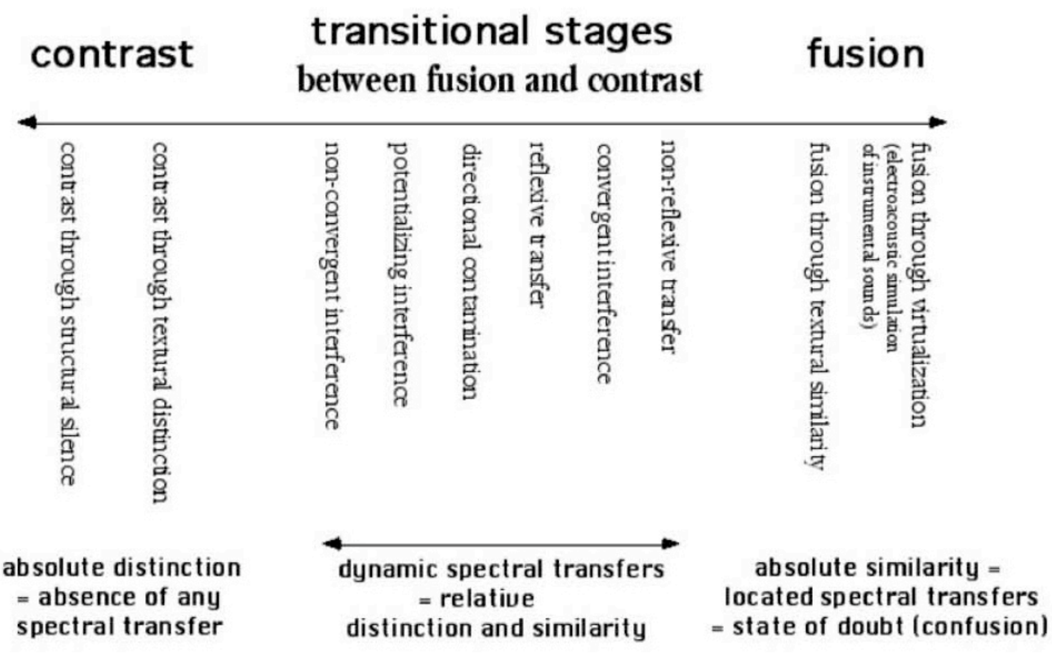

Figure 19. Morphology of interaction, by Flo Menezes[136]

[134] Ibid.
[135] Ibid.
[136] Ibid.

Menezes links fusion with another interesting phenomenon, which is *condition of doubt*[137] that in certain measure brings the confusion for the listener:

> ... listener relapses in constant doubts concerning the nature of what he/she is listening to: if it is coming from the acoustic instrument or from the electroacoustic diffusion, if the instrumental writing is dynamically operated through spatial, harmonic, timbric and temporal interference or if the listening is being, in face of pre-elaborated structures in the studio, derived from the employed acoustic instruments or at least correlated to these sources.[138]

Amount of experienced confusion then will be a kind of measurement of effectiveness of interaction and integration of two distinctive materials (one instrumental and other electroacoustic) in the mixed work.

Menezes' morphology of interaction focuses on the fusion/contrast relations in simultaneity – textural similarity or distinction and transitional stages represented by spectral transfers. But in our opinion, fusion and contrast in a mixed electroacoustic work may be perceived also as time passes, and may be demonstrated on the examples of gesture relationships. For example two gestures may be similar or different even separated in time. In these contexts we may create models of interaction between gestures according to their organization over time – subtle or more complex counterpoints, or in relation to other than spectral characteristics, such as rhythm, loudness or more semantic characteristics, such as direction or energy. Two gestures may closely relate or blend ("fusion") because of their similar rhythmical structure, while having very different spectral characteristics, increasing energy of one gesture may potentiate the onset of another one, two gestures may relate with each other also through the direction in space, such as convergent and divergent ways of interaction, etc.

At this point it becomes interesting to mention another concept, which relates with some of our considerations, although being initially thought for pure electroacoustic music and it is Trevor Wishart's concept of gestural ordering. His concept is based on organization of gestures according to horizontal and vertical criteria

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[137] Ibid.
[138] Ibid., p.309

that involves first identification of gesture character (similar/dissimilar) as time progresses (horizontal comparison) and then recognition of relationships between gestures in different parts or blocks of time (vertical comparison). As a result of this process, Wishart distinguishes **six archetypes of gesture relationships**,[139] (Figure 20) according to their vertical ordering, considering the gestures in various parts over short period of time, which may appear similar to each other (homogeneous) or different for one another (heterogeneous), independently of whether they are homogeneous or heterogeneous in an individual part, or if they appear to interact or behave independently. Similar gestures in all parts may create *parallelisms*, *semi-parallelisms* or appear *independent* (*homogeneous independence)* while gestures, which are different may have *triggering*, *interactive* or *independent* (*heterogeneous independence)* relationships.[140]

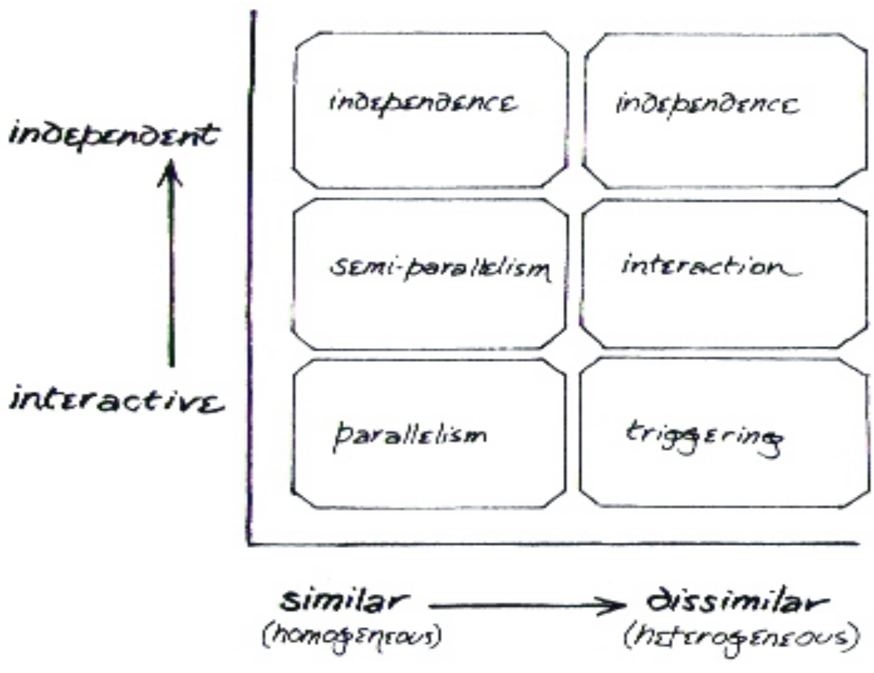

Figure 20. Six archetypes for vertical ordering of gesture, by Trevor Wishart[141]

[139] Wishart, Trevor. 1996. *On Sonic Art* (new revised edition, Emmerson, Simon, ed.). New York: Routledge. p. 120-122
[140] Ibid., p.121
[141] Ibid., p.122

Now we can easily stand for, that effectiveness of musical interaction lies entirely in composer's work – his personal perspectives, abilities, skills and knowledge of the wide range of possibilities how to connect distinct materials and make transitions between them – how to work with all these "essences" to create an original aurally rewarding mixed electroacoustic work.

2.3. Interactivity.

At this point, it should be noted that in connection with electroacoustic music, and particularly electroacoustic music involving instruments and electronics, there is another term used frequently – **interactivity**. We should make distinction between interaction and interactivity.

Interactivity is defined as an

> ... extent to which something is interactive; the extent to which a computer program and human being may have a dialog.[142]

In music interactivity refers to

> ... human-computer musical interaction, or human-human musical interaction that is mediated through a computer, or possibly a series of networked computers that are also interacting with each other.[143]

From this point of view, music for instruments and tape would not be an interactive music, even when aurally perceived musical interaction is present without any doubt.

Interactive musical performance often involves programming software that is responding to pre-determined aspects of a 'live performance' and is determining other musical aspects by generating synthesized sound or modifying in some way the live instrumental sound. The computer may behave on a highly determined way or indeterminate, as defined by the musicians. Level of determination and exact musical

[142] ElectroAcoustic Resource Site 2002
[143] Ibid.

role of the computer may be modified from performance to performance or even in a course of a single performance. Interactive music often stands in the edge between compositional and improvisational activities. Interactivity is often connected with the temptation to push further the limits of what is technically possible. To avoid failures (which so often happen during interactive 'live' performances) and to lead to a successful performance, accessibility and reliability should be the essential aspects always considered in creation of an interactive work.

Chapter III. TOWARDS THE UNDERSTANDING OF MUSICAL GESTURE.

They seemed strange only because we couldn't actually see them
And we realized this only at a point where they lapse
Like a wave breaking on a rock, giving up
Its shape in a gesture that expresses that shape.

(John Ashbery, Self-portrait in a convex mirror)[144]

Gestures play important role in our lives – we make gestures, respond to gestures, read and interpret gestures - we live in a gestural world. The word gesture is derived from the Latin words *gestura* (bearing, carriage, mode of action) and *gerere* (the infinite form of to carry, to behave, to take charge of, to behave, to take on oneself, to perform or to accomplish).[145] The use of gestures allows individuals to express variety of feelings and thoughts, people also use gesture as a form of non-verbal communication instead or in combination with verbal communication (gesticulation coordinated with speech), they can be used also as a replacement of words (f.e. nodding the head in agreement or as a visual "sign language", incorporated in the deaf people's communication). It is believed that gesture is the oldest form of language and it developed simultaneously with speech or even before (for example studies of primates, such as chimpanzees, indicate a complex use of gesture for communication)[146].

Gestures have been calling attention of scientists and researchers and were studied throughout the centuries from different points of views in communication and speech. Already in the first century, Roman rhetorician Marcus Fabius Quintilianus in his work about rhetorics – Institutio Oratio, writes about gestures:

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[144] http://www.poemhunter.com/poem/self-portrait-in-a-convex-mirror/
[145] http://www.wordswarm.net/dictionary/Gesture.html
[146] some research points out to the evolution of the spoken language in humans from the non-verbal communications seen in primates. See Lieberman, Philip.1991. *The Evolution of Speech, Thought and Selfless Behavior*. Cambridge: Harward Univeristy Press.

> Gestures of the head can indicate humility, haughtiness, langour or rudeness... The face can be suppliant, menacing, soothing, sad, cheerful, proud, humble... With your arms and hands: ask, promise, threaten, suplicate; show fear, joy, grief, doubt, acknowledgement, penitence, indicate measure, quantity, number, time...[147]

Biologist and experimental psychologist Adam Kendon focuses his life on study of gesture and sign languages and how these relate to spoken languages. He defines gesture as :

> a form of non-verbal communication in which visible bodily actions are used to communicate particular messages, either in place of speech or together and in parallel with spoken words.[148]

Gesture, as form of expression, doesn't have universal meaning. Use of specific gestures, as well as the meaning of gesture may vary in different cultures, they are culture specific. Some gestures which are quite common for one culture may be unknown in another one. Furthermore, a gesture which is considered polite in one culture may be understood as manifestation of bad manners, sometimes even impertinence or rudeness in another culture. Gestures are crucial part of everyday life and have been documented in the arts for centuries (paintings, sculptures, photography, architecture, dance, indigenous cultures, etc.). They have their place also in religious or spiritual rituals – ritualized gestures of prayer, worship and humility in Catholicism, different positions of the body during spiritual communications to provoke spiritual harmony, etc. Gesture in its multiple forms represents the most primal and on the same time the most complex phenomenon for communicating ideas, thoughts and emotions to others and self.

In the past few decades concept of gestures received much attention of various musical disciplines and became an important and challenging object of study in musicology, analysis, composition, semiology, musical psychology, etc.. Our understanding of how gestures function and how they are related to our musical lives is constantly developing, as well as our awareness of different types of gesture. Various

[147] Quintillian citation from Sulivan, Mark. 1984. *The Performance of Gesture: Musical Gesture, Then, and Now*. Urbana, Illinois: University of Illinois at Urbana Champaign. Doctoral thesis.
[148] Kendon, Adam. 2004. *Gesture: Visible Action as Utterance*. Cambridge: Cambridge University Press.

types of gesture form vital and integral parts of musical activity and any human activity, including physical, cognitive, psychological, expressive, communicative, emotional, sociological and analytical gestures.

Gesture has been approached from many perspectives - different theoretical works have been dedicated to the study of a gesture as the model for analysis and interpretation of technical and stylistic questions in music (Hatten, Lidov, Nattiez, Tarasti, Zampronha).[149]

Many works have been related with the performance and new technologies with gestural control in the music made by the electronic means, construction of new interactive instruments and interfaces, detecting and translating the physical movement into sound (Cadoz, Battier, Wanderley, Iazzetta).[150]

The problem of gesture attached also attention of composers of contemporary and electroacoustic music, who approached it from different perspectives, writing about various dimensions and characteristics of the gesture and different parameters in music (Delalande, Ferneyhough, Schaeffer, Smalley, Wishart).[151] Although, many of these works were unable to determine a general system of gestural types and functions, many of them agreed that theory of musical gesture may begin with understanding of human gesture.

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[149] Zampronha 2005.
Tarasti, Eero. "The Emancipation of the Sign. On the Corporeal and Gestural Meanings in Music." *Applied Semiotics* 2(4): 15-26. http://www.chass.utoronto.ca/french/as-sa/ASSA-No4/ET1.htm (accessed September 5, 2008)

[150] Cadoz, Claude and Wanderley, Marcelo M. 2000. Gesture and Music. Reprint from Wanderley, M.M. and Battier, M. eds. *Trends in Gestural Control of Music*. Paris: Ircam – Centre Pompidou.
Iazzetta, Fernando. 2000. "Meaning in Music Gesture." Reprint from Wanderley, M.M. and Battier, M. eds. *Trends in Gestural Control of Music*. Paris: Ircam – Centre Pompidou.

[151] These concepts will be presented in chapters 3.1. - 3.4.

3.1. Gesture as a movement.

Most common characterization of the term gesture, we can find in different encyclopedias and writings, is a definition of gesture as:

> ... a movement or position of the hand, arm, body, head or face, that expresses or emphasizes an idea, opinion, thought, emotion, intention or attitude.[152]

In music, it is important to distinguish between 2 fundamental types of gestures: the *physical gesture* and the *musical gesture*. It is the musical gesture, in which this research is focused on. Both of them involve movement, but each one in a different sense.

Physical gesture in music, is related with the definition of the human physical gesture (as above) and it can be represented by a variety of different actions of the performer – to produce or accompany sound, which are perceptible to our vision during the time of their execution (performer playing techniques or performer's actions, etc.) On the other hand, gesture in music may be a non-physical and non-visual movement, such as movement of sound, this is the domain of ***musical gesture*** that we will try to define and explain through following chapters.

There is no doubt that while in case of instrumental music the relation between physical gesture and musical gesture is very close - the way performer moves to produce sound affects the final result - the sound itself, in electroacoustic music this relation between physical and musical may be less evident, because many sound sources

[152] paraphrase on definitions of gesture from different sources: 1. *"motion of hands or body to emphasize or help to express a thought or feeling"*, *"the use of movements (especially of the hands) to communicate familiar or prearranged signals"*, *"something done as an indication of intention - a political gesture, a gesture of defiance"*(wordnetweb.princeton.edu/perl/webwn); 2.*"movement of the body or a part of the body used to express an idea or emotion. Such movement could include a wave, handshake, head nod, shaking of the fist, etc. Ritual gestures may include gestures that are part of ceremonies or functional gestures such as brushing teeth or washing clothes"*
(www.ncpublicschools.org/curriculum/artsed/scos/dance/glossary)
3. "movement of the body or limbs as an expression of feeling", "movement of the body or any part of it as expressive of thought or feeling" (The Shorter Oxford English Dictionary, Oxford University Press, 1973); 4. "bodily movement expressing or emphasizing an idea or emotion". (The Scribner-Bantam English Dictionary, Bantam Books Inc. 1979); 5. "manner of carrying the body; position of the body or limbs, posture", "a motion of the body or limbs expressive of sentiment or passion; any action or posture intended to express an idea or a passion, or to enforce or emphasize an argument, assertion, or opinion" (Webster Revised Unabridged Dictionary, 1913).

are of different than human or instrumental nature or even those of human-instrumental source are undergoing such manipulations, that the origin of the electroacoustic sound remains unknown.

However, in the act of listening to music, we may focus just on the movement of the sound itself – its structure, signification, energy, etc., regardless of the ways how it was produced, which physical gestures or what technological means and procedures were used for its manipulations - we will focus on the "musical gesture".

3.1.1. Gestural spaces. "Internal gestural space" – perceptual space.

In physics (kinetics), motion is defined as:

> ... change of location or position of an object with respect to the time, and more generally it signifies any spatial and/or temporal change in a physical system.[153]

This definition embraces both – physical and musical gestures, as both of them involve spatial and temporal change (they occur at specific time in specific space). From this, it is apparent that approaching gesture from the perspective of movement - motion, we have to consider also the space, in which this movement (gesture) is performed. We can imagine that in case of the physical gesture, the space would be the real physical three-dimensional space, or according to the modern physics a spacetime - the four-dimensional continuum, which combines space and time (three-dimensional space and time as a fourth dimension). But what would be the "space equivalent" for the case of musical gesture? Analogically, musical gesture could be understood as a performance in "musical space", which in this case would be represented by our ear and our perceptual properties.

Various authors talk about this "musical space" in different terms and conditions. Xenakis suggested a **music vector space**,[154] integrating the musical parameters, as fundamental factors of sonic events, such as pitch or melodic intervals –

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[153] http://en.wikipedia.org/wiki/Motion_(physics)

[154] Xenakis, Iannis. 1992. *Formalized Music. Thought and Matematics in Music* (revised edition). New York: Pendragon Press. p.161

H, intensity intervals – G, time intervals or durations – U and intervals of time separating the sonic events, and independent of them – T. This model allows formalizations of musical structures, offering an immediate disposition of all results and properties of vector spaces for their study. Therefore we can study and analyze a sonic entity (sonic event), first as *structure outside-time*[155], composed of pitch, intensity and duration (H, G, U) then in time – *temporal structure*[156] (T) and at last the correspondence between the structure outside-time and the temporal structure as *the structure in-time*.[157] (H, G, U, T relations). Every sonic event then may be expressed as a vectorial multiplicity. Our summary of the vector space and its relations is presented in following Figure 21.

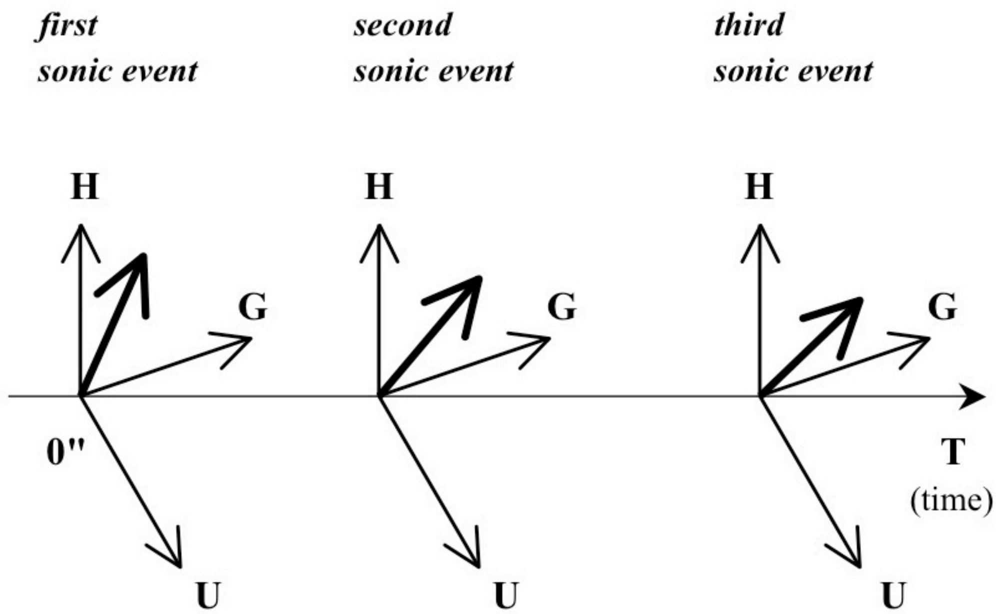

Figure 21. Example of relationship of three different sonic events happening in time (vector space). Each sonic event (bold arrow) is described in 3 vector space (H-pitch, G-intensity and U-duration), they represent outside-time structure. Their relationship on the time axis T is expressed by the distance from each other (their temporal structure) and shows them as in-time structures.

155 Ibid.
156 Ibid.
157 Ibid.

The Schaeffer's concept of "musical space" is represented in his two proposals of "three-dimensional musical spaces" - *trieder of reference*[158] and *perceptual field,*[159] the first as a physical representation of measurable reality of the sound (frequency, time and amplitude), second as an organization of the aural perception according to the typomorphological criteria (pitch, duration and intensity).

Trieder of reference (Figure 22) distinguishes *three plans of reference*, formed in 3 axis (x-time, y-frequency, z-intensity), each one expressed in two-dimensions:
melodic plan (x, y) – expresses evolution of frequency in time
dynamic plan (x, z) – variation of intensity in time
harmonic plan (y, z) – distribution of intensity according to spectral frequencies.

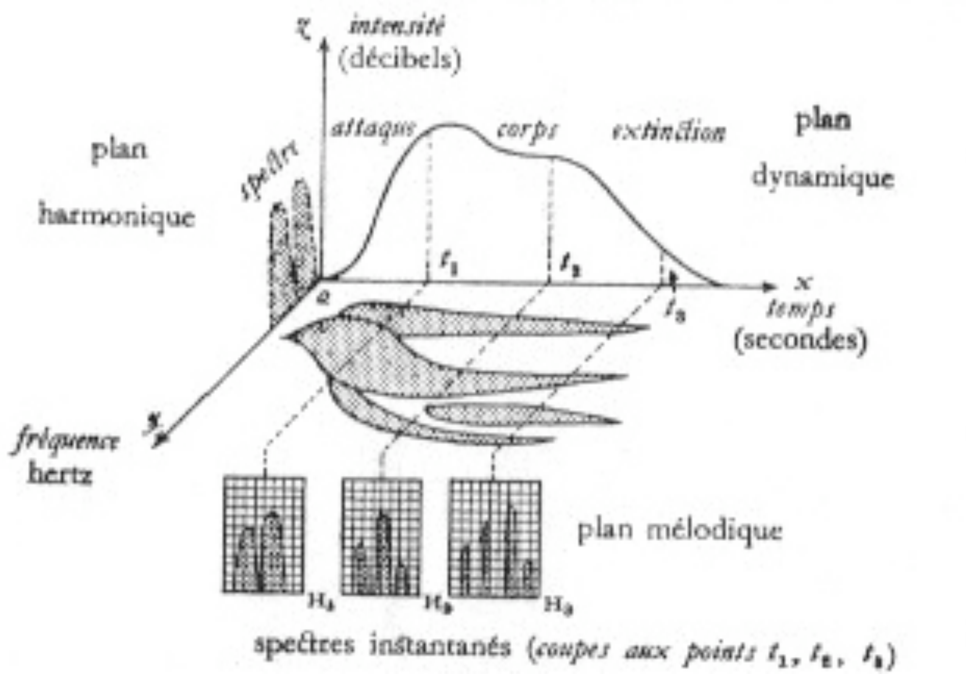

Figure 22. Trieder of reference, by Pierre Schaeffer[160]

[158] Schaeffer 1966, p.415
[159] Chion 1995, p.64
[160] Schaeffer 1966, p. 415

Perceptual field,[161] as a natural perceptual field of the ear, represents the "space" in which sound objects (or as we can imagine any musical structures), their criteria and relationships emerge and are located in accordance with natural laws. This field consists of three dimensions:

pitch field

duration field

intensity field.

The dimension of pitch here represents two modes of pitch perception:

- the fixed and locatable (tonic) - *harmonic field* (perception of intervals and scale formations, as in traditional music) and
- the variable non-locatable (complex) pitch - *coloured pitch field* (perception of clusters, effects, masses, etc.).

The relationship between morphological criteria and the three dimensional organization of the aural perception is a complex one - some criteria such as, for example mass or harmonic timbre belong to one perceptual field; some other criteria, such as dynamic criterion belong to two perceptual fields and finally, criteria as grain, allure, melodic profile and mass profile belong to all three perceptual fields. Each morphological criterion has its dominant field/fields. For example, the dynamic criterion is perceived in the field of intensity, but with dynamic development in time, we perceive it also in the duration field.

Notion of this "musical space" – perceptual field, as proposed by Schaeffer, made a radical change in music theory - focus has been shifted from physical parameters of the sound to the qualities of the human perception and it allows not only musical interpretation and translation of physical parameters (frequency, time, amplitude) into musical (melody, harmony and dynamic) but also examination of sound objects or sound structures and their comparison in perceptual field according to different morphological criteria.[162]

Although Schaeffer in his concepts focuses on sound objects and not on gestures, specifically, there is a strong potentiality of his theory for the re-interpretation

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[161] Chion 1995

[162] This comparison of morphological criteria in perceptual field belongs to process of Analysis, the fourth stage of PROGREMU, as described in the chapter 1.4.

and application to other musical sonorous structures (including gestures), due to the relations with the movement.

Perceptual field is based on another important basic principle - ***concept of variation and permanence***[163]:

> Every musical structure functions through the variation of certain aspects of the sound from one object to another, a variation made perceptible by the permanence of certain other aspects. The aspects of sound whose variation is pertinent and forms the abstract musical discourse are called values; those which give concrete permanence are called characteristics or genres.[164]

The permanence of genres together with variation of values seem to be observed in every musical structure and is found in any level of musical structure. In traditional music we can see this model in the case of timbre-pitch relationship – in perception of the melody played on certain instrument (for example flute), the timbre is permanent, but the pitch varies between the individual notes of the melody. Another case may be shown on the relation of the flute timbre to the sound of the ensemble or orchestra, where flute timbre represents the permanence; variation is achieved by the various techniques which are idiomatic for the flute itself.

> What varies is what remains the same – amongst several objects we notice constant presence of one characteristic (f.e. pitch), provided that pitch varies amongst different objects, forming a melody and emerging as a value.[165]

In summary, permanence of genre-characteristic (represented by certain combination of criteria) allows us to observe variation of the criterion in one or in more dimensions of perceptual field. Chion very elegantly in one sentence relates all these concepts (object-structure, permanence-variation, characteristic (genre)-value, concrete-abstract, sonorous-musical) (Figure 23).

[163] Chion 1995
[164] Chion 1995, p.79
[165] Ibid., p.80

amongst several (sound) OBJECTS the PERMANENCE of a CHARACTERISTIC is the CONCRETE SONOROUS basic

of a STRUCTURE of VARIATIONS of VALUE forming the ABSTRACT MUSICAL discourse.

Figure 23. The law of the musical, by Michel Chion[166]

The consideration of variation leads also to recognition of two types of musical structures, corresponding to two types of perception, as they have been described by Schaeffer and later by Chion:[167]

continuous musical structure, based on continuous variations of criteria within the structure and

discontinuous musical structure, based on the contrasts and comparisons between discontinuous elements. These two structures are mutually dependent and inter-referential, it means that:

> We can't perceive discontinuous phenomena unless there is a minimum of continuity in each of its component fragments. Thus, we can't make a melody (of discontinuous pitch values) unless we can perceive every pitch degree in a continuous form – sensing pitch an A, and not distinguishing 440 rhythmic pulses.[168]

For example, in case of instrumental glissando, which is a continuous structure, we try to analyze it by reducing it into pitches that form the interval of this glissando from its beginning to the end and these pitches represent discontinuous structures. This situation happens in the discontinuous harmonic pitch field. In the case of continuous or coloured pitch field the glissando appears as a complex mass (nonlocatable pitch).

[166] Ibid., p.71
[167] Schaeffer 1966, Chion 1995
[168] Chion 1995, p.68

Going back to the "space in which movement is perceived", Trevor Wishart writes about **sonic space**[169] as multi-dimensional continuum, where all sound reality takes place. He sees this continuum as continuous space that "*exhibits different topological structures and allows qualitatively distinctive ways of movements"* through this continuum rather than *"just some kind of undifferentiated endless fog extending in every direction"*, where all parameters can extend indefinitely in all directions to the limits of our audibility.

In Wishart's writings often the term timbral space is used to describe this multidimensional sonic continuum. The proper definitions sometimes seem to be avoided, although they might be deduced from the context of writing. The texts compare lattice-based music (instrumental) with non-lattice based music (electroacoustic). From the point of view of lattice based music, electroacoustic music is usually seen as the *"undifferentiated seamless fog, opaque to human intellectual control"*[170], but through applications of Catastrophe theory for continuum (to behaviour of physical objects through time and description of time-based acoustic phenomena) on the examples of organic structures and their continuous growth process, Wishart attempts to prove that even continua exhibit specific topological structures with qualitatively different ways of motion, which he later in his text calls dynamic morphologies, and we understand them as gestures. He further suggests that there might be a link between morphology of sound-objects or streams of sound and the quality of human response to these events (regardless of the fact if they are intentionally produced by human gesture or not). Because of these entire aspects continuum is not just an endless uncontrollable fog extending to all ways but a "*wonderful new area for exploration, that we have all tools to control it and approach it with the right conceptual categories"*.[171]

We will get to this concept of continuum again later in the relationship between continuum and structure, or in our case continuum and gesture.

[169] Wishart 1996, p.71-92.
[170] Ibid., p.82
[171] Ibid., p.92

3.1.2. "External gestural space" – Architectural acoustic space.

It should be noted, that musical gesture, as a movement, is realized not only in the dimensions of our perceptual field, which we would call the "internal space", but is performed also in the real physical three-dimensional space or in the four-dimensional continuum of spacetime – "external" architectural acoustic space. This is the situation of spatialization of musical structures during the concert performance (their behaviour and evolution in this space as time passes). Such structures or gestures articulated in space, we would call "spatial gestures".

According to Smalley's spatio-morphology *"gesture is reflected in spatial trajectories"*[172] or Wishart's concept of sonic space *"any directed aspect of a motion may be considered a spatial gesture"*.[173]

Imagining a basic virtual acoustic space (where sound structures appear right-left-front-rear), we may distinguish between many different motion trajectories of gestures in space, such as straight line, arc, circular, cyclical; symmetric or asymmetric, etc. The way sound structures or gestures move in space will affect the way they are perceived. For example, gesture moving in a straight line from right to left will sound different from the same gesture moving circularly around the listener. Interactions of musical structures with space by spatial manipulations can result in their morphological transformations, which we will perceive through different changes, such for example changes in spectral richness or spectral contour. Spatial articulation therefore functions as a morphological determinant. (Figure 24)

Here we would like to add, that Smalley in another of his writings about space form, talks specifically about "gestural space"[174], but in another sense, as:

> ... an intimate space of individual performer and instrument. Performance gesture produces and defines a spatial zone within reachable space, the space being activated by the nature of causal gesture moving through that space in relation to the instrumental source, the whole event being united

[172] Smalley 1986, p.91
[173] Wishart 1996, p.231
[174] Smalley, Denis. 2007. "Space-form and the acousmatic image." *Organized Sound* 12(1): p. 41-42.

> in the resulting spectromorphology. The temporal unfolding of energy therefore articulates a spatial zone. Performed events are source-bonded, so under acousmatic conditions (as with a recording) spectromorphologies are the carriers of enacted, agential space.[175]

Then the spectromorphology, in our case a "musical gesture" will be carrier of the energy resulted from the physical gesture of performer executed on the instrument in this intimate space between them. As we understand Smalley's definition, alongside the transmodal perception, we should be able to perceive the intimacy of this space relationship at a source-cause level even from a distance through the visual and aural observation of proprioception.

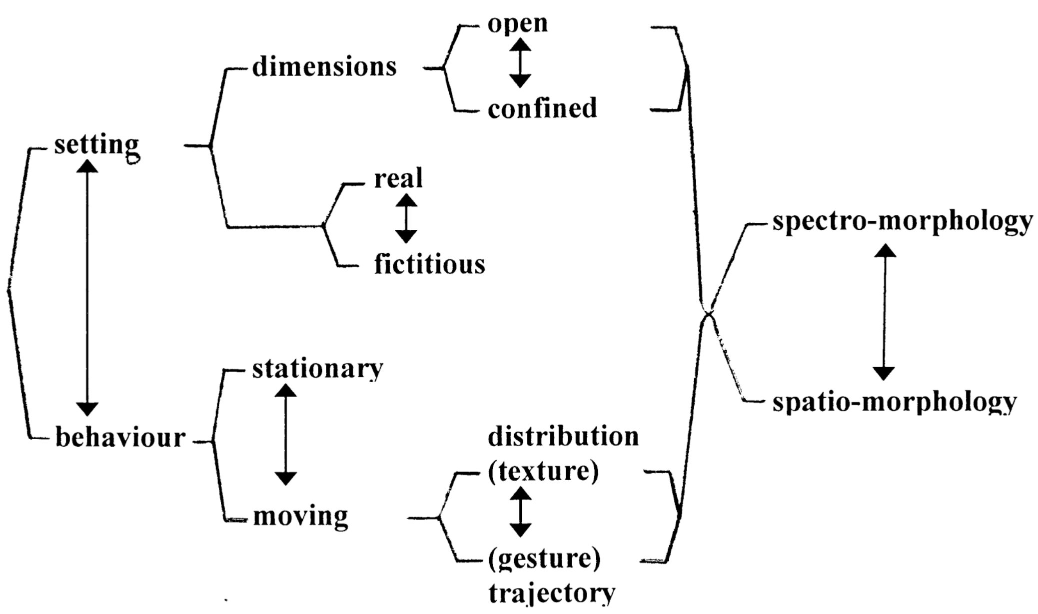

Figure 24. Spatial articulation, transcription of the scheme of Denis Smalley[176]

[175] Ibid.
[176] Smalley 1986, p.91

3.1.3. Motion and time.

From the physical definition of motion as *"spatial and temporal change",* motion is characterized not only by its path in space but also by its behaviour in time. Wishart distinguishes three levels of time properties of motion, which determine its perceived aesthetic character:[177]

first order time property - different speeds of motion,

second order time property – the way in which the speed changes through time, acceleration/deceleration of motion and

third order time property – the way in which the acceleration or deceleration changes through the time). For example, very slow motion will be experienced more as an indefinite intensity less 'energy-poor' relocation of position, while medium speed motion will have a feeling of definiteness, an intentional movement from one location to another. Fast motions will have a feeling of urgency and increased energy. According to these time properties (speed changes) he differentiates six classes of motion (time-contours): four basic - *constant*, *accelerating*, *decelerating* and *irregular* and two combined - *accelerating-decelerating* and *decelerating-accelerating*.[178]

The temporal characteristics of motion affect significantly its character – for example in case of direct motion, the motion contour will determine the gestural feel of motion, while the motion contour of cyclical and oscillatory motions will determine more the spatial structure of the path.

From different temporal and spatial models of motion, we may create a counterpoint of gestures and their interactions, which might be independent, interactive or triggering. Gestural interaction then will rely in the relation of spatial and temporal characteristics of spatial gestures and their intrinsic morphologies. For example, some gestures will have similar temporal structures but different spatial qualities and vice versa (two accelerating gestures moving in different directions, having different spatial contour or two gestures moving symmetrically in space, but one would have accelerating and the other decelerating time-contour.).

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[177] Wishart 1996
[178] Ibid.

3.2. Gesture and meaning.

If all meanings could be adequately expressed by words, the arts of painting and music would not exist. There are values and meanings that can be expressed only by immediately visible and.... audible qualities, and to ask what they mean in a sense of something that can be put into words is to deny their distinctive existence.

John Dewey

In the last decades, many theoretical writings have been trying to study music from the semiotic perspective, several authors made connections between musical gesture and meaning mostly drew upon the theory of signs, developed by Charles Sanders Peirce. The main aspects of this theory may be summarized in following: According to Peirce,[179] all of our experience of different phenomena (by phenomenon he means whatever is in front of our minds in any sense) can be classified and organized in 3 basic categories (three kinds of elements that attentive perception can make out in the phenomenon):

firstness (mode of being without reference to anything else or in other words state of mind in which something is present without compulsion and without reason; qualities of feelings or mere appearances),

secondness (mode of being with respect to a second, but regardless of any third or in other words sense of acting and being acted upon, which is our sense of reality of things – both outward things and of ourselves, it essentially involves two things acting upon one another; sense of reaction, experience of effort, prescient from the idea of a purpose),

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[179] Summary from following sources:
Bergman, Mats and Paavola, Sami. 2003. *The Commens Dictionary of Peirce's Terms - Peirce's Terminology in His Own Words*. http://www.helsinki.fi/science/commens/dictionary.html (accessed October 7, 2009); Short, T.L. 2007. *Peirce's Theory of Signs*. Cambridge: Cambridge University Press; Borges, Priscila Monteiro. 2007. *The Sign Tree: From Sign Structure To Peirce's Philosophy Through Reading A Visual Model Of The 66 Classes of Signs*. Communication presented at the 9th World Congress of International Association of Semiotic Studies. IASS-AIS. Helsinki/Imatra and Wikipedia.

thirdness (mode of being, bringing a second and third into relation to each other or in other words being aware of learning or of going through a process by which phenomenon is found to be governed by a rule, or has a general knowable way of behaving; covers all that is in our minds, thinking) and then the division of the experience in these 3 categories results in Quality (firstness), Objects (secondness) and Mind (thirdness). A relation of dependence, established between the three categories is following: firstness is independent of anything, secondness depends on firstness and thirdness depends on secondness and firstness.

Peirce proposed classification of the signs according to the three categories applied to three undisociable elements, which constitute a sign:

representant (sensible aspect of the sign),

object (aspect of reality associated to the sign) and

interpretant (its relation with other signs).

Sign due to its relation to the object may be considered:

icon - refers to its object through similarity (firstness),

index - refers to its object through factual connection - cause (secondness) or

symbol - refers to its object through interpretative habit or norm of reference - convention (thirdness).

The broad theory of semiology of musical discourse, with some of its roots grounded in Peirce, has been developed by Jean-Jacques Nattiez.[180] He proposes a general definition of meaning:

> An object of any kind takes on meaning for an individual apprehending that object, as soon as that individual places the object in relation to areas of his lived experience – that is, in relation to a collection of other objects that belong to his or her experience of the world.[181]

[180] Nattiez, Jean-Jacques. 1990. *Music and Discourse: Toward a Semiology of Music* (tr. Carolyn Abate). Princeton: Princeton University Press.

[181] Ibid., p.9. another definition more simple*: "meaning exists when an object is situated in relation to a horizon".*

In accordance with Peirce's notion of interpretant and Granger conception of meaning[182] as residue of a process of formalization, Nattiez draws up another definition of meaning:

> The meaning of an object of any kind is the constellation of intepretants drawn from the lived experience of the sign's user – the "producer" or "receiver" – in a given situation.[183]

For example, in the case of language, we may say "something" to someone else, but we will never know how this person interprets what has been said and vice versa, he will not know how we interpret what he said to us. The one, who is speaking fills the words with his own meanings, with what they mean for him. The other one receives the words with the meanings he gives to the words and what they mean for himself again. So even by using the same language, there is different range of interpretation of any word or combination of words. Analogically then, in our opinion, in music we can face the same situations, the meaning transferred into the musical work by a composer, through different articulations and manipulation of the musical sound material might not necessarily correspond to the meaning caught (understood) by the listener. Each one of them – composer or listener (analyst) has different lived experiences and different palettes of interpretations of these musical signs.

Nattiez recognizes that even despite the arbitrary nature of interpretants it is possible to assign an identical formal description of phenomena through comparative description and observation of the characteristics and relations of formulas, such as for example "*formula A is to B as X is to Y*) and distinguishes three dimensions of the symbolic phenomenon:[184]

The poietic dimension – the symbolic form results from a process of creation that may be described or reconstituted. So we understand it as dimension coming from the viewpoint of the "producer" (in case of music may be a composer).

The esthesic dimension – in confrontation with symbolic form receivers may assign one or many meanings to the form. We understand this dimension as one from the viewpoint of the "receiver" (in case of music, it may be listener or analyst). Receiver

[182] Ibid. The essential aspect of Granger concept of meaning is the "*proliferation of interpretants when an object of any kind is placed for the individual relative to his or her lived experience*."
[183] Ibid., p. 10
[184] Ibid., p. 11-12

is some kind of a "constructor" of a meaning, as he is not receiving the meaning of the message, but constructs his own meaning, regardless from what was the intended meaning of the producer (composer) or even if there was no intended producer's meaning (often unintentional meanings of a composer, which may or may not be realized by himself and others later). This dimension is dependent upon the lived experience of the receiver. Then, for example, every listener or analyst will approach the musical work and construct its meaning in confrontation with his own experience. As a result, two analyses of the same musical work may have quite different esthetic dimensions as well as may vary meanings constructed by different listeners, although the poietic dimension (the meaning composer input into his work is just one).

The trace – physically and materially embodied symbolic form, accessible to the five senses, in other words *"neutral level"*.

Some authors, for example Stephane Roy,[185] consider traditional musical score generally corresponding to this neutral level. Score, constructed of notes – basic units, from which analyst departs his analytical process and recognizes cells, motives, themes, phrases, etc. He puts this problem in question when he asks if there is any neutral level in the electroacoustic (acousmatic) music, where there is no score and even in case of having some visual representation of the electroacoustic sound, this is just pure artefact and can't serve for segmentation of the work to basic units as it is in case of the score in traditional instrumental music. He neither considers transcription of electroacoustic sounds into graphic score in process of analysis a neutral level because it is not the work,

> it is no more than a symbolic representation of the work, closely reflecting the criteria adopted by the analyst to make an analysis of the neutral level of the work. These criteria of découpage and description, based on a theory, do not take in account any strategies of production and reception; they are in a neutral zone and its purpose is to provide an inventory as large as possible of the morphological units of a work. Transcription is an indispensable artefact, it is the visual instance of the analysis of the neutral level, that the analyst constructs, to allow him to

[185] Roy, Stephane. 2003. *L'analyse des musiques électroacoustiques: Modèles et propositions*. Introduction. Paris: L'Harmattan. p. 29.

> proceed further in its research of the poietic and esthetic dimensions of the work.[186]

As the neutral level in electroacoustic music Roy further proposes the sound nature (*"nature sonore"*):

> The only neutral level of electroacoustic music is the sound nature and not visual, and it is contained on the recorded medium.[187]

Considering this and the above Roy's assumption, neutral level in electroacoustic music would be presented by the morphologic units from which the electroacoustic piece is constructed, which are not visual, but they exist on the recorded medium. But to start an analysis of the electroacoustic work, the analyst has to first identify these morphologic sound units and then create his own analysis towards the poietic and esthetic dimensions of the musical work. Although Roy's premises and propositions may look quite interesting and they correspond in some ways with what we resumed in the subchapter about score in analysis (subchapter 1.3.), precisely the creation of graphic score in process of analysis as a very helpful process to understand the piece and unfold most of the possible information about it, there are some contradictions in his assumptions: First transcription of electroacoustic sounds into graphic score is not neutral, because it is not the work and is just a symbolic representation of the work, which reflects very closely the analyst's criteria to make an analysis of the neutral level of the work. On the other hand transcription is an essential artefact – a visual instance of the analysis of neutral level constructed by the analyst.[188]

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[186] Ibid. .*"(...) elle n'est qu'une représentation symbolique de l'œuvre, qui reflète étroitement les critères adoptés par l'analyste pur réaliser une analyse de l'œuvre. Ces critères de découpage et de description, fondés sur une théorie, ne tiennent compte ni des stratégies de production ni des stratégies de réception, ils résident dans une zone de neutralité et leur objectif est de fournir un inventaire le plus large possible des unités morphologiques d'une œuvre. La transciption est un artefact indispensable, c'est l'instance visuelle de l'analyse que construit l'analyste pour lui permettre de poursuivre ultérieurement son investigation des dimensions poïétique et esthésique de l'œuvre."*

[187] Ibid. *"Le seul niveau neutre de la musique électroacoustique est donc de nature sonore et non visuelle, et il est contenu dans le support d'enregistrement."*

[188] If we talk about visual transcription of electroacoustic sounds, the immediate question of sonogram or spectrogram's role will arise. Leigh Landy arguments, that these are clearly the neutral-level tools. (Landy, Leigh. 2007. *Understanding the Art of Sound Organization*. Cambridge: MIT Press.) Nevertheless, sound parameters interfere with each other in too complex way to be treated separately, furthermore, as we said in earlier chapters not all what we see in the images of sonogram can be heard, as well as not all what we hear can be seen in sonogram. From this point of view, creating analysis just from a sonogram (as neutral level), may be quite tricky and not very relevant process.

We are not sure if we can agree with existence of neutral level, or in more concrete, with the statements, that visual instance as a result of transcription of electroacoustic work by analyst (according to his criteria) may be considered a process belonging to the neutral level. This is based on following arguments:

In instrumental music the composer (producer) has to formalize his thought and input his meaning into conventional system of signs (notation – "organization of notes"), notes that are generally understood by any performer, analyst, or listener with musical education. Notes-signs that we understand but without "interpretation" they are just an "objective dimension" – notes and their organizations – the neutral level. Receiver may extract, output the information contained in score and construct his own meaning either directly from the score (some procedures of analysis constructing meaning from the relationships between notes, phrases, etc.) – visual (analyst) or from the performance of the score by performer – aural (listener, etc.). The meanings of performer, analyst or listener may vary from the meaning that was initially input into the work by a composer, according to their different live experiences. Score then represents some kind of an "objective material" to which the composer (producer) *inputs* a meaning and from which a meaning may be *out-put* - extracted, transferred by performer or constructed by an analyst. We have here all dimensions Nattiez suggested – the poietic (composer's meaning), trace-neutral level (score) and aesthetic (listener/analyst/performer's meaning).

However, in electroacoustic music, although composer inputs his meaning into his work through the sound ("organization of sound units"), it is the analyst who has to construct the so called "analysis of neutral level" from those sounds by identification of basic morphologic units to depart his analysis towards the constructions of his own meanings. This takes into account that the analyst will apply his own criteria to identify the sound units for starting an analysis and such a process is already quite individual approach, which may not be so "neutral". It is not composer who creates the visual representation (whatever symbolic it would be), but the analyst, so in our opinion this process of creation of transcription of electroacoustic sounds and its result – the graphic score, belong already to the aesthesis. The sound nature then is not an objective (as for example the notes are, note C is always a C, we know what it is, and we may even know how it sounds played by different instruments), but morphologic sound units identified by analyst don't have the same role or function. We don't know how they sound unless we hear them. That's why sound nature in our opinion is a phenomenon that connects, interpolates meanings between the producer and the receiver, without some kind of "objective intermediary", because sound by itself is an intermediary of its own, it immediately involves the "interpretation" and construction of meaning.

In our research we are dealing with music composed for instruments and electroacoustic sounds. Even if we admitted the existence of neutral level (score) for instrumental music, its role as neutral level in mixed music would be more than doubtful. Score doesn't represent any objective level of the mixed electroacoustic work and it neither symbolically represents the piece as a whole (with all its parts included – instrumental and electroacoustic). If we cannot notate electroacoustic sounds, it is very difficult to reach the "distance" necessary to achieve the neutral level.

As a conclusion, in our opinion, in case of electroacoustic music as well as music composed for instruments and electroacoustic sounds, the musical meaning will interpolate between the poiesis and aesthesis, without necessarily needing "the existence of the neutral dimension". This will be evidenced in Chapter IV, when approaching gestural interaction by aural analysis the neutral level loses its justification.

These are some of the general concepts connecting music and meaning. The more specific problems and relations of gesture and meaning will be presented in next subchapters.

3.2.1. Gesture as a "movement which is marked as meaningful"

The proposal of **David Lidov**[189], based on semiotics, treats the relation of musical signs to the movement and sensations of the human body. He departs from the observations that there are direct and immediate correspondences between details of music and bodily properties (gestures, tensions, postures), as well as psychosomatic or neurochemical properties (state of consciousness, mood, emotions) - music is a transmutation of physiological impulses and also a product of mental activity. This

[189] Lidov, David. 2005. "Mind and Body in Music." In: Lidov, David. *Is Language a Music? Writings on Musical Form and Signification*. Bloomington: Indiana University Press. pp. 145-164.

immediacy of kinesthetic and somatic connection is transferred into signs functioning in formal system. From this perspective he proposes to clarify the referential aspects of music through the analysis of its references to the body:

> The abstractive, transformational, and compositional processes by which sound takes shape and motivation from the body but transcends it to become music is representative of a general semiotic phenomenon. In acquiring signs, sensations and impulses formed in and of the body transcend it to become mind.[190]

According to Lidov the transformations from "bodily" to "meaningful" in music is the transcendent process of articulation. The criterion of transcendence - the capacity of the sign to transcend the biological determination, will induce the hierarchy in sign typology from signs belonging to independently articulated systems to strongly determined signs. From this it is clear that not all of signs will have equal power to transcend biological determination. Some signs will be directly expressive and representing an immediate mutual influence between body and sound, which are later defined as *indexes*. Other ones will be not direct and immediate copies or consequences of somatic movements, that will require interpretation and reconnection with the body during the performance, they are later defined as *icons*. At last there will be signs that will be least connected to the body or furthest removed from the body, existing as most abstract types. They will have the most indeterminate somatic content and they are defined later as *symbols*.

For Lidov articulation is prerequisite for semiosis, it is the condition and the result of formal sign systems, providing the vocabulary of individual and distinct sign types (equivalence classes) from which more complex structures, such as scales of pitches, etc. may be constructed. As musical signs involve all – the articulate, the inarticulate and the particular, then in music we study:

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[190] Ibid., p.147. Lidov further documents the distance between mind and body on an example of freedom of composition and freedom of performance. Freedom of performance is *"the uninhibited effect of a cause, the freedom to follow an impulse or to obey a force. It is essential to art but not specific to mentality. It may seem to display the subjugation of intellect to passion, instinct, or to other powers."* Freedom of composition on the other hand *"is specific to semiosis and occurs nowhere else. It resides in the possibility of choice among alternatives and in a capacity of the relationship between an articulated formal system and its users. It is neither the user nor the subsystem which enjoys this freedom, but the semiotic act itself, which comprises decisions irreducible to real causes or real randomness."* Composition is articulate, while performance is particular, as it concerns variables outside the system.

> ... the interrelation of performance signs barely removed from unarticulated somatic experience, compositional structures formed by the free play of pure articulation, and the full spectrum of musical imagery that lies between these poles.[191]

For classification of musical signs, Lidov adopts the Peirce's triad of icon, index and symbol, but instead of using the standard definitions (icon – a sign by similarity, index – a sign by cause, symbol – a sign by convention), as for example some other authors did,[192] he rather bases his definition on a general rule that similarities have real causes and the real connections transfer features of similarity. From this point of view the index and its object are dependent, the icon is independent of its objects, and symbol is the sign freed from its natural meaning (cause and similarity) and therefore is available for a conventional assignment but which stands as the antipode to natural reference. Therefore, if applied to music, Lidov defines:

> ***index*** as the most particular and least articulate (unarticulated) sign, for example tempo rubato, nuance of intonation, or other performed nuances or dynamic level,[193]
>
> ***icon*** as a particular arrangement of articulated materials into formal units - articulated shapes, which may be interpreted as the isomorph or trace of some object or force not immediately in contact with it, for example the melodic contour, harmonic modulations and rhythmic patterns,[194]
>
> ***symbol*** as an articulated arrangement of articulated materials, that is the relation of arrangement as well as the materials are abstract types. In music symmetries of structure or further substitutions of formal relations for physiological values - fragmentation, inversion, transposition, etc. give rise to symbols.[195]

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[191] Ibid.

[192] By connecting gesture to the body - *"body is the instrument through which the gesture becomes actual"*, Fernando Iazzetta recognizes 3 ways how gesture acquires its signification: by similarity, by causality, by convention. *Gesture operating by similarity (similar gesture type)* is the corporal gesture trying to imitate or emulate the behavior of processes and objects in the world. *Gesture operating by causality (causal gesture type)* is connected to an event through a cause-and-effect relation, and usually function as a response to an actual circumstance. *Gesture operating by convention (conventional gesture type)* is constructed and shaped by external factors such as culture and language and does not neccessarily keep any relation of similarity or causality. It acquires signification by an abstract and functional process and must be learned to be shared by a specific group. (Iazzetta 2000)

[193] Lidov 2005

[194] Ibid.

[195] Ibid.

We present these Lidov's perspectives and transformation of "the bodily" into the "meaningful", together with the relations of the signs and their expressive potential, as we understood it, in our summary scheme of transformation of the physical gesture into the musical gesture (Figure 25).

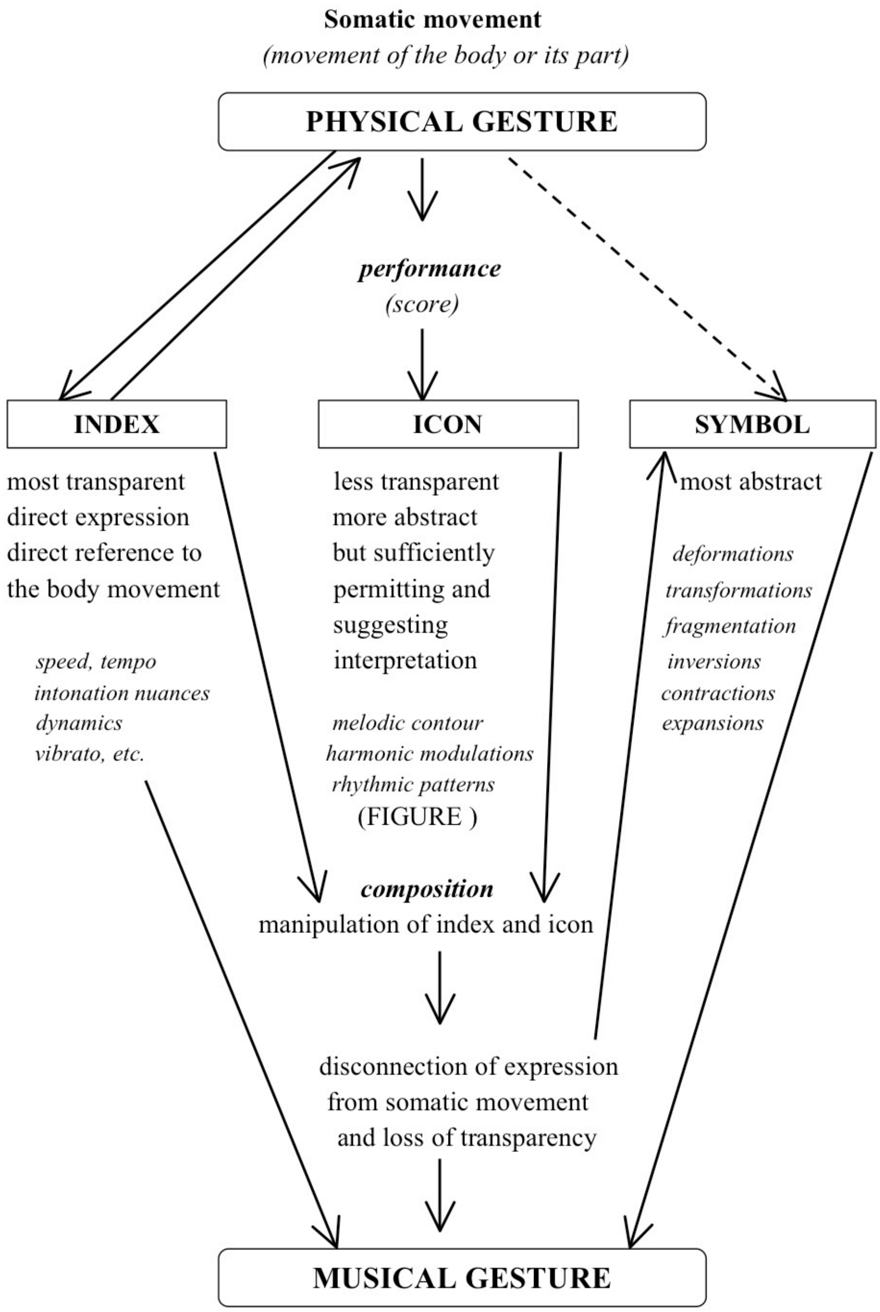

Figure 25. Transformation of physical gesture into the musical gesture from the semiotic perspective.

There are another important Lidov's assumptions regarding the gesture in music viewed from the perspective of semiosis in another of his writings about emotive gesture in music.[196] As he suggests semiotic approach enables at first to distinguish between the musical representation of gesture and the bodily gestures that are represented, and then between bodily gestures from other bodily actions. Second, the differentiation within objects of representation - gestures themselves and distinction between different function in bodily gesture, between innate gestures and acquired gestural behaviors, between gesture and other kinds of movement and between gesture as molecular and compound schemata for gesture. According to these distinctions (and his belief that they are all represented in music) he analyses gestures as realizing 3 functions:[197]

emotive (charged with emotion, like sad and happy),

phatic (as in emphasis, asserting personal power and relationships, not a raw emotion) and

diagrammatic (gestures which point or outline shapes and structures, analogical to linguistic pragmatics).

One gesture may express more than one function, as well as some elements of our gestural behavior are innate, but much of it may be acquired. The bridge between both of these in one gesture may be regarded as a *"further act of representation – the performed bodily gesture represents its innate tendencies through particular behaviour"*.[198] The same innate gesture in one context may be modified in other ways in another context; certain gestural models are innate but the gestural behavior is acquired, culture dependent and shaped by the circumstance. The gesture which is "natural" in one context may become "unnatural" in different context. He concludes his statements that:

> Bodily gesture is a highly delimited and very articulate system of expression, whether or not we can write a dictionary and a grammar for it. It is only when we define gesture narrowly as a class of schemata for brief effort patterns linked with primary emotions that we see the possibility of an innate vocabulary, whatever the details may be. If we

[196] Lidov, David. 2006. "Emotive Gesture in Music and its Contraries." In: Gritten, Anthony and King, Elaine. *Music and Gesture*. Aldershot: Asgate. p. 24-44.
[197] Ibid., p. 25
[198] Ibid.

> think of bodily gesture in this way and if we regard a musical gesture as representing that system, then we are able to formulate an interpretative language for music otherwise impossible. After all, you could not hear a piece starting with truncated gesture unless you already had a notion of that gesture as it could be completed to compare it with. If we do theorize that we have such notions, we can talk about gesture which is repressed, aborted, ambiguous, socialized or ritualize or gesture which is latent or absent. Surely, we do need such composite conceptions to give an account which is elaborate and subtle enough to complement our experience of hearing gesture.[199]

3.2.2. Gesture as "significant energetic shaping through time"

One of the most comprehensive and synthetic approaches to gesture in classical instrumental music has been demonstrated in writings of **Robert Hatten**.[200] His proposal is to see and understand human gesture more generally as expressively significant, energetic, temporal shaping across all human modalities of perception, action and cognition. He defines human gesture as

> any energetic shaping through time that may be interpreted as significant. It may be created or interpreted in any medium or channel, and it may entail any sensory perception, motor action, or their combination.[201]

As we can see, his definition includes not only all variety of significant human motion and their perception, but also the translation of energetic shaping through time into humanly physically produced or interpreted sounds (directly - intonation curves of language, song, instrumental music, or indirectly - representation of sonic gesture in

[199] Ibid., p.42

[200] Hatten, Robert. S. 2004. *Interpreting Musical Gestures, Topics, and Tropes: Mozart, Beethoven, Schubert*. Bloomington: Indiana University Press.

[201] Hatten, Robert S. *A Theory of Musical Gesture and its Application to Beethoven and Schubert.* In: Gritten and King 2006. p.1
Our perceptions and actions are based on the function of *sensorimotor system* that enables us to perceive, move to enhance perception and guide interpretation, manipulate objects, articulate all parts of the body to communicate attitudes, emotions, and information of all kinds and move to interact with environment. Our perceptual awareness of our own body in space and in motion – *proprioception*, provides feedback for our actions no less than our perception of objects and events – *exteroception*.

notation). As musical gestures emerge from musical elements including texture, articulation, dynamics, pitch, and duration, Hatten believes, that any listener will understand "gestural" meanings intuitively.

> Any energetic shaping through time, whether actual or implied, and whether intentional or unwitting, may be considered as a gesture if it may be interpreted as meaningful in some ways.[202]

Hatten's conception of gesture focused on an aural gesture - *significant (meaningful) energetic shaping of sound through time* encompasses also a wide range of gestural competencies, such as interpretation of visual notation and the correlation of aural gesture with other senso-motoric and affective realms of human experience. Although he explores gestures in realms of Western classical music, we will present several of his perspectives and proposals, as they might be applied with some transformations also to other areas of music, such as electroacoustic music, for example. With some attention we may also observe certain similarities with approaches related to gesture in electroacoustic music, which are presented in next chapter.

In Hatten's main observations – movements, involving several parts of sensorimotor system, are integrated into synthetic movement, which with their affective and communicative potential are marked as meaningful and emerge new meanings (not just a sum of their components). These synthetic movements may be considered prototypes of gestural movement. This prototypical gesture *"takes place in the perceptual present of our working memory"*[203] and may be interpreted by 2 perceptual modes: the imagistic and the temporal gestalt perception.[204]

Imagistic perceptual mode is described as a perception of short prototypical gesture and is characterized by an imagistic synthesis of immediate qualitative depth; it enables to process the qualities of timbres and chords, as well as recognizing them as singular objects. (This synthetic mode is common for all object perception and cognition).

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[202] Ibid., compare the similarity of this definition with the Lidov's view of gesture as *"movement which is marked as meaningful"* (Lidov 2005)

[203] Ibid., p.2

[204] Ibid.

Temporal gestalt perceptual mode is the gestalt perception of temporal continuity, which is associated with the cognition of an event (and not simply an object), motivated by the functional coherence or purposeful coordination of its movement; it enables to hear a string of frequencies as a single melody.[205]

Thus, prototypical gesture represents an extremely coherent perceptual gestalt, as it combines in perceptual present both imagistic - qualitative and temporal - dynamic modes of gestalt perception.[206] (Figure 26)

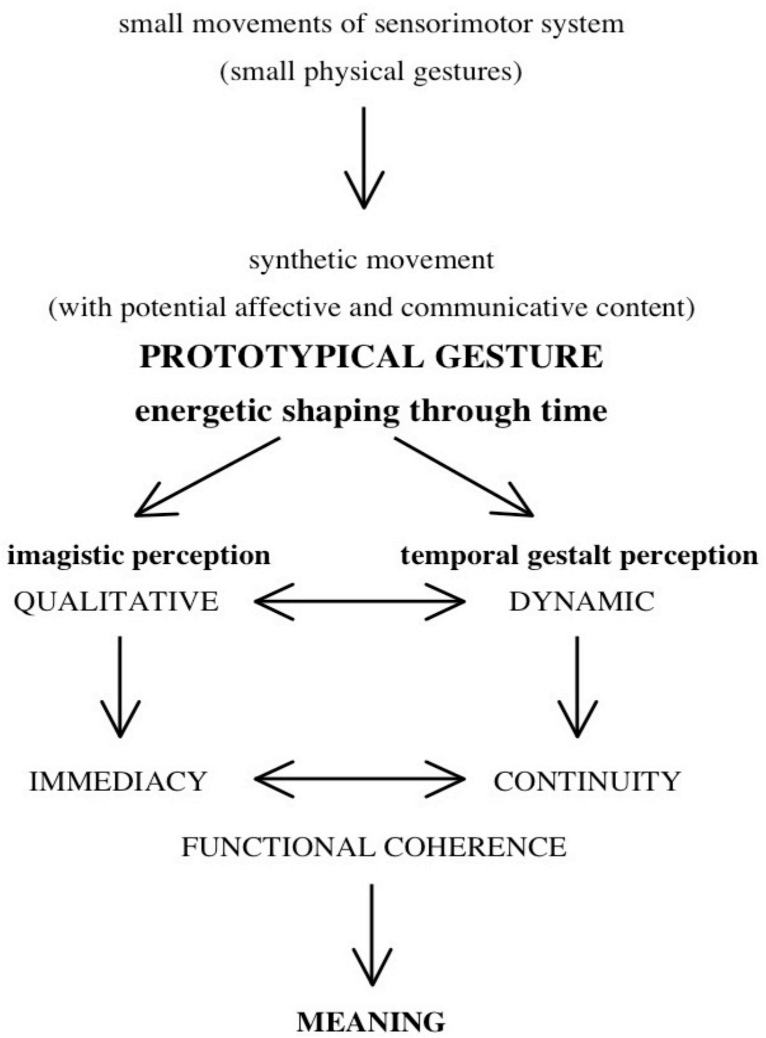

Figure 26. Our scheme of Hatten's concept of prototypical gesture as coherent perceptual gestalt with meaning.

[205] Ibid. The imagistic mode is the crucial mode also for immediate recognition of faces, when we identify the individual and also asses their emotional state.
[206] Ibid.

Hatten's concepts of musical gestures are based on several perspectives, derived from his own observations and we summarized them in the scheme of Figure 27.[207]

1	**Musical gestures are grounded in human affect and its communication.**
	They are not just physical gestures to produce sound or sounds from notated score but characteristic shaping that gives an expressive meaning to those sounds.
2	**Musical gestures have meaning that is both complex and immediate, and often directly motivated by basic human expressive movements.**
3	**Musical gestures may be inferred from musical notation as well as from musical performance.**
	Even if we don't have visual access to the motions of the performer – we can auraly reconstruct the sounds as meaningful gestures.
4	**Gestures may be comprised of any of the elements of music, although they are not reducible to them.**
	They are perceptual coherent synthetic gestalts with emergent meaning and may be synthetized of specific timbres, articulations, dynamics, tempo and their coordination.
5	**The prototypical musical gesture is a unit in the perceptual present (typically within 2 seconds).**
	It has initiation and closure and it can create series of gestures or gestural units analogically to prosodic units in speech.
6	**When gestures encompass more than one musical event (a note, a chord, or even a rest), they provide a nuanced continuity that binds together otherwise separate musical events to continuous whole.**
7	**Gestures may also be hierarchically organized, in that larger gestures can be comprised of smaller gestures.**
	For example phrase structure and melodic contour.
8	**Certain motive-length gestures may be marked as thematic for the movement.**
	They may develop and evolute through variation.
9	**Gestures may encompass and help express rhetorical action, as in a sudden reversal, a collapse, an interruption, or a denial of implication.**
	This is the case of rhetorical gestures and their appearance in a course of work may influence the musical discourse by disruption or deflection and creation of the contrasting discourse trajectory.
10	**Gestures may play a narrative role at a higher level.**
	These higher-level gestures employed by a performer may help direct the listener's attention to the main structural or formal aspects of the work, or an expressive genre.
11	**Gestures provide a level of musical truth, in that they reveal intentions and modalities of emotion and action that make it difficult for music to "lie",**
	but not impossible.

Figure 27. Summary of Hatten's perspectives for concept of musical gesture.

[207] Hatten 2004, p.93-96.

From these perspectives he derives the foundation for following **semiotic theory of musical gesture:**

> Musical gestures are analog, continuous (in shape, curve or motion), possessing articulate shape, hierarchical potential (smaller gesture – low level category can be subsumed by larger ones – high level synthesis) and significant envelope (pre- and postmovement can substantially affect the quality of the sounding gesture), contextually (stylistically and strategically) constrained and enriched, typically foregrounded, beyond precise notation or exact reproducibility but amenable to type-token[208] relationships via cognitive categorization or even conceptualization, and thus potentionally systematic to the extent of being organized oppositionally by type, as in gestural "languages" or ritual movements.[209]

and defines **musical gesture** as:

1. a movement (implied, virtual or actualized) interpretable as a sign, whether intentional or not, and as such it communicates information about the gesturer (or character, or persona the gesturer is impersonating or embodying).[210]

2. movement that is marked as meaningful[211] (according to Lidov's semiotic proposal).

3. emergent gestalt that convey affective motion, emotion, and agency by fusing otherwise separate elements into continuities of shape and force.[212]

and following the Peirce's triad categorizes musical gestures as:

qualitative (firstness) (concerning attitude, modality, or emotional state of the gesturer or presumed agent)

dynamic/directional/intentional (secondness) (revealing reactions, goals and orientations) and

symbolic (thirdness) (relying on conventions or habits of interpretation in artistic styles to convey an "extra meaning' beyond its qualitative and dynamic characteristics).

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[208] Ibid. In Hatten's text t*okens* should be understood as type of gestures that are new sub-types of preexisting stylistic types of gestures. He calls these gestures strategic gestures.

[209] Ibid. p.124

[210] Ibid., p.125

[211] Ibid.

[212] Ibid.

With application of these perspectives in the analysis of Mozart, Beethoven and Schubert gestures, he derives different classes and functions of musical gestures:[213]
stylistic gestures (gestural types, classes) - as conventional energetic shapings through time – with general correlations both expressive (gracious, grieving, etc.) and structural (opening, closing, etc.)
strategic gestures (representing the strategic functions of musical gestures) - tokens of preexisting stylistic types, divided into (sub)types, such as spontaneous, thematic, dialogical, rhetorical or trooping of gestures.

The main goal of Hatten was to construct a useful theoretical concept of musical gesture and demonstrate its importance for analysis and interpretation of musical structure and expressive meaning. His synthetic concept of musical gestures serves for analysis of musical structures not in their separate elements (such as melody, harmony, rhythm, meter, tempo, articulation, dynamics and phrasing, etc.), as it has been done commonly in traditional analysis, but as the indivisible whole – perceptual gestalts. His notion of prototypical gesture as coherent perceptual gestalt allowing through interchange of perceptual information between imagistic (qualitative) and temporal gestalt perceptual modes (dynamic) interpretation of energetic shaping through time as meaningful gesture is one of the most important concepts of his theory, and of the theory of musical gesture.

3.3. Gesture in new contexts. Gesture in electroacoustic music.

The development of new electronic and digital technologies and appearance of electroacoustic music have influenced not only the way we listen to music, but lead also to significant changes in conception of musical ideas in the creative process of composition. In this new context, musical discourse is constructed mainly from sounds, which are elaborated and processed in studio and no more from sounds produced by instruments or performer actions (vocal, instrumental and performer gestures). This

[213] Ibid., p.136.

affects also the role of human physical gesture in the context of musical production as well as its relation to musical gesture.

In first chapters we introduced some of the main aspects of Schaeffer's theory. Although Schaeffer didn't relate his concepts directly with gesture, they became a base for other important researches done in the field of electroacoustic music and contemporary music in general. Interpretation of his concepts of perceptual space have been presented and explained on the relation between gesture and motion.[214] His 7 morphological classes of describing sound objects – mass, harmonic profile, grain (composing a matter), dynamic, allure (composing the form), melodic profile and mass profile (referring to variation) and 3 couples of morphological (related to object facture and its mass), temporal (object duration and its variation during this duration) and structural criteria (considering the balance of the object chosen among the possible structures and the degree of originality for the chosen structural level), represented a point of departure for several important 'gestural' perspectives of last few decades (Smalley, Wishart, Delalande), which are explained in following subchapters.

3.3.1. Gesture as an energy-motion trajectory. Causality.

One of the important approaches concerning the crucial role of gesture as one of forming principles structuring electroacoustic music is spectromorphological concept of Denis Smalley. He is aware of problems, which appeared with new technologies and affected not only listener but also composer of electroacoustic music. Composer stands in front of new task how to draw a new aesthetic path, discover the stability in a wide-open sound world and develop appropriate methods for fabricating sound by selecting the suitable software and technologies. In spectromorphological conception of music and strong concern with gesture and texture, he is trying to find solutions for these problems. Musical gesture, derived from our experience of physical gesture that is concerned with tendency of sound-shapes move forward and texture as a more interior activity drawing attention to the inner details of sounds. According to Smalley, the heart of our experiences in musical time lies in the interplay and balance between these

[214] chapter 3.1.

forming principles. His concept of gesture arises from the observations that although the direct link between gesture and human activity from traditional instrumental music has been disrupted in electroacoustic music, we will somewhat perceive it in the energy of the sound movement.

> Even if the actual sound of structures based on a spectromorphological approach often appears to leave voices and instruments far behind, their formative influence nevertheless persists through gesture: the spectral shapes and shape-sequences created by the energy of physical and vocal articulation.[215]

Thus, gesture may be seen as an "*energy-motion trajectory*"[216], which links the human physical activity with the spectromorphological consequences – the actual sonorous structure. From the point of view of human agent and listener, the musical gesture process may be tactile and visual, but most importantly aural (as the most evident characteristic in case of electroacoustic music), which is related with our more detailed psychological experience. Gesture in Smalley's concepts represents the fundamental strategy of structuring music, together with its complement - the texture and refers to:

> an action directed away from a previous goal or towards a new goal and is concerned with the application of energy and its consequences, it is synonymous with intervention, growth and progress and married to causality.(...) Causality, actual or surmised, is related not only to the physical intervention of breath, hand, or fingers (which is the case of instrumental gesture), but also to natural and engineered events, visual analogues, psychological experiences felt or mediated through language and paralanguage, indeed any occurrence which seems to provoke consequence, or consequence which seems to have been provoked by an occurrence.[217]

Causality plays an important role in this concept of gesture, it relates the event with its consequences (spectromorphology) and is also essential in any kind of interactive projects in mixed music. In instrumental music human agent causes the spectromorphologies through the gestural motion. Even if we don't know what caused

[215] Smalley 1986, p.62
[216] Smalley 1997, p.111
[217] Smalley 1986, p.82

the gesture we can deduce from its energetic profile and spectromorphology the nature of this cause. Deducing the gestural activity from the spectromorphologies may refer back to the proprioceptive and psychological experience. For example, by listening to a energetic crescendo sound (musical gesture), we may imagine a wide "bowing" gesture of the violinist (physical gesture). Therefore, the gestural process is not thought just in one direction, cause → source → spectromorphology, but also the reversed way spectromorphology → source → cause.

> The listener's experience of listening to instruments is a cultural conditioning process based on years of unconscious audiovisual training. Knowledge of sounding gesture is culturally very strongly imbedded.[218]

This cannot be ignored in electroacoustic music creation, where sources and causes participating on sound production are remote and detached from the known physical gestures. If there is no real musical instrument involved, not even an aurally identifiable cause of the produced sound, electroacoustic sounds do not carry the perceptual information equivalent to the intuitive recognition of physical gestures as it is in the instrumental music. According to Smalley, causality then will not be related only with physical human intervention (such as for example breathing or moving hands), which is the case of instrumental music, but also with natural or constructed events, visual analogies, felt psychological experiences or any other occurrences that have capacity to trigger a consequence or vice versa.

The detachment – or remoteness from the known sources and causes Smalley calls ***surrogacy***.[219] He recognizes basically four levels, or degrees of surrogacy, to which listeners perceptually relate 'sounding gestures' to real or imagined physical gestural sources:

first-order surrogacy refers to the situation, where both gestural cause (instrumental) and source (type of material, such as wood, metal) are recognizable – we "see and hear" the gestures (instrumental gestures, or even a recognizable instrumental sound source in electroacoustic music);

[218] Smalley 1997, p.112
[219] Smalley 1986, 1997

second-order surrogacy involves situations, where traditional instrumental gesture is removed from its typical situation - the performance, it can be surmised from the energetic profile but actual instrumental cause doesn't exist or can't be recognized, we cannot verify it by seeing the cause (for example electroacoustic music using the recordings of identifiable instruments or simulations of instrumental sounds);

third-order surrogacy is the case when gesture is deduced or imagined, but we are unsure about the reality of the cause or the source, or both (for example resonant sound structure – we imagine that there was some kind of cause which made the sound sounding as it does, but we don't know what source – material was used, because the sound is not familiar or behaves unexpectedly);

remote surrogacy is related with the most profound and extended transformations of the original sound, where both cause and source are unknown, the human action behind the sound is disappeared and we enter in the domain of psychological interpretation alone.

Working, manipulation and balance between degrees of surrogacy represents one of the main challenges for composer - to explore the medium of electroacoustic music in a way, it would be innovative and perceptively attractive for the listener. Moreover, notion of surrogacy will play also important role in distinguishing timbral relationships between different gestures (instrumental and electroacoustic) in mixed music.

With entering to the field of electroacoustic music, whatever remote the musical gestures would be from the physical causes and sources – human physical gestures, these are somewhat transcended and perceived in the trajectory of the gesture, the energetic tensions and releases conveyed through spectral change. Following this, we may consider movements (trajectories) of the sonorous structures in the space as gestures. This takes us back to the consideration of a space, notion of different spaces and articulations of gestures in these spaces.[220]

[220] chapter 3.1.

3.3.2. Gesture as an articulation of continuum.

Another approach, which influenced the view of gesture, is concept of sonic continuum, developed by Trevor Wishart, the time-space continuum, where all sonorous reality takes place. In his writings gesture is understood as

> ... essentially an articulation of the continuum (...) and the most immediate and yet notationally the most elusive aspect of musical communication.[221]

Wishart describes the western classical composition as the *lattice* based, where primary functions are characterized by three plans – pitch, duration and timbre. Conventional lattice is dealing with the organization of pitch in finite sets and rhythms using summative notation, in usually fixed tempo (two-dimensional lattice, represented in notation, Figure 28) and sets of instruments grouped into clearly differentiated timbre-classes (three-dimensional lattice, Figure 29). For anyone with conventional musical training the sound objects were divisible into these three distinct categories. The combination of each of them may produce different models of sound. Lattice concept and the developed notation based and dependent on this lattice, has led to finite number of possibilities of parametric combinations and so to "restriction of freedom in composition".

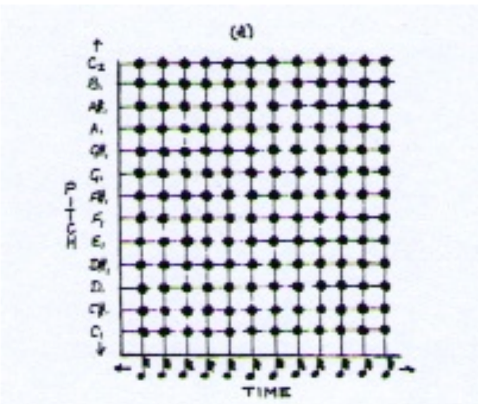

Figure 28. Music on two-dimensional lattice, by Wishart[222]

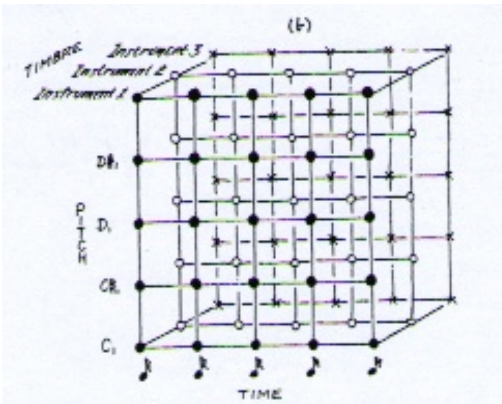

Figure 29. Music on three-dimensional lattice, by Wishart[223]

[221] Wishart 1996, p.17-18
[222] Wishart 1996, p.25, schematic representation
[223] Ibid., p.26, schematic representation

With electroacoustic music we deal no more with the conventional lattice but the sonic reality represented by continuum,[224] which offers interminable possibilities for creating and modeling the sound, infinite world of sound objects with perceptible and differentiable morphological characteristics. (Figure 30)

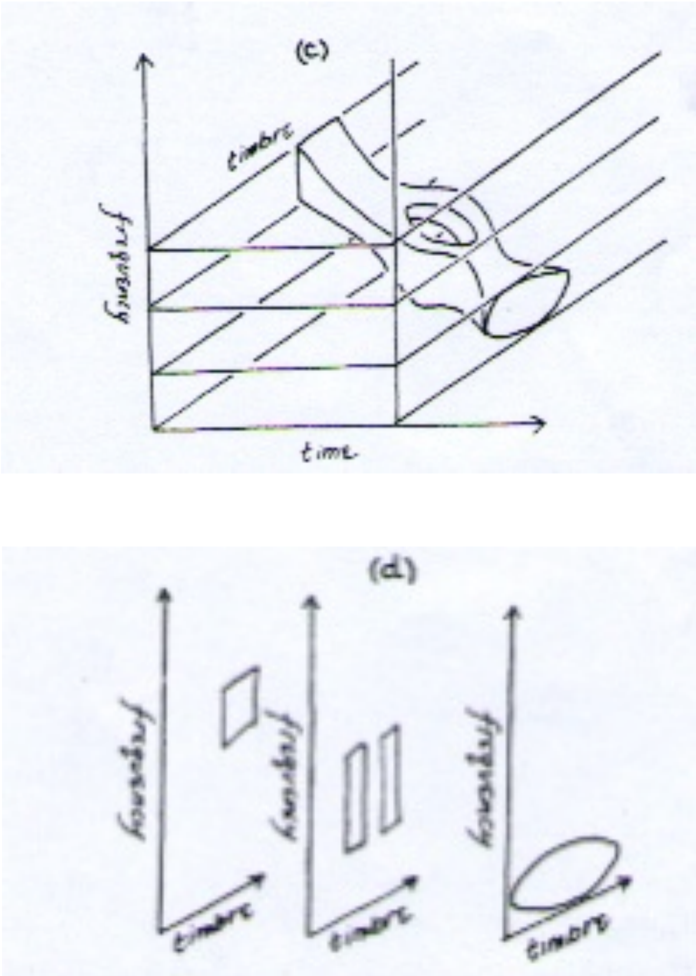

Figure 30. Complex sound object moving in the continuum and the frequency/timbre cross-section of sound at its start, mid-point and end, by Wishart[225]

Wishart arrives to these assumptions through examinations of particular theories and their application to other than musical structures in continuum. By studying the Catastrophe Theory, the evolution of systems through time and differentiation of regimes in time he assumes that similarly as this theory can be applied to formation of

[224] chapter 3.1.1.
[225] Ibid., p.26

bubbles or crown droplets when a drop of water hits the water surface or break the waves or to continuous growth processes of organic structures – various cup-like structures in minute organisms or evolution of organic structures from shells of sea creatures to skulls of primates or humans, it might be applicable also to structures evolving in sonic continuum more precisely to the behaviour of physical objects through time, such as instruments, electronic sources, voice, etc. and to description of time-based acoustic phenomena.

The specific sound structures in this continuum then are *defined as dynamic morphologies* and are characterized as *"sound objects - gestalts with all or almost all their properties in state of change"*.[226]

According to stability of morphologies, he distinguishes between sound objects of stable morphologies and sound objects of unstable complex morphologies (multiplexes). The unstable morphologies are further divided due to their intrinsic morphology to several differentiable perceptual classes: turbulence, wave-break, open-close, siren/wind, creak/crack, unstable-settling, shatter, explosion and bubble and due to their external grouping into alarum, Dunlin-effect and Streaming effects.

We might speculate here and consider these structures proposed by Wishart complex musical gestures. In our opinion, Wishart doesn't talk about sound objects in a sense Schaeffer proposed his definition. Wishart's sound objects don't exist *"independently of their origin and their meaning"*, but they are gestalts with more or less evident connection to both - their source-cause and meaning. For example, creak-crack is strongly related to the concept of physical tension, explosion is found in natural explosions or sound of thunder, bubble is related with physical process of bubble breaking the surface of a fluid, siren/wind is found in waste number of utterances in animals or human beings, wave-break is related to anacrusial tension and resolution, etc.

Apropos Wishart also assumes that in music, which deals with continuum, musical gesture is evidenced in the internal morphology of sound objects as well as in the external overall shaping of groups and phrases. In the context of multidimensional sonic continuum, gestural structure then becomes the primary focus of organizational effort.

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[226] Wishart 1996, p. 93

3.3.3. Gesture and temporal semiotic units.

In the Laboratoire de Musique et Informatique in Marseille (MIM), the team of researchers tried to find the way how to approach electroacoustic music, and give to listener the tools for understanding the evolution of the musical thought in the new contexts, where music is no more represented by certain styles, neither does refer to common basis of musical expression and composer's interest is shifted to the morphologic qualities of the sounds. They departed from the typomorphological research of Pierre Schaeffer, which offers a useful descriptive vocabulary and classification of the sounds according to the morphological criteria (see chapter 1.4.). However, as his perspective is based on reduced listening, which disregards all causal or associative meanings of the sounds, it becomes unsuitable, when we consider music as *"meaningful object"*.[227]

As a possible solution MIM developed the new approach for analysis and comprehension of electroacoustic music, based on both - morphologic (duration, reiteration, phases, matter/material, acceleration, temporal progression) and semantic characteristics (direction, movement and energy) (Figure 31). From analyses of temporal organizations expressed in different musical works, segmentation of these works and examination of the segments according to morphologic and semantic criteria, they identified numerous dynamic forms, which were grouped in classes - called ***temporal semiotic units*** (UST)[228]**.**

They are defined as

> sound fragments that, even out of their musical context, have a temporal signification due to their morphological organization.[229]

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[227] Delalande, François. 1996. "Les Unités Sémiotiques Temporelles: Problematique et essai de définition" In: Jacques Mandelbrojt (ed.) *Les Unités Sémiotiques Temporelles – éléments nouveaux d'analyse musicale*. Marseille: Édition MIM – Documents Musurgia. 17-25.

[228] in related bibliography there is often used an abbreviation of the term - UST, which is derived from its french original – *"unité semiotique temporelle", unit* - musical fragment, *semiotic* - these fragments are carriers of meaning (often in relation with something extra-musical), *temporal* - the meaning is a function of the way how the sonorous matter is organized, evolves in the time. Favory, Jean. 2007. "Les Unités Sémiotiques Temporelles." *Mathematics and Social Sciences* 178 (2): 51-55.

[229] Delalande 1996.

Caractéristiques morphologiques

Durée	Délimitée dans le temps Non délimitée dans le temps
Réitération	Avec Sans
Phases	Une Plusieurs
Matière	Continue Discontinue
Accélération	Oui (donc évolution dans le temps "exponentielle") Non (donc évolution linéaire) Positive (en allant de plus en plus vite) Négative (en allant de moins en moins vite) Variée
Déroulement temporel	Rapide Moyen Lent

Caractéristiques sémantiques

Direction	Avec Sans
Mouvement	Déplacement Sans déplacement
Energie	Convertie Maintenue Accumulée Retenue

Figure 31. Morphologic and semantic categories for classification of UST[230]

[230] Mandelbrojt, Jacques. 1996. : *Les Unités Sémiotiques Temporelles– éléments nouveaux d'analyse musicale*. Marseille: Édition MIM – Documents Musurgia.. Marseille: MIM. p. 49

The new classification, consisting of 19 different types of UST determines a nomenclature (vocabulary) of terms, showing the main "behavioral" features of each of these specific units, often as a metaphor evoking the meaning: falling, contraction-expansion, momentum, floating, in suspension, stretching, braking, heaviness, obsessive, by waves, advancing, turning, that who wants to start up, without direction by divergence of information, without direction by excess of information, stationary, wandering, suspension-interrogation, inexorable trajectory.[231] Each class type is then provided with a description of global morphologic, semantic and other important characteristics. In the electroacoustic music, UST exist as:

> ... sound configurations, that seem to be carriers of a very specific "signification" on the temporal plan. Sometimes, it is a configuration that we find in a particular piece, but sometimes on the contrary, it appears in diverse contexts and under slightly different shapes, but always having more or less the same effect or the same temporal significance (meaning).[232]

Although Delalande and the team in MIM don't employ the term 'gesture', in this context, we may consider the temporal semiotic unit an equivalent of gesture or in other words, gestures may be seen as "*units with meaning, which are developing in time*" (there is a temporal, spatial and semiotic component).[233] The perspective of temporal semiotic units seems to be one of the most synthetic theoretical approaches to the phenomenon of gesture. As this perspective is approaching musical work independently from culture, period, style or genre, it may be applied not only to electroacoustic music but to any contemporary or classical music and practically to any musical work produced nowadays or in the past.

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[231] these names should be considered just as a label, not as the meaning of UST (Favory 2007)

[232] our translation of original citation: *"... des configurations sonores qui semblent produire un "effet", ou, dans une formulation pour l'instant tout aussi vague, être porteuses d'une "signification" bien spécifique sur le plan temporel. Quelquefois c'est une configuration qu'on ne trouve que dans une œuvre particulière, mais quelquefois au contraire elle apparaît dans des contextes divers et sous des formes légèrement différentes, mais en ayant toujours a peu près le même effet ou la même signification temporelle."* (Delalande 1996, 18)

[233] compare with chapters 3.1. and 3.2.

3.3.4. Gesture and figure.

Brian Ferneyhough in his **duality concept of gesture and figure**,[234] distinguishes between gesture as *"an objective unit, material-bound presence",* that has a *"specific delineation"* in time and space and *"can be examined in whatever level",* and that is *"an iconic representation of the emotion"* (composer writes down the gesture from the observation of the emotion in himself) and figure as a subcategory of gesture - a consequence of *"gesture deconstruction in parameters"*.[235] But it is not that "simple", as his further statements show.

> The thing which distinguishes the figural way of constructing or observing a gesture from the gestural part of the gesture is that one is attempting to realize the totality of the gesture in terms of its possible deconstruction into parametric tendencies.[236]

Ferneyhough is convinced, that nowadays composer no longer tries to create gestures through automatic results of combinations of abstract parameters, as it used to happen in serial music. On the opposite:

> ... one attempts to so construct gestures that the parametric qualities of which they are composed are released into the world of music – into the future (...) So at the moment in which the gesture actually dissolves into the future, certain parametric elements (...) embedded in this gesture are released in order to be able to conflate in different ways, or coincide to produce new gestural units.[237]

At the moment of dissolution of gesture, gestural material is able to be released as formal energy (figure), that may be further 'shaped' and configurated in new gestural forms. Then figure, according to Ferneyhough is proposed as following:

> Gesture whose component defining features – timbre, pitch contour, dynamic level etc. – display a tendency towards escaping from the

[234] Ferneyhough, Brian. 1982. "Form-Figure-Style: An Intermediate Assessment." p. 21-28; "Il Tempo Della Figura." p. 33-41; "Interview with Richard Toop." p. 250-289. In: Boros, James and Toop, Richard (eds). *Brian Ferneyhough – Collected Writings*. 2006 (reprint of 1998). London: Routledge.
[235] Ferneyhough 1983, p.285
[236] Ibid.
[237] Ibid.

> specific context in order to become independently signifying radicals, free to recombine, to 'solidify' into further gestural forms may be termed figure.[238]

He describes then the ideal situation of compositional concern as such, where neither the abstract gesture, nor the generation of gestures according to parametric thinking stands in center, but the *"gesturally justified free employment of parametric information."*[239] Going back to the distinction between gesture and figure from the beginning of this subchapter, gesture for Ferneyhough is not "just" a representation of emotions, neither the abstract parametric organization, as well as figure is not "just" result of a gesture deconstruction in parameters. He further examines gesture and figure along the concepts of musical energy and force, as the more precise perspectives for understanding the relations between musical objects. While musical energy is invested in concrete musical objects to make them capable of rendering the forces acting upon them, musical forces arise in the "space" between objects – in a moment of perceptual differentiation, *"when identity is born"*.[240] The vehicle of these forces is the connective stimulus arisen from the act of moving from one discrete musical event to another. In this context he defines gesture and figure as following:

> Gesture is a 'frozen force', it stands for expressive sentiment, for an absent exchange of expressive energies. (...) Figure stands at the intersection of defined, concretely aperceptible gesture and the estimation of its critical mass – its energic volatility."[241]

Figure then represents a kind of vehicle of musical meaning, a constructive and purposive reformulation of gesture and the means of contact with the other gestures:

> ... it does not exist, in material terms, in its own autonomous right; rather, it represents a way of perceiving, categorizing and mobilizing concrete gestural configurations. (...) No figure is exclusively or merely a figure, just as no gesture is ever devoid of its proper aura of figural connotations to be activated at will."[242]

[238] Ferneyhough 1982, p.26
[239] Ferneyhough 1983, p.285
[240] Ferneyhough 1984, p.35
[241] Ibid., p.35-38
[242] Ibid., p.37-41

This leads to the central concern - establishment of criteria of intentionality:

> If parametric constituents of gestures are not to be more plausibly perceived as largely independent of their 'matrix' (in the sense of being consciously 'aimed' elsewhere) we will scarcely be able to speak of their particular directional energies. (...) Without the ability to 'infiltrate' the structure of the work on various parallel levels composers would scarcely find themselves possessed of the capacity to trap, accumulate and strategically redirect the energies which the figural dissolution of the gesture calls forth.[243]

As figure is not an autonomous unit, but an abstract unit constructed of relations between parameters, to be understood and exist in reality, needs the concrete sonic manifestation – the gesture. Gesture, on the other hand, to relate with other gestures will need a mediator – the figure. Thus, figure will serve as a "connective stimulus" in the relationship between two or more gestures – to explain and understand particular directional energies between these gestures. In other words, figural content of gesture (the deployment and layers of parametric information) has to be able to generate enough energy to escape from the *"gravitational walls of the gesture itself",* dissolve the gesture to which it belongs. The figural content then after dissolving out of general context of gesture and expanding into conceptual space, has to have enough individual energy to connect with other parametric layers to form new gestural units. This is the condition of significance of the figure. For Ferneyhough, in composition *"to lay out set of propositions one must be concerned with gestures"* – gestures as extremely clearly focused musical ideas that have the capability to draw attention to the piece.[244] Gesture in this context has to have a developmental potential, which is provided by its significant figural content.

Maybe little simplicistic, but enough exemplified, we would like to make a final summary of the difference between figure and gesture, as we understood, by borrowing an analogy from the genetics, and present figure as "genotype" - combination of parameters determining a specific characteristic or trait and gesture as "phenotype" – the realization of the genotype in the perceptual space.

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[243] Ibid., p.38
[244] Ferneyhough 1983, p.286

3.4. Gesture and energy.

The energetic conception or conception of musical energy seems to be one of the key features in approaching the phenomenon of musical gesture and is present not only in Hatten's perspectives in classical instrumental music – gesture as *energetic shaping through time,* seen in an example of a melody, where its gestural energy is phenomenologically more fundamental than a sequence of pitches which constitute the melody, but also in many other above presented perspectives in contemporary music: *energy and force* as crucial concepts in distinguishing between gesture and figure, gesture in electroacoustic music as *energy-motion trajectory*, concept of gesture as *energetic shaping through time* or *criterion of energy* as an important semantic characteristic in the categorization of semiotic temporal units.

In music, energy is present in motion, in time, it is never destroyed, just may be transformed. Force has to be applied to change the form of energy. Neither force nor energy can exist without the other. Energy transforms to other forms because of the force, but the existent force is also dependent on the amount of energy. This reaction between energies and forces may be seen in the gestural interaction, when one gesture may potentiate or trigger the onset of another one, or accelerate its termination. In terms of energy, we may imagine that gesture can have increasing intensity, decreasing intensity or be constant; energy may be maintained, accumulated or converted; localized or diffused. Energy is condition of movement and of temporal shaping. Energy in music is omnipresent; there are no events without its presence, without its application or its shaping. Finally, the sound itself is the energy, a form of mechanical vibration, which propagates into our "aural universe".

> The concept of gesture (like the one of time itself) is endlessly fascinating, because it touches upon a competency that is fundamental to our existence as human beings – the ability to recognize the significance of energetic shaping through time.[245]

[245] Hatten 2004, p.93

3.5. Gesture and notation.

Approaching the phenomenon of musical gesture we can't avoid mentioning the problem of gesture and notation, which drew attention of many discussions. Already by analyzing the traditional instrumental music, it was recognized that the score doesn't represent the gesture in its all qualities. Lidov is very sure about this aspect when he writes:

> I am absolutely convinced that musical notation cannot fully specify representations of gesture (...) I do not think that gestural expression relies on a system of equivalence classes as notation must, and, furthermore, the critical particularities of gesture are very subtle.[246]

Hatten's investigations about gesture suggest, that:

> Gestures may be inferred from musical notation, given knowledge of the relevant musical style and culture or even without access to these informations.[247]

He assumes that performers even without access to relevant cultural or stylistic information will try to find the suitable gestural expression of musical score by adapting it to the expressivity of their own body. According to this, certain gestural qualities may be deduced from the score. Gestures may be inferred also from a musical performance, and more - even when we do not have visual access to the motions of the performer, we have sufficient aural imagery to deduce gestures, by reconstructing as meaningful gestures those sounds, which are combined in a nuanced way. However, the notation, discrete in its symbols cannot adequately represent the continuities of gesture. That might also be one of the reasons, in Hattens's words, why historically there is given the importance of gesture to interpretation. Conventions of style in earlier times helped performers to create gestural continuities beyond those represented in the score.

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[246] Lidov 2006, p.25
[247] Hatten 2004, p.94

> The history of the slur the smoothly analog curved line connecting two or more notes, gives evidence of one attempt to represent not merely continuity of the sound, but more importantly continuity of gesture.[248]

According to Wishart, gesture due to its nature is elusive, regarding the notation and can't be crystallized in the graphy. As musical notation doesn't comprise all the aspects of music, in this context the occurrence and recognition of gesture from the phenomenological perspective represents certain difficulty. It is not possible to fully capture musical gesture in notation (score), it is possible only to indicate the gestural intention for what one looks for in the composition. The problematic relationship of gesture to the notation is presented in following Wishart's quotation:

> I am not suggesting for one moment that melody is reducible purely to a gestural description but mean merely to indicate that gestural thinking is not confined solely to aspects of sound experience which are not normally notated. The important thing about gesture or dynamic morphology in general, is that it is essentially a time-varying property of a whole sonic object and cannot be atomized in the same way that pitch-lattice components can be separated through their discrete notation. Conversely, this property of the gesture is one reason why it can be applied to the analysis or control of sound-objects which are varying in a continuous manner in many dimensions of the continuum. It does not need to be atomized or broken into dimensions, though of course, gesture articulated in independent ways in several different dimensions can carry more information than a gesture whose evolution takes place in the same way in all dimensions.[249]

Wishart affirms here that not all aspects of the musical gesture escape from the score; on the other hand the essence of the gesture is certainly not contained in the musical notation. The musical gesture happens in the time in itself, and therefore it cannot be dissected into its component elements and crystallized through the notation. The "atomization" of the gesture brings his de-characterization.

The impossibility of capturing all gestural aspects in score has been a "justification" for using a score only as a supportive material in analysis in this research and the main focus has been concentrated on the "aural gesture" and the way we perceive it and its relations.

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[248] Ibid., p.113
[249] Ibid., p.112

3.6. Summary.

Understanding musical gesture from the wider perspective and considering its *hierarchical potential*, it can be regarded on different levels as:

- detail in a piece of music,
- overall movement of the piece or
- feature of a whole style.

Musical gesture may also be understood from different perspectives, as:

- *"movement"* and *"expression (meaning)"* (Lidov),
- *"meaningful energetic shaping through time"* (Hatten)

Gesture may be related more to:

- *"notion of causality"* and be "*concerned with application of energy and its consequences"*, it is an *"energy-motion-trajectory"* (Smalley)
- or to its communicative and expressive potential as an *"articulation of continuum"* (Wishart)

- relationships between gestures may be created through their figural content (Ferneyhough)

So, what is this rich and complex phenomenon, called musical gesture? We could say, that by listening to music, in certain moments we (intuitively) have feeling of "structural sound elements" – determined by:

- moving from one point to another; they have their own specific path in time (MOVEMENT)
- expressing "something" (MEANING)
- transferring and carrying "kind of energy" (they have an ENERGETICAL POTENTIAL)
- and may represent and induce specific emotions and psychological states (CARRIER AND INDUCTOR OF EMOTION).

- We can sense that these structural elements are musically "multidimensional" (location, time, space…) and if simplified, can have different graphical representations (line, curve, zigzag, etc.) [250]

We may say that musical gestures are in a certain sense objective, but our attitudes towards them is subjective and may vary quite significantly. In other words, just imagining a case of a simple interval, for someone it is "just an interval", for another one it may be a "cell" or a "motive" and somebody else may consider it even a "theme", etc. Probably each one will have his own true, approaching the interval with different perspective.

In other speculations, we may examine a single pitch (note), which just by itself won't be a gesture. As soon as there is an energy applied, carried or put into an articulation of this note, we may consider the musical result - the articulated note a smallest gesture (there is a "micro" movement – vibration of the frequency in time (duration), it carries an energy which has been applied to make it vibrate, the energy may be perceived as a shaping of intensity and evoke a tension and expectation (crescendo vibrato note) or relaxation (decrescendo vibrato note), which will represent the semantic character in musical context.

The identity of musical gesture is born only when we hear it, in our perception; it starts to exist only when we can listen to it in the musical context.

[250] Although Wishart disagrees with simplification and atomization of the gesture in graphic symbols, in our opinion some of the sound characteristics, such as for example the overall gestural shapes, may be simplified using the graphical representation.

Chapter IV. ANALYSIS – IDENTIFICATION, DESCRIPTION AND CLASSIFICATION OF INTERACTIVE GESTURE RELATIONSHIPS.

The sensitive ear interacts with sound, constantly experimenting, probing, assessing. What is 'right' is what works for the ear and for the perceptual/intellectual mechanism of interaction we call listening. Listen…

Jonty Harrison

The complex qualities and potential of gesture in structuring music establish an important role of gesture in creation and analysis of musical discourse. In mixed electroacoustic music, which connects two distinct worlds each based on materials of different nature, interaction through musical gesture represents a 'point of contact', one of the possible connections between these two worlds. This analytical part of the research departs from the variety of approaches to musical gesture in electroacoustic, contemporary music and music in general, to include the relations between two sound events with different characteristics - the electronic and the instrumental. The aim is to show how the phenomenon of musical gesture can be used in perception and understanding of musical interaction in mixed music, through examples of analysis, systematization, classification and categorization of different kinds of interactive gestural relationships between instruments and electronics. The goal is to establish specific models of interaction that can be applied with a personal perspective, both to analysis as well as to the composition of new works. Some of the researched models and new ones invented have been used as models for my own works for instruments and electronics, or even applied in my instrumental or acousmatic compositions.

The interaction on the level of musical gesture may be explored from many different perspectives and will be studied here in following levels:

1. from the perspective of elementary musical characteristics, such as pitch, duration/rhythm. timbre and dynamics;

2. from the viewpoint of tripartite model of structure (onset – continuant – termination);

3. from the perspective of counterpoint;

4. from the point of view of certain spectromorphologic-semantic characteristics, such as direction and energy;

5. in the spatial context, considering the diverse space relationships of gestures, due to their motion characteristics during spatialized performance.

These perspectives let us arrive to numerous models and categories of interactive gesture relationships. We would like to remark, that all examples may have different interpretations and even one example can be analyzed from different perspectives. Although presented examples have been chosen to represent specifically one category, they may apply to several categories (for example one example of gesture interaction may be categorized because of pitch or rhythmic relations, but can be analyzed also from the semantic or contrapuntal perspective).

4.1. Elementary models of gesture interaction.

This perspective is focused on different ways of interaction between two or more gestures from the point of view of the elementary musical characteristics - pitch, duration/rhythm, timbre and dynamics, as integrated dimensions of gesture.

In conventional instrumental music we were used to consider pitch and rhythm the two primary parameters of musical structure, where pitch was concerned with the disposition of the frequencies of musical notes and rhythm with the description and understanding of their duration and durational patterns. Along Wishart's concept of lattice, the development of traditional notation, based on representation of pitch and duration, delineates two-dimensional lattice. The concept of instrument as a source of stable timbre and grouping of instruments into families with distinct timbral characteristics expand the lattice notion further – into three-dimensional lattice, made up of discrete pitch-levels, durational values and timbral types (pitch, duration, timbre).

However, in electroacoustic music, according to Wishart, we are dealing with the sonic continuum, where the whole sonic objects are dynamic morphologies - gestalts with constant evolution of all their properties through time and they often cannot be atomized into the separate components as it was possible in the lattice based musical objects through their notation. In the definition of dynamic morphology Wishart avoids using the term parameter,[251] as the concept of musical event based on integration of parameters is related directly to the lattice-based musical theory and instead he uses the term property. Dynamic morphology then is seen as the totality (gestalt) of various properties. Thus, in general

> sound objects with dynamic morphology can be only apprehended in their totality and the qualities of the process of change will predominate in our perception over the nature of individual properties.[252]

As we mentioned in chapter about gesture and its relation to continuum (chapter 3.3.2.) the term dynamic morphology in Wishart's texts may be often understood as a 'synonym' of musical gesture.[253] Of course, Wishart writes about dynamic morphologies in acousmatic music. However, in approaching mixed music, where musical objects are based both on traditional lattice and continuum, in our personal opinion, the nature of individual sound properties and their evolution and comparison, will be the point of contact for analyzing or creating connections and interactions between musical gestures, each one based on such distinct concepts as lattice and continuum. We can note that the concept of gesture-figure, finds here its useful practical application, where connections between gestures will be found in their figural organizations and evolutions (organizations of different sound properties/parameters). We can go further and state that although our perception of gestures as gestalts will primarily predominate the perception of individual gestural properties, the intentional turn of attention towards the aspects of gestural articulations in their different properties will help to understand the connections and unfold possible ways of interaction between gestures (Figure 32).

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[251] Wishart defines parameter as *"any property of a sound or a sequence of sounds which can be musically organised. Parameter often implies the measurability of that property."* Wishart, Trevor. 1994. *Audible Design. A plain and easy introduction to practical sound composition.* Orpheus the Pantomime Ltd., p.126

[252] Wishart 1996, p.94

[253] Ibid., p.112

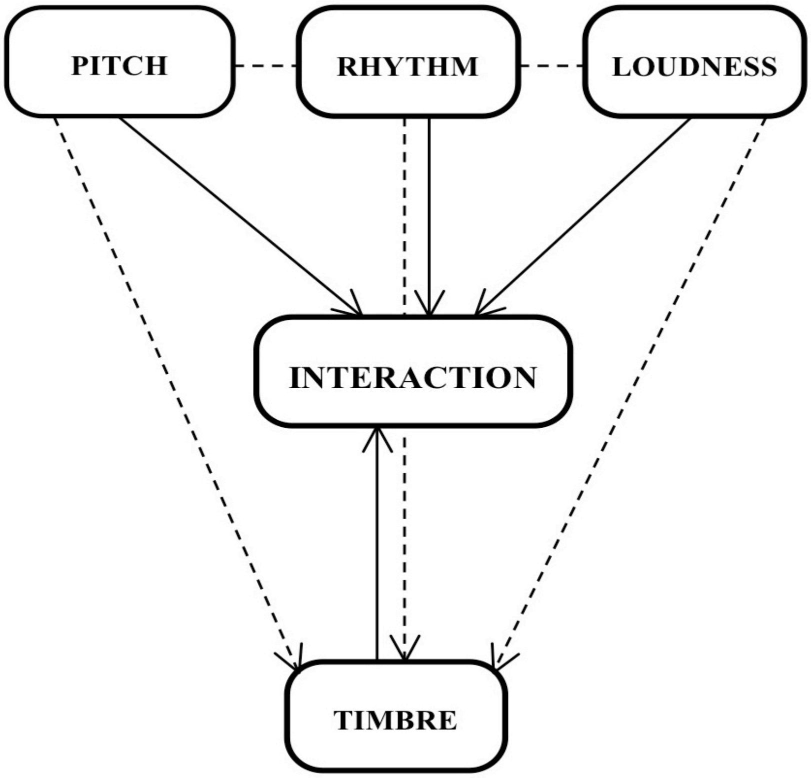

Figure 32. Gesture interaction based on elementary musical characteristics.

4.1.1. Gesture interaction by pitch/frequency similarity or difference.

Pitch is subjective sensation, generally defined as a

> particular quality of a sound that fixes its position in the scale and is determined by what the ear judges to be the most fundamental wave-frequency of the sound,[254]

in other words, it is

> human perception of the physical phenomenon of frequency – the number of oscillations per second of a periodic waveform.[255]

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[254] The Oxford Online Dictionary of Music, (accessed on November 26, 2009).

[255] Simoni 2006, there is logaritmic correlation between frequency (Hertz-Hz) an our perception of frequency described as a pitch.

Pitch is the basic dimension of musical sounds in which they are heard to be high or low. It is the subjective sense of frequency and is concerned with perception of sound (psychoacoustic variable), whereas frequency is concerned with the physical characteristics and behaviour of sound (acoustic variable). In electroacoustic music, there is often no exact pitch to be identified and in describing electroacoustic sounds we may refer rather to the frequency and frequency ranges of sounds.

Two or more gestures may be related according to their composed pitches/frequencies and create relationships either by similarity of pitch/frequencies or their difference. Then we can recognize following gestural relationships:

1. Fusion by merging identical pitch/frequency – both instrumental and electroacoustic gestures are identical in their pitch/frequency structure.

Ex. 1: Jean-Claude Risset: Passages.[256] In this example interaction between electroacoustic gesture and flute gesture is done by merging in the identical pitch (d2). Flute vibrato blends with the same frequency and vocal sound vibrato in the electroacoustic part.

Ex. 2: Petra Bachratá: Reflection.[257] In this example there is identical pitch structure in simultaneously sounding marimba gesture and virtual marimba gesture in tape.

Ex. 3: Jonathan Harvey: Advaya.[258] Although in the score the gesture structure and pitches indicated in the cello are the same as in the tape part, the recording reveals that in reality the same pitches in both gestures are presented in different octaves.

The previous three examples show merging in pitch/pitch structure in simultaneity. But two gestures may relate by identical pitch structure also separated in time:

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[256] Risset, Jean-Claude. 1982. *Passages* for flute and tape. In CD: *Jean-Claude Risset. Songes. Passages. Computer suite from little boy. Sud.* Wergo Schallplatten, Mainz. WER 2013-50. 1988. Track 3, 4:22-4:37. Risset, Jean-Claude. 1988. *Passages pour flûte et bande magnétique*. Paris: Editions Salabert. p. 22 - 23, 3:04-3:19.

[257] Bachratá, Petra. 2005. *Reflections*. Unpublished author's recording. 5:48-5:49. Bachratá, Petra. 2005. *Reflections* for marimba and tape. Unpublished author's manuscript. p. 6, 5:48-5:49.

[258] Harvey, Jonathan. 1994. Advaya pour violoncelle solo, clavier numérique et dispositif électronique. In CD: *Jonathan Harvey. One Evening..., Advaya, Death of Light/Light of Death.* Ensemble Intercontemporain. IRCAM, Centre Georges Pompidou, Paris. Adès 206 942. 1999. Track 5, 5:39-5:46. Harvey, Jonathan. 2001. *Advaya for cello, electronic keyboard and electronics*. Harlow: Faber Music.p.8

Ex. 4: Petra Bachratá: Reflections.[259] In this example superimposed on the accelerando-ritardando marimba gesture there is a "little-bell-like" resonating tape gesture, which is repeated in marimba with exactly the same pitches.

2. Fusion by similarity of frequency – where closer connections between gestures are created by similar frequency range. According to the approximate frequency range, we may distinguish:

a. Fusion in low frequency range – two gestures are composed of pitches or sounds belonging to low frequency range.

Ex. 5: Jonathan Harvey: Advaya.[260] Cello and electroacoustic glissando gestures are blending in the low and middle frequency range.

b. Fusion in middle frequency range – two gestures are composed of pitches or sounds belonging to middle frequency range.

Ex. 6: Petra Bachratá: Mystic Garden.[261] Interaction between instrumental gestures in accordion and flute and electroacoustic gesture is done by their fusion in the middle frequency range.

c. Fusion in high frequency range – two gestures are composed of pitches/sounds belonging to high frequency range.

Ex. 7: Isabel Soveral: Heart.[262] Tape glissando gesture interacts with the guitar accelerando gesture by similarity of their frequencies in high register.

Ex. 8: João Pedro Oliveira: Cassiopeia.[263] Fast piccolo and harp gestures in high register are blended with similar type of tape gestures (derived from the flute sound) in

[259] Bachratá 2005. 0:40-0:44, p. 1.
[260] Harvey 1994. 3:12-4:00, p. 5.
[261] Bachratá, Petra. 2007. *Mystic Garden*. In CD: *Música Contemporânea*. Numérica. NUM 1156. 2008. Track 6, 5:09-5:19. Bachratá, Petra. 2007. *Mystic* Garden for flute, accordion, piano and electronics. Unpublished author's manuscript. p. 9, measures 77-80.
[262] Soveral, Isabel. 2001. *Heart*. In CD: Isabel Soveral & António Chagas Rosa. *Pas de deux*. Portugaler. 2010. Second beat: 2:48-2:52. Soveral, Isabel. 2001. *Heart* for guitar and tape. Unpublished authors manuscript. p. 12.
[263] Oliveira, João Pedro. 2008. *Cassiopeia*. Unpublished author's recording. 8:27-8:45. Oliveira, João Pedro. 2008. *Cassiopeia* for orchestra, amplified percussion and electronics. Unpublished author's manuscript. p. 21.

high frequency range.

3. Contrast by distinction of frequency represents combination of two gestures, which are composed of pitches/sounds belonging to distinct frequency ranges (for example instrumental gesture constituted from high pitches combined with electroacoustic gesture constituted of sound/s of low frequency or vice versa).

Ex. 9: Rajmil Fischman: Los Dados Eternos.[264] Sad crying high oboe gesture is contrasting with the low tape vocal gesture.

4. Interaction by fluctuation of the frequency widths is a relationship between two gestures (connection of two gestures), which are both instable in pitch, for example instrumental vibrato articulation and electroacoustic gesture composed of sound/s with fluctuating, oscillating frequency.[265]

Ex. 10: Rajmil Fischman: Los Dados Eternos.[266] High screaming oboe gesture and the lower frequency electroacoustic gesture interact by vibrating and fluctuating their frequency.

5. Noise-based interaction – relationship between gestures, which don't have identifiable pitch.

Ex. 11: Karlheinz Stockhausen: Kontakte.[267] In this example interaction between sforzando, crescendo and decrescendo instrumental gestures - percussive gong and tam-tam tremolos, piano glissandos and crescendo-decrescendo electroacoustic gestures is based on the noise-characteristics of the sounding gestures. Perceptually there is no pitch identifiable.

Ex. 12: João Pedro Oliveira: Cassiopeia.[268] Instrumental glissandi on xylophone,

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[264] Fischman, Rajmil. 1991. *Los Dados Eternos*. Unpublished author's CD recording. 2:53-3:06. Fischman, Rajmil. 1991. *Los Dados Eternos* for oboe, tape and real time processing. Unpublished author's manuscript. p. 9, approx. 2:38-2:51 – part corresponding to the text - oboe: Dios mio - Dios mio estoy llorando - Dios mio - llorando el que vivo, tape: Dios-mio - Dios – Dios-mio.

[265] The fluctuation in the sustainment of sound objects is described in Schaeffer's theory as *"allure"* and in general it may be described as every type of vibrato. (Schaeffer 1966, Chion 1983)

[266] Fischman 1991. 8:50-9:01. p. 19, 2:36-2:47.

[267] Stockhausen, Karlheinz. 1959-1960. *Kontakte*. In CD: *Karlheinz Stockhausen: Kontakte, Refrain, Zyklus*. Koch Schwann-Musica Mundi. 1994. Track 3, 23:30-24:00. Stockhausen, Karlheinz. 1966. *Kontakte* for electronic sounds, piano and percussion. London: Universal Edition. p. 26-27.

[268] Oliveira 2008. 22:41-22:49, p. 51.

vibraphone pipes and harp, tremolo on small percussion instruments – ratchet, sand blocks and guiro are fused with tape percussive type of fast gestural articulations into a large noise gesture. Simultaneous harmonic trill on the strings becomes more audible only at the end of the noise-based gesture, which "somewhat" filters into this clearer sound, that continues till the end of the piece.

Ex. 13: Petra Bachratá: Mystic Garden.[269] There is an interaction between noise-based gestures in accordion and tape with similar timbral characteristics.

4.1.2. Gesture interaction based on temporal organization.

Duration is defined as:

> length in time of a musical event and may be described in terms of relative or absolute time.[270]

One event is twice as long in relation to another one (relative) or the duration of an event is precisely three seconds (absolute). The notational system recognizes objects to characterize relative durations, such as whole note, half note, quarter note, eight note, sixteen note, etc. If included precise tempo, these may be interpreted as absolute. For example, without tempo indication eight note is a relative duration – it is one eight of a whole note; with indication of tempo quarter note equal to 60 beats per minute, the absolute duration of an eight note will be half second.

There are three basic modes of temporal organization of music – pulse, meter and rhythm. While pulse is one of a series of regularly recurring, precisely equivalent stimuli, which mark off equal units in the temporal continuum, meter is the measurement of the number of pulses between more or less regularly recurring accents and rhythm may be defined as the way in which one or more unaccented (weak) beats are grouped in relation to an accented (strong) one.[271]

In other words, rhythm is a movement (temporal organization) that is marked by succession of strong and weak elements, it involves patterns of duration. More broadly,

[269] Bachratá 2007. 5:24-5:54. p. 9, measures 81-88.
[270] Simoni 2006
[271] Grosvenor Cooper and Meyer, Leonard B. 1960. *The Rhythmic Structure of Music*. Chicago: University of Chicago Press.

rhythm may be understood "everything which has to do with time and motion" - with organization of musical events in time.

According to Leonard Meyer and Grosvenor Cooper, rhythm represents our ability to mentally group or ungroup events that are close or far from each other in terms of pitch, time, timbre, space etc.[272] Not all durations are perceived alike, as there is a number of psychophysical limits on our ability to perceive durations and durational succession.[273] Our understanding of rhythm may be investigated by perceptual psychology similarly as apprehension of musical texture under the concept of 'auditory streams'.[274] Evidences from the research of auditory streaming are showing that there are factors, such as pitch, timbre, loudness and perceived location in space, that affect our ability to segregate sounds into separate streams. Streaming interacts also with our perception of duration and enables to perceive series of different durations and layers of temporally organized sounds within the complex musical surface.

In traditional instrumental music, we were used to recognize several types of rhythmical structures and groupings, such as for example:

Syncopation – disturbance or interruption of the regular flow of rhythm and placement of rhythmic stresses or accents where they wouldn't normally occur.

Polyrhythm – simultaneous appearance of two or more different rhythmic patterns.

Regular divisive rhythms – rhythm in which larger period of time is divided into smaller rhythmic units.

Irregular additive rhythms – are created by addition of sequences of smaller rhythmic units to the end of previous rhythmic unit to construct larger rhythmic (temporal) units.

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[272] Ibid.

[273] London, Justin. "Rhythm" In: *Grove Music Online*. Oxford: Oxford Music Online. (Fundamental concepts and terminology) http://www.oxfordmusiconline.com:80/subsciber/article/grove/music/45963 (accessed May 13, 2009).

[274] Concept of auditory stream has been introduced by Albert S. Bregman, Bregman 1994. Auditory streams are perceptual groupings of the sounds corresponding to the parts of the neural spectrogram, that go together. Through the process of auditory streaming we are able to pick out some sounds in our environment and hear them as connected and coherent, whether they are a single voice in a crowded room or a single part in a complex musical texture. (Grove Music Online. Rhythm: Fundamental concepts and terminology) The term auditory stream is used as a conceptual tool for the creation and perceptual analysis of textures that comprise of clearly distinguishable bands of sonic activity within the overall spectrum of possible available audible frequencies. (ElectroAcoustic Resource Site 2002)

These all above mentioned rhythms were more or less related with sense of meter and pulse. However, in electroacoustic-acousmatic music metre and pulse, as we know them from traditional musical praxis, are often not present, but we still may sense different "rhythmic impressions". As stated by Garcia-Valenzuela:

> ... certainly we do not often find rhythmic and/or melodic structures in electroacoustic music but we do find durational proportions, non-pulse-based rhythms and other relational strategies of organization.[275]

Valenzuela explain this alongside the Kramer's concepts of linearity and nonlinearity, which are defined as determination of some characteristics of music in accordance with implications that arise either from earlier events of the piece (linearity) or from principles or tendencies governing an entire piece or section (nonlinearity).[276] Thus,

> linearity in electroacoustic music may be present as isolated sound objects that create a gesture or in textural sections that progress towards a predictable or non-predictable goal and nonlinearity as a more dominant force, using conceptual or timbral relations to hold the piece together.[277]

While linearity is concerned with principles creating a process, nonlinearity is related with those principles of organization of a piece, which don't involve a process creation. In accordance with these concepts of linearity and nonlinearity, Garcia-Valenzuela distinguishes five different levels of temporal organization with or without relation to groupings:[278]

Non-pulse-based grouping which relates to the ability of the mind to group or ungroup events without involving pulse or metre and involves repetitions of sound objects or small structures, creating expectations that need to be dealt with.

Textural grouping is related to extremely irregular rhythms balanced between pulse-based rhythm and random impulses.

[275] Garcia-Valenzuela, Pablo. 2006. *Temporal Forces in Electroacoustic Music*. EMS: Electroacoustic Music Studies Network Beijing. http://www.ems-network.org/spip.php?article238 (accessed July 10, 2009)
[276] Ibid.
[277] Ibid.
[278] Ibid.

Durational proportions are natural strategies, imposed or allowed by the composer, which may become especially relevant in the structuring processes of electroacoustic music.
Contemplative experience represents situations of "atemporal organization", where no grouping or ungrouping forces exist. In the perceived sound there is no reference to any kind of rhythmic organization.
Sonic surrealism may be considered with the situations of juxtapositions of different unrelated 'aural scenes' or transformations of their natural behaviour, for example juxtapositions of acoustic spaces, juxtapositions of everyday sounds, environmental and everyday sounds in spatial motion, environmental sounds used in different domain of temporal organization without destroying their behaviour and surrealism derived from temporal elongations.[279]

According to Bregman:

> One of the most important aspects of sound is the temporal relation between them. This includes how far they are apart in the time, any temporal patterns that they may generate, and their temporal order.[280]

From our definition of gesture as a "movement in time", it is clear that time aspect will play an important role in generating an inter-gestural communication. We are convinced that awareness of temporal organizations, patterns and their orders represents one of the principal targets of our attention whether analytical - identification or compositional – creation of interactive temporal models between instrumental and electroacoustic gestures. For identification/creation of these models we are considering two main criteria – criterion of synchronicity and asynchronicity.[281] Generally, synchronicity is observed, when two objects or events are coordinated in time. They are "somewhat" dependent from each other. Asynchronicity, on the opposite, is seen in situations when objects or events are not coordinated in time. They act independently from each other. Other criteria used for classification were proportionality or

[279] Ibid.
[280] Bregman 1994, p.143
[281] The words are of Greek origin, where "syn" means "with", "asyn" means "not with" and "chronos" means "time".

proportional temporal relationships between gestures, temporal forces and situations known from pure electroacoustic (acousmatic) music, such as textural grouping and sonic surrealism, as presented by Garcia-Valenzuela.

Furthermore, in our opinion, in the music, which combines instruments and electronics, where each one is governed by different temporal organization, the approximations in temporal relations between sound events derived from these distinct worlds may be created by application of principles from one medium to the other. Thus, some rhythmical patterns from the instrumental music may be applied to the organization of electroacoustic material, 'break its organicity' and create new 'architectonic relationships'; or perceptually observed grouping strategies of the acousmatic music applied to the instrumental sound, may bring a kind of 'organicity' to its often very strict 'architectonic' nature. As a consequence of all these strategies applied on temporal properties of gesture, we may identify and create some of the following gestural relationships:

1. Synchronic temporal interaction – temporal patterns of two gestures act in synchronous way (dependence).

a. Regular synchronic interaction – when gestures have either identical rhythmic structure/durational pattern – "unirhytmic" or they may not have identical rhythmic structure, but the interdependence and regularity in synchronization between their durational pattern is recognizable.

Ex. 14: Jean-Claude Risset: Passages.[282] This is an example of fusion by identical rhythmic/durational pattern – unirhythmic relationship. Flute gesture and "percussive" electroacoustic gesture have identical rhythmic structure. (the first 4 beats are also unisonic).

Ex. 15: Rajmil Fischman: Los Dados Eternos.[283] This is another example of unirhythmic interaction, where the rhythm of the oboe gesture is identical with the rhythm of the low sound electroacoustic gesture.

[282] Risset 1982. 0:19-0:32. p. 16, third system.
[283] Fischman 1991. 0:50-1:24. , p.7.

Ex. 16: Karlheinz Stockhausen: Kontakte.[284] In this example, instrumental piano chords and cymbal, hihat percussion gestures are regularly synchronized with small attack-decay and inversed attack-decay gestures in tape.

Ex. 17: Panayiotis Kokoras: Morphallaxis.[285] There is regular synchronization between flute frullato, hand drum flutter and sweeping articulation and accentuation with the electroacoustic sound of percussive flutter character.

Ex. 18: Petra Bachratá: Reflections.[286] In this example, there is regular synchronic interaction between marimba and tape. Accentuated marimba gesture is synchronous with the layer of short attack type gestures and fast gestures in tape.

b. Irregular synchronic interaction – represents situations, when gestures don't have identical rhythmic structure and their synchronization is irregular.

Ex. 19: Denis Smalley: Clarinet Threads.[287] Synchronization between clarinet and tape in this example is done irregularly in some moments of their rhythmical patterns (such as accentuations).

Ex. 20: Denis Smalley: Clarinet Threads.[288] In presented example regular clarinet gestural articulation (fast group of notes of the same duration) is occasionally synchronized with the irregular rhythmical articulation in tape.

Ex. 21: João Pedro Oliveira: Cassiopeia.[289] In this example synchronization between orchestral gestures and tape is also irregular, it is present between snare drum tremolos and tape gestures of similar timbre, fast bongo, tom-tom gestures and fast tape gestures of distinct timbre, jeté articulation in strings and rustling gestures in tape.

Ex. 22: Bernard Parmegiani: Jazzex.[290] Irregular synchronization is observed on relationship between gestural articulation in double bass (later also percussions) and

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[284] Stockhausen 1959-60. 25:26-25:32.

[285] Kokoras, Panayiotis. 2008. Morphallaxis. In CD: *Panayiotis Kokoras – Metasound*. Panayiotis Kokoras Label. 2008. Track 8: 0:37-0:41. Kokoras, Panayiotis. 2008. *Morphallaxis* for amplified flute, hand drum, violoncello and electronics. Unpublished author's manuscript. p. 4, measures 13-14.

[286] Bachratá 2005. 8:06-8:11. p. 9.

[287] Smalley, Denis. 1985. *Clarinet Threads*. In CD: *Denis Smalley: Impacts intérieurs*. Empreintes DIGITALes. IMED 0409. Montréal. 2004. Track 6. 7:33-7:58. Smalley, Denis. 1985. *Clarinet Threads* for amplified clarinet and tape. Unpublished author's manuscript. p. 6-7.

[288] Ibid. 3:50-3:54. p. 3.

[289] Oliveira 2008. 18:06-18:27. p. 37-38, measures 235-242.

[290] Parmegiani, Bernard. 1966. *Jazzex* for saxophone, trumpet, drums, doublebass and tape. In CD collection: *Bernard Parmegiani – L'oevre musicale en 12 CD*. CD 1:Violostries, Jazzex, L'instant mobile, Capture éphémère. INA-GRM. Ina G 6000. 2008. Track 4: 1:20-2:02.

electroacoustic sound.

Ex. 23: Petra Bachratá: Reflections.[291] Different tremolo and accelerating gestures in marimba and tape are synchronized by irregular accentuations in their rhythmic patterns.

As a subcategory of this type of relationship we consider:

Syncopated rhythmic interaction, where rhythmical structure of two gesture is syncopated in relation to each other, it means a certain disturbance or interruption of the regular or irregular flow of rhythm of one gesture by the rhythmic pattern of the other gesture.

Ex. 24: Denis Smalley. Piano Nets.[292] Superimposition of the two gestural layers with different rhythmic patterns (piano and tape) creates a sense that we perceive them as one syncopated rhythmic gesture.

2. Asynchronic temporal interaction – temporal patterns of two gestures act in asynchronous way (independence).

a. Regular asynchronic interaction – combinations of gestures with regular rhythmic structure without synchronization. All gestural layers are rhythmically independent.

Ex. 25: Rajmil Fischman: Los Dados Eternos.[293] Regular character of 3 layers of gestures in this example – oboe gestural articulation and regular heart beat sound and low repeated attack type gestures are in asynchronic relationship. Their rhythmic structure is independent from each other.

Ex. 26: Petra Bachratá: Mystic Garden.[294] Decelerating gesture in flute of air sound character is asynchronous with gesture in tape of similar timbre.

b. Irregular asynchronic interaction – represents combination of gestures with irregular rhythmic pattern without any synchronization between them.

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[291] Bachratá 2005. 2:45-3:00. p. 3.

[292] Smalley, Denis. 1990-91. *Piano Nets*. In CD: *Denis Smalley: Impacts intérieurs*. Empreintes DIGITALes. IMED 0409. Montreal. 2004. 2nd movement: 0:03-0:20. Smalley, Denis. 1990-91. *Piano Nets* for piano and electro-acoustic sounds. Unpublished author's manuscript. p.7.

[293] Fischman 1991. 4:41-4:53. p.12.

[294] Bachratá 2007. 8:21-8:25. p. 13, measures 125-126.

Ex. 27: Jonathan Harvey: Advaya.[295] In this example cello gesture and tape gesture are similar in timbre (electroacoustic gesture is derived from instrumental sound of cello), both of them have irregular rhythmic structure and their relationship is asynchronic.

Ex. 28: Tristan Murail: Desintegrations.[296] Gestures of irregular rhythmic patterns in crotales, glockenspiel and piano are asynchronic with irregular gestures of similar timbre in tape.

Ex. 29: Panayiotis Kokoras: Morphallaxis.[297] In this example there is asynchronic relationship not only between instrumental gestures themselves (flute, hand drum and cello) but also between them and the very softly heard low pulse sound of the tape.

c. Polyrhythmic interaction – several layers of gestures with different temporal patterns or groupings. These more complex relationships may be perceived as a "hybrid" temporal pattern - a sum of the combination of rhythms/temporal groupings, from which it is composed.

Ex. 30: Denis Smalley: Piano Nets.[298] Piano and tape gestures have different rhythmic structure (each one could be understood as separate layer) and their relationship is perceived as polyrhythmic.

Ex. 31: Rajmil Fischman: Los Dados Eternos.[299] In this example, there are three main layers of sound. First one is the oboe gestural movement with the same rhythmical structure as the low tape sound that is very slightly delayed in comparison with the oboe and create kind of resonant or "echo" structure. The third layer is the whispering gestural articulation in tape, which has distinct temporal pattern and we perceive the interaction again as polyrhythmic.

Many composers use **combination** of synchronic and asynchronic relationships in a course of gestural articulation – desynchronization of previously synchronized gestures or layers of gestures; or synchronization of previously asynchronic gestures or

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[295] Harvey 1994. 1:28-1:41. p. 2.
[296] Murail, Tristan. 1989. *Désintégrations*. In CD: *Tristan Murail. Gondwana, Désintégrations, Time and again*. Montaigne/Naïve. MN 782175. 2004. 6:51-6:59. Score: Murail, Tristan. 2004. *Désintégrations* pour 17 instruments et bande magnétique. Editions Henry Lemoine. Paris. p. 29.
[297] Kokoras 2008. 5:12-5:19. p. 25, measures 97-98.
[298] Smalley 1990-91. 2nd movement, 1:14-1:37. p. 8.
[299] Fischman 1991. 7:03-7:38. p. 15-16.

layers of gestures. These models are presented in following examples:

Ex. 32: Jonathan Harvey: Advaya.[300] At first unirhythmic, regular, synchronized relationship between cello and tape becomes during the course of gestural movement desynchronized and irregular.

Ex. 33: João Pedro Oliveira: Cassiopeia.[301] In this example there is more complex rhythmic interaction between orchestra and tape. The first interactive relationship is between orchestral tubular bells, glockenspiel, harp and bell sound in the tape, which is synchronic and unirhythmic. Addition of fast different repeated rhythmic pattern in vibraphone and later in marimba desynchronizes the initial regular synchronic relationship between instrumental and tape gestures and desynchronization is completed by addition of irregular small fast tape gestures of different timbral character till the end of the example. The rest of the orchestra (long holding pitches of crescendo character in wind, brass and string instruments, randomly repeated patterns in strings, as well as fast gestures in wind and brass instruments and string glissandos) function in asynchronic way with the mainly present rhythmical pattern of orchestral percussion and tape bell sound.

3. Proportional temporal interaction – one gesture is proportionally reduced (diminution) or multiplicated (augmentation) in duration/durational pattern of another gesture.

Ex. 34: Rajmil Fischman: Los Dados Eternos.[302] This is an example of proportional reduction of temporal pattern (pulse-based interaction), where the spoken gesture in tape (Sanctus) is a diminution of the sung gesture in oboe, more precisely, the pulse of the tape gesture is reduced in comparison with the oboe gesture.

4. Interaction by textural grouping – interaction of irregular or random rhythms/durational gestural patterns, which occur in different layers of sounds - auditory streams.

Ex. 35: Denis Smalley: Clarinet Threads.[303] Sporadic irregular clarinet grasping

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[300] Harvey 1994. 11:33-12:28. p. 16.
[301] Oliveira 2008. 18:50-20:01. p. 40-43, measures 250-273.
[302] Fischman 1991, 7:38-7:52. p. 17.
[303] Smalley 1985, 6:20-7:04, score: p. 6.

gestures ("teeth-tones") are interacting with the random irregular groupings of middle frequency range gestures on top of the low sound texture in tape.

5. Atemporal interaction – there is no rhythmic organization or any grouping force in the perceived interaction between gestures, sense of any rhythm, pulse or metre is lost.

Ex. 36: Karlheinz Stockhausen: Kontakte.[304] Although piano and percussion gestures are rhythmically organized, in the interaction with the tape gestures we cannot perceptually recognize any sense of rhythm or pulse based relationships.

6. Temporal sonic surrealism is a special category of gestural relationships, that may be created for example by simultaneous application of traditional rhythmic patterns to the sounds with organic nature (such as recorded sounds of sea, forest, etc., syncopated rhythm of rain drops or sea waves) and atemporal organization of instrumental material, or by combination of traditional rhythmic patterns applied on the electroacoustic material simultaneously with temporal groupings or situations similar to contemplative experience (as described by Garcia-Valenzuela) applied to the instrumental material. Here we would classify also situations where the "instrumental" and "electroacoustic" have exchanged roles from the viewpoint of "rhythmic/temporal" organization: tape gestures composed of naturally rhythmic environmental and ambiental sounds, for example train sound, rain drops falling, pulsation of the sea waves, machine sounds, etc. – they all involve some kind of regularity in their rhythmic pattern; and instrumental gestures without significant rhythm or rhythmic pattern.

Ex. 37: Panayiotis Kokoras: Morphallaxis.[305] In this example rhythmic gestural articulation in instrumental ensemble (flute, hand drum, cello) transforms into the regular rhythmic pattern of the train sound in tape.

Ex. 38: Panayiotis Kokoras: Morphallaxis.[306] This example creates a surreal situation: while tape gestural movement – the sound of the waltz - has "instrumental" character, the "live processed" instrumental gesture composed of cello ascending-descending glissando played between sul tasto and sul ponticello together with the fricative gestures of the hand drum and air sound in flute sounds more

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[304] Stockhausen 1959-60, 0:15-0:24, score: p. 1, 15.7"- 24.3".
[305] Kokoras 2008. 2:24-2:40. p. 12-13, measures 46-50.
[306] Ibid. 8:19-8:35. p. 39, measures 154-157.

"electroacoustically".

Ex. 39: Panayiotis Kokoras: Morphallaxis.[307] Interaction between rhythmic instrumental gestures in ensemble (flute, hand drum and cello) and falling rain drops and train sound in tape is done by simultaneous or alternating combination of regular, accelerating or decelerating instrumental rhythmic patterns and regular rhythmic patterns of the rain and train.

Besides all these above presented models of interaction according to pitch and duration characteristics, it is important to be aware of another level of relationships related to pitch and temporal organizations of gestures – the semantic level, which will be analyzed later in the subchapter 4.4.1.

4.1.3. Gesture interaction by loudness trajectories.

Dynamics refers to the *"variation in loudness"*[308] of specific note or sound, which is expressed by the difference between the quietest and the loudest – *dynamic range*.[309] Psychoacoustics define loudness as

> subjective impression of the intensity or magnitude of the sound.[310]

The most common markings in traditional instrumental notation corresponding to the dynamic range are pp-pp-p-mp-mf-f-ff-ff. These terms are relative to each other according to the musical context. The objective measurable term corresponding to loudness is intensity, which is expressed in measurable units – decibels. The term dynamic in electroacoustic music has different meanings – it may refer to time-dependent behaviour - the motion of a dynamic microphone or time-dependence of dynamic filtering or spatial modulation,[311] or to dynamic morphologies – sound objects

[307] Ibid. 2:40-3:10. p. 13-15, measures 51-60.
[308] Truax, Barry. 1999. Hanbook for Acoustic Ecology, online version of the second edition http://www.sfu.ca/sonic-studio/handbook/
[309] Ibid.
[310] Ibid.
[311] Ibid.

with all or most of their properties (pitch, duration, timbre) in state of change[312]. To avoid confusion we will talk about loudness and intensity, instead of dynamics.

Two gestures may create connection according to their variations in loudness, loudness trajectories and their intersections in several ways:

1. Crescendo interaction – represents situations when intensity of instrumental gesture increases "crosses over" to the electroacoustic gesture and ends up in the maximum power or vice versa. Gestures may relate also by simultaneous increase of their intensity. Another situation may be reached by creating large crescendo gesture from layers of smaller instrumental and electroacoustic gestures. Separately these gestures may have different intensity character but in conjunction they are perceived as a large crescendo gesture. This kind of interaction is often observed in pieces for ensemble/orchestra and electronics, where although some of the instrumental and electroacoustic gestures may have even decrescendo character, the main stream built up of gestures with increasing loudness will be the one which we will perceive as a crescendo (<).

Ex. 40: Petra Bachratá: Reflections.[313] Here is the simple example of a crescendo relationship, where marimba tremolo played with mallet sticks is combined with similar gesture in tape and their increasing loudness results in a tape attack sound.

Ex. 41: Petra Bachratá: Mystic Garden.[314] In this example, although there are instrumental and electroacoustic gestures with different loudness characteristics, the general loudness trajectory of their combination is perceived as a large crescendo.

2. Decrescendo interaction – opposite to crescendo relationship (>)

Ex. 42: Denis Smalley: Piano Nets.[315] This example presents two gestures, one in piano another in tape, with simultaneously decreasing intensity (f > p).

Ex. 43: Karlheinz Stockhausen: Kontakte.[316] In this example instrumental gestures in piano and african wood drums together with tape gesture of distinct timbral quality are continuously decreasing in their intensity (ff > mf > pp).

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[312] Wishart 1996
[313] Bachratá 2005. 8:21-8:28. p. 9.
[314] Bachratá 2007. 5:10-5:20. p. 9, measures 76-80.
[315] Smalley 1990. 3rd movement: 1:59-2:04. p. 11, measures 30-31.

3. Interactions by intersections and cross-overs in loudness trajectories – simultaneously sounding gestures with different loudness trajectories.

Ex. 44: Denis Smalley: Clarinet Threads.[317] The loudness trajectories of clarinet gestures and tape gestures are intersecting each others in different moments of loudness level.

Ex. 45: Karlheinz Stockhausen: Kontakte.[318] Interaction between percussion tremolos and tape gestures is done by manipulation of their loudness trajectories (crescendo-decrescendo, decrescendo-crescendo types) in an alternating way "by loudness waves" - in a moment when one gesture is in crescendo phase, the other is in decrescendo phase and vice versa.

4. Combination of previous models (< >, > <, etc.)

Ex. 46: João Pedro Oliveira: Cassiopeia.[319] In this case, initial solo marimba gesture, accompanied by tape gesture of similar loudness (ff) are decreasing in their intensity (> p) to the moment when orchestral sound enters to the continual crescendo phase (< fff) - composed of fast ascendent gestures starting in low strings, brass and low wind instruments, adding high strings glissandi, fast high wind instrumental gestures and solo vibraphone tremolo together with tape glissando sounds, followed by decrescendo phase (> mp) – composed of descendent glockenspiel and harp glissandi, zig-zag glissandi on vibraphone, ascendent glissandi in cellos and descendent tremolo and glissando type gestures in tape. Although there are different types of gestures (fast groupings, glissandos, with different directions, interaction is done by their cooperation and participation on the general loudness trajectory of the large (decrescendo-crescendo-decrescendo gesture).

[316] Stockhausen 1959-1960. 0:30-0:40. p.1.
[317] Smalley 1985. 0:50-1:08. p. 1.
[318] Stockhausen 1959-1960. 16:42-16:56. p. 19.
[319] Oliveira 2008. 3:15-3:36. p. 9, measures 44-49.

4.1.4. Gesture interaction according to the timbral characteristics.

Timbre was traditionally understood as a tone-colour that represents the quality of tone, which distinguishes one instrument from another. Timbre was considered:

> an 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.[320]

Of course, in this sense the term timbre could be applied only to the conditions where the two sounds were presented at the same pitch. From this point of view it would not be possible to talk about timbre in cases when the two sounds are not able to be presented at the same pitch, such as many percussion "unpitched" instruments or for many electroacoustic sounds that have no pitch (noise-based sounds).

In psychoacoustics timbre or tone/sound quality

> is determined by the behaviour in time of the frequency content or spectrum of a sound, including its transients which are extremely important for the identification of timbre.[321]

Combination of these frequency components (harmonic or inharmonic), their onset, growth and decay in time and phase relations between them, gives every sound its distinctive tonal quality or timbre. Timbre is perceived and understood as a gestalt – reflexion of the entire sound rather than a function of the analytic components of the sound. Therefore, qualities of timbre are often described using metaphors and analogies to colour or texture (for example bright or dark timbre, rough or smooth timbre).

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[320] often cited definition of American National Standard Institute (source: Smalley, Denis. 1994. Defining Timbre – Refining Timbre. Contemporary Music Review 10(2), p.37, Bregman 1994)

[321] Truax 1999. "*Transient*" is a sudden and brief fluctuation in a sound. In the initial part of any sound, there occur a number of these fluctuations, such as moment when violinist puts the bow to the string or trumpet player tongues the notes. These "*onset transients*" are important in identifying the sound source and its spatial location and timbre. If these are spliced out of a recording of the sound, it will easily be confused with other sounds.

Timbre may be also defined as

> an ensemble of the parameters of pitch, duration, amplitude, spectral components and dynamic evolution" which determine the "colour of the sound.[322]

In electroacoustic music timbre represents complex phenomenon, in a fragile relationships and continua with frequency, spectral content, sonic identity and source of recognition of the sound. Composers of electroacoustic music have been trying to find the answers what timbre exactly is when it is meaningful to use the term or if the concept of timbre might be useful in the context of electroacoustic music.

Smalley on the way to define timbre compares what timbre meant in the traditional instrumental music - timbre as an extension of harmony and vice versa, when composer used the spectral analysis to conceptualize the relationship with pitch and sound qualities, or notion of the instrumental note as comprising pitch with timbre; and how its meaning expanded with the appearance of electroacoustic music - the awareness of the multiple variables which determine the timbral identity. According to his observations, instrumental music involved identifiable sources and listener could link the sound with the source - sounding body (instrument) and the human physical cause (performer's movement). Smalley refers to this *source bonding*[323] as

> the natural tendency to relate sounds to supposed sources and causes, and to relate sounds to each other because they appear to have shared or associated origins.[324]

However, we have experiences that in electroacoustic music, there may be many different sources and causes with evident, ambiguous or unknown character, which may not be known in advance, but only in the course of listening they may or not be discovered by listener. In this situation of unstable cause-source, its non-existence or an illusory existence, according to Smalley, timbre will be concerned with the *"temporal*

[322] ElectroAcoustic Resource Site 2002
[323] Smalley, Denis. 1994. "Defining Timbre – Refining Timbre." *Contemporary Music Review* 10(2), p.37
[324] Ibid.

unfolding and shaping of sound spectra – spectromorphology"[325] related with motion, growth and energy; and is defined as

> general sonic physiognomy whose spectromorphological ensemble permits the attribution of an identity.[326]

According to duration and separability from the context, timbre as a coherent identity may be a discrete object (short term entity) which is separable from its context or a continuity (entity evolving in a long term) which is not separable from its context, because its start and end are not recognizable or it is obscured with other continuities. These two continua and their relationships delineate the concept of timbral level.

As Smalley states, in instrumental music based on a note and its articulation by an instrumental source we could recognize timbral levels as source-cause aspects of timbral identity. For example, considering the cause-source relationship - the violin and the bowing gesture of violinist, the lowest cause-source level - ***imminent level*** will be represented by intrinsic musical context, where we encounter the instrument (violin sound). Through the musical style the listener becomes aware of articulations of note-objects into phrases over continuum of registers (registration). Next ***cumulative level*** represents the experience of violin source in the hands of another violinist. The ***extended level*** includes family of the string instruments, and ***dispersed level*** includes all bowed and plucked instruments of all cultures. The totality of all these levels Smalley calls ***source-cause texture***.

However, in case of electroacoustic music, this hierarchical basis for establishing the cause-source aspect of timbral identity does not exist and continuing contexts resist the low-level segmentation. That's why it is hard to separate timbre from the overall musical discourse – timbral attributes are merged in the spectromorphological structure. Therefore, Smalley suggest that in searching the identity of timbre in electroacoustic music, we must turn our attention to intrinsic spectromorphology of the musical work – the imminent timbral level.

Of course, even in electroacoustic music, along the Smalley's concepts, we may have an identifiable non-instrumental source, such as for example water and we may

[325] Ibid.
[326] Ibid.

recognize the cause either as a self-activated activity of the water (sea waves) or behaviour activated by other human or non-human intervention (splashing). Then, in musical work water can exist on imminent and cumulative levels. We will recognize water and its different activities as well as different interventions. As we cannot establish any musical repertory beyond the cumulative level, the extended and dispersed levels in electroacoustic music will have to refer outside musical works to the extrinsic matrix – source-bonding referring to sounding experiences outside the work (experiences of water sound in nature, such as rain drops, sea sound, stream of water from tub, etc.) as well as real or imagined non-sounding extrinsic phenomena. The latter - non-sounding area will be emphasized in case of electroacoustic works, where the source-cause are not identifiable, unstable, illusory or non-existent – the source-cause texture doesn't exist. Source-cause bonding is not possible, as we can't identify real sources and causes. In this situation, to search a timbral identity we have to shift our attention to spectromorphological ideas and attributes related with motion, behaviour, spatial experience, energy, psychological tensions, etc., which represent the non-sounding substitutes for the extended and dispersed levels. It is important to note, that in these Smalley's considerations:

> In instrumental music behind the causality of instrumental gesture lies both a broader experience of the physicality of gesture and its proprioceptive tensions, and a deeper, psychological experience of gesture. Human-bonded source-cause texture represents these primal levels of gesture found in the extrinsic matrix, whereas in electroacoustic music, where source-cause links are severed, access to any deeper, primal, tensile level is not mediated by source-cause texture. In a certain physical sense there is nothing to grasp – source-cause texture has evaporated.[327]

In electroacoustic music use of different digital technologies to synthesize and treat sounds allows manipulations of different attributes of timbre. This flexibility influences also the balance or stability of the musical discourse. There are many ways how to achieve and loose this balance. As a solution for electroacoustic music discourse concerned with timbre, Smalley recognizes following interactive types of music discourse:

[327] Ibid.

a. music discourses primarily concerned with identities and our ways of interpreting them, such as:

source-cause discourse concerned with "*bonding play*"[328], as an inherent perceptual activity, when listeners, while listening to electroacoustic music, may either share source bondings or have very different source bondings according to their personal experience. They also may be quite different from composer's intentions and imagination;

transformational discourse,[329] where an identity is transferred while retaining significant vestiges of its roots. Condition of this discourse is stability of certain attributes together with variability of other attributes and it may be created by different techniques, such as time expansion or contraction, manipulations of the growth process by thickening or spreading in spectral space, variation or reshaping of a morphology without affecting the timbre identity; and

typological discourse[330] - associative, where identities are recognized as sharing timbral qualities but are not regarded as being descendants of the same imminent identity. This will embrace the generic timbres of electroacoustic music as its idiomatic properties. The examples of generic electroacoustic timbres are - timbres of noise, such as granular noise[331] and inharmonicity.

b. music discourses concerned with relations among identities, such as:

behavioural discourse including relationship changes between sounding identities in a sense of cohabitation or conflict and dominance or subordination.

motion discourse based on relations among sounding identities due to their type of motion, growth and their directional tendencies.

tensile discourse concerned with the formal tensions resulted from combination of all five above mentioned discourses.

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[328] Ibid.

[329] Ibid.

[330] Ibid.

[331] Ibid. Granular noise may be defined as "textured impulses of varying consistencies and resolutions ranging from roughness through granularity to grit, with an internal behaviour which varies in different degrees of regularity or irregularity, but remains a coherent entity. It has wide range of source-cause bondings, such as sea, water, wind, fracturing wood or stone materials, motions of frictions, unvoiced vocal behaviours, breathing and fluid congestion, mechanical noise, etc."

Wishart in another of his texts Sound Symbols and Lanscapes[332] writes about recognition of individual sound-objects due to our lived experience of them. From his observations certain sounds will retain their intrinsic recognizability even under the most extreme forms of distortion, such as for example human voice (able to produce timbrally distinct entities – screaming, glossalalia, erotic sounds, crying, etc. in a rapid stream), due to their immediate significance to listener and their unique complexity of articulation. We will recognize human voice even when its spectral characteristics have been changed, but it will be very difficult to imitate it electronically without recognizing the "synthetic nature". This will not be the case of some synthetized sounds – electronic imitation of a real environmental and ambiental sounds. In this case recognizability of the origin of these sounds will depend on their contextual placement. The isolated electronic imitation of some environmental sounds (such as for example cricket, bird or a sea wave) may be difficult to identify as the cricket, bird or a sea wave. On the other hand if they are placed in the created and sufficiently realistic acoustic ambient even these electronic imitations may sound "real", without our recognizing of their true synthetic (electronic) origin.

Departing from the psychoacoustic experiments on timbre identification in mixed music (timbre reproduction, integration and association), as they were suggested by Christopher Biggs and presented in the chapter 1.6., Smalley's notion of source-bonding and surrogacy, presented in chapter 3.3.2., and Wishart's contextual timbral recognizability, we may distinguish following interactive timbral relationships between gestures:

1. Interaction by timbre-reproduction – the timbre of electroacoustic gesture is a kind of reproduction of the timbre of the instrument (using slightly manipulated recorded instrumental sound).

[332] Wishart, Trevor. 1986. "Sound Symbols and Landscapes." In: Emmerson, Simon (ed.) *The Language of Electroacoustic Music*. London: MacMillan Press. p. 49-50.

Ex. 47: Chris Cree Brown: Sound Cylinders.[333] The timbre of the flute tongue ram gesture without resonance (produced by inhalation through the instrument) is reproduced in tape (recorded flute gesture produced by exhalation).

Ex. 48: Tristan Murail: Desintegrations.[334] Gestures in tape are reproducing the timbre of instrumental gestures (crotales and glockenspiel).

Ex. 49: Bernard Parmegiani: Jazzex.[335] Gestural articulation in tape has the same timbral characteristics as the instrumental. The timbre of double bass is reproduced in tape without more evident manipulation.

Ex. 50: Petra Bachratá: Mystic Garden.[336] In this example fast flute gesture is timbrally reproduced in the tape and the timbre of the piano high attack-resonance gesture is reproduced with a slight manipulation in the tape gesture. In both examples there is no doubt that the timbre of the tape gesture is a reproduction of the instrumental timbre.

2. Interaction by timbre-derivation – the timbre of instrumental gesture is reproduced in the timbre of electroacoustic gesture but with more extended manipulation.

Ex. 51: Jonathan Harvey: Advaya.[337] The timbre of electroacoustic glissando gesture is derived from the timbre of the cello scratchy-distorted glissando. The timbre-derivation enables blending of the two gestures into one gesture, which filters into the single pitch at the end.

Ex. 52: Denis Smalley: Clarinet Threads.[338] Fast tape gestures are timbrally derived from small groups of clarinet gestures, based on the indefinite air-pitch sound.

Ex. 53: João Pedro Oliveira: Cassiopeia.[339] In this example timbre of fast repeated tape gestures is derived from the ratchet and guiro tremolo-type of gesture. This derivation becomes more clear at the end of the example, where the orchestral

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[333] Brown, Chris Cree. *Sound Cylinders*. In CD: *Contemporary Canterbury*. Key Words, New Zealand. KWCD9801. 1999: 0:00-0:05. Brown, Chris Cree. 1996-1997. *Sound Cylinders* for flute and tape. Unpublished author's manuscript. p.1., 0:00-0:04.
[334] Murail 1989. 6:59-7:06. p. 29.
[335] Parmegiani 1966. 7:20-7:52.
[336] Bachratá 2007. 2:26-2:30. p. 4, measures 37-39.
[337] Harvey 1994. 8:50-9:14. p.13, second system.
[338] Smalley 1985. 3:54-4:04. p. 4
[339] Oliveira 2008. 8:58-9:07. p. 23, measures 130-132.

sound is mute and with the sustained note of double-bass we can recognize the timbral character of tape gesture.

3. Interaction by timbre-association – the distinct timbre of electroacoustic gesture is of different than instrumental nature, however it may simulate somewhat the instrumental characteristics and even being not real, may be perceived or associated as "instrumental". For example use of synthetic sound simulating some properties of instrumental sound, such as use of wind sounds simulating the breath sound of the wind instruments or synthetic sounds "with metalic flavour" simulating some of the percussion instruments, etc.

Ex. 54: Denis Smalley: Clarinet Threads.[340] The electroacoustic air-wind-wave type gestures are associated with the timbre of the clarinet air-sound gesture.

Ex. 55: Petra Bachratá: Reflections.[341] Although the tape synthesized trill is of different nature than the marimba trill, both gestures connect by simulation of some characteristic of the marimba sound; we perceive the tape gesture "somewhat" as instrumental.

All these 3 categories express different degrees of **timbral fusion** and represent what Smalley calls source bonding and correspond to first and second order surrogacy.

4. Contrast by timbre dissociation is the situation of coexistence of timbrally independent gestures, when the distinct timbre of electroacoustic gesture can't be associated with the timbre of the instrumental gesture. This situation would be equivalent to what Smalley refers as remote surrogacy.

Ex. 56: Bruno Maderna: Musica su due dimensioni.[342] "Cold aggressive timbre" of the tape gesture is contrasting with previous gentle timbre of the flute.

Ex. 57: Rajmil Fischman: Los Dados Eternos.[343] Timbre of the oboe gesture merges into the very distinct timbre of the tape gesture.

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[340] Smalley 1985. 4:42-4:51. p. 4.
[341] Bachratá 2005, 0:21-0:27, Score: p.1.
[342] Maderna, Bruno. 1958. *Musica su due dimensioni*. In CD: Bruno Maderna: Electronic Music. Stradivarius 1994. STR 33349. Track 4, 8:46-8:54.
[343] Fischman 1991. 6:50-7:06. Score: p.15, 0:36.5-0:49.

4.2. Models of gesture interaction based on tripartite model of structure.

The flexibility of tripartite model of structure – onset-continuant-termination allows its application to any level of musical structure (for example note, object, gesture, texture, type of motion, etc.).

Smalley distinguishes four basic morphological archetypes of musical structure: attack (impulse), attack-decay, inversed attack-decay and graduated continuant.

If these are applied to gestural structure, we would get following models of gestures:

Gesture - Attack – very short gesture without continuant phase (onset = termination)

Gesture with attack-decay – gesture, in which attack is prolonged by resonance (onset + termination +/- continuant).

Gesture with inversed attack-decay – inversed version of previous example.

Gesture with graduated continuant – gesture with graduating onset phase, settled continuant phase and graduated termination phase (fade-in onset + continuant + fade-out termination).

Wishart in his investigation of sound-objects due to the way of their continuation in time, recognizes three basic morphological categories:[344]

Discrete continuation is represented by single unresonant sounds (for example drumstroke, dry string pizzicato)

Iterative continuation is observed in sounds with sustaining rapid attacks of sound (for example single note trill on a xylophone, drum tremolo, stream of rapid clicks produced by vocal grating).

Continuous continuation is recognized in sustained sounds (for example sustained note on a wind instrument, synthesizer or bell).

For Wishart it is important within these morphological categories further recognition between the *intrinsic morphology*, related with the physical properties of the sounding medium (for example bells due to their internal resonating properties will continue sounding also after the initial energy input, etc.) and the *imposed morphology*, related to continuous input of energy (for example flute sound requires continual energy

[344] Wishart 1986

input (breath) to produce the sound or cello sound requires continual energy input through the bowing gesture of the performer, etc.). Intrinsic morphology then will be more related to the source in a sense of its physical characteristics, while imposed morphology will have stronger relation to the cause.

Although we can realize important similarities in concepts of morphologies of Smalley and Wishart, it is interesting that while Smalley's main morphologic archetypes may be more widely related with "external" morphology of sound structures, precisely because of their broad possibility of application to musical structures or even their relationships, Wishart's morphological categories will be concerned more with the "internal" morphology (either intrinsic or imposed) of the sound objects and might be used for description of delicate nuances in sound-object, but with less potential to be applied in the relationships between them.

Due to these observations, and consequences they have for the purpose of our research - to find relationships between gestures as gestalt forms, we extend the tripartite model of structure and Smalley's main morphological archetypes beyond the individual gestures and try to embrace the whole relationship between them, regardless to the intrinsic or imposed morphology of the sound, or the source and cause of the sound. From this perspective we generate different kinds of interactive gestural relationships, as following:

1. Interaction by attack – relationship of two or several attack types of gestures either simultaneous or separated in time.

Ex. 58: Petra Bachratá: Reflections.[345] Interaction is created by simultaneous short attacks in marimba and tape.

Ex. 59: Karlheinz Stockhausen: Kontakte.[346] This example presents relationship of two similar morphologies (attack type of gestures) separated in time - tape and piano.

[345] Bachratá 2005. 8:06-8:08. p.9.
[346] Stockhausen 1959-60. 19:43-19:45. p. 23.

2. Iterative interaction – combination of several short attack models of gestures in a way that they are no more perceived as separate but as one unit (several small short attack gestures are perceived as one big gesture[347])

Ex. 60: Karlheinz Stockhausen: Kontakte.[348] In this example several short percussive gestures of attack-type in piano, percussion and tape are in iterative relationship. They are not perceived separately but as a part of a gesture that terminates by sudden loss of density and resonance.

3. Resonance interaction may be perceived in a sense of attack-decay, when one gesture represents the 'attack', the other one 'decay', or in situations, when the end of instrumental gesture resonates in electronics or vice versa.

Ex. 61: Tristan Murail: Desintegrations.[349] In this example attack of combined instrumental and tape sound transforms into a decay phase with resonance consisting of more evident tape resonant sound and less evident slow vibrato articulation in flutes and clarinets.

Ex. 62 and 63: João Pedro Oliveira: Cassiopeia.[350] First example presents simple resonance interaction, where simultaneous attack in percussion harp and tape decays during the gong decelerating gesture until its resonance in tape. Second example presents three smaller instrumental attacks (percussion, harp), followed by decays represented by fluctuation in flutes and clarinets and terminating by resonance in tape.

Ex. 64: Panayiotis Kokoras: Morphallaxis.[351] There are two gestures demonstrating resonance interaction in this example. Both gestures start with instrumental attack and shorter decay which ends up by long resonance in tape.

Ex. 65: Petra Bachratá: Mystic Garden.[352] Strong attack composed by piano and tape sound transforms into the resonance.

Ex. 66 and 67: Petra Bachratá: Luminiscencia.[353] In the first example melodic gesture in flute is followed by the gesture in tape, which functions as its resonance. In

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[347] If we consider the hierarchical potential of gesture – when more loosely understood smaller gestures may create bigger, etc., the iterative relationship is not only hypothetical, but practically possible.
[348] Stockhausen 1959-1960. 7:22-7:27. p. 9.
[349] Murail 1989. 0:08-0:14. p. 9.
[350] Oliveira 2008. 0:03-0:15. p. 3, measure 1; 5:10-5:25. p. 13, measure 72.
[351] Kokoras 2008. 8:35-9:11. p. 40-43, measures 159-169.
[352] Bachratá 2007. 0:03-0:09. p. 2, measure 1.
[353] Bachratá 2006. 0:21-0:31. p. 1; 1:38-1:46. p. 2.

the second example end of the flute gesture resonates in the tape and represents the decay phase of the flute gesture.

Ex. 68: Chris Cree Brown: Sound Cylinders.[354] Flute gesture resonates in the tape.

Ex. 69: Karlheinz Stockhausen: Kontakte.[355] This example represents attack-decay type of resonance gestural interaction, where the attack phase is represented by percussion attack sound and the decay phase by the resonance in electronics.

Ex. 70: Petra Bachratá: Reflections.[356] This is simple example of resonance relationship where marimba gesture is resonating in tape.

4. Inversed resonance interaction may be perceived in a sense of inversed attack-decay, where one gesture represents the inversed decay phase leading to another attack gesture, or as a transition from instrumental gesture to electroacoustic gesture and vice versa, with abrupt end.

Ex. 71: Petra Bachratá: Luminiscenia.[357] This is simple inversed resonance relationship, where inversed attack-decay gesture in tape resolutes in softer onset ("soft attack") of flute frullato articulation.

Ex. 72: Chris Cree Brown: Sound Cylinders.[358] Flute breath-type gesture blended with tape gesture composed of air-type sound resolutes into the tongue-ram. The breath type of gestures (flute, tape) functions as inversed resonance of tongue-ram (tape), which represents the attack.

5. Combination of resonance (attack-decay) and inversed resonance (inversed attack-decay) interaction.

Ex. 73: Tristan Murail: Desintegrations.[359] Very clear example of combination of resonance and inversed resonance relationships between two gestures composed by both instrumental (ensemble) and tape sounds.

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[354] Brown 1996-1997. 6:59-7:05. p. 11.
[355] Stockhausen 1959-60. 3:14-3:24. p. 4.
[356] Bachratá 2005. 0:04-0:08. p. 1.
[357] Bachratá 2006. 2:06-2:09. p. 2.
[358] Brown 1996-1997. 0:24-0:34. p.1.
[359] Murail 1989. 21:44-22:04. p. 73.

Ex. 74: Chris Cree Brown: Sound Cylinders.[360] In this example there is combination of attack-decay air gesture in flute and the inversed attack-decay air gesture in tape (which is timbral reproduction of the flute sound).

Ex. 75: Isabel Soveral: Heart.[361] This example is demonstration of various combinations of resonance and inversed resonance relationships between guitar and tape, where guitar gestures resonate in tape or tape resonant type of sound continues as gestural articulation in guitar.

6. "Cadential" interaction – electroacoustic gesture is accenting and/or prolonging the end of the instrumental gesture or vice versa. We understand cadence as motion conventionally associated with the ending of a phrase, section, movement, or composition, which has to do with a sense of emphasizing the end by arrival of something more or less expected (in traditional music it has been the interval or chord most fundamental to the work) or resolution, which may vary in its degrees of explicitness or ambiguity. In a sense cadence is a opposite of abrupt sudden ending, which is the case of attack model or inversed attack-decay model of relationship.

Ex. 76: Mario Davidovsky: Synchronisms No.9.[362] Short electroacoustic (metalic) gesture functions as a cadence of the violin gesture.

7. Interaction through cross-fading – represents hybrid models of relationships between gestures which are merging or blending in some of their temporal phases.

Ex. 77: Brown: Sound Cylinders.[363] Graduated continuant phase of flute gesture leads to the onset of tape gesture.

Ex. 78: Petra Bachratá: Reflections.[364] Initial tape glissando merges its termination phase with the onset of marimba tremolo which later by graduation of its continuant phase leads to the onset of another tape gesture.

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[360] Brown 1996-1997. 0:00-0:05. p. 1.
[361] Soveral 2001. second beat: 1:57-2:17. p. 11.
[362] Davidovsky, Mario. 1988. *Synchronisms No.9*. In: CD Computer Music Currents 2. WERGO Schallplatten GmbH, Mainz, Germany. WER 2022-50. 1989. Track 1: 8:29-8:31. Davidovsky, Mario. 1988. *Synchronisms No.9*., violin and tape. New York: C.F. Peters Corporation (Edition Peters, No. 67213): p. 20, meassures 223-224.
[363] Brown 1996-1997. 6:59-7:04. p. 11.
[364] Bachratá 2005. 1:40-1:50. p. 2.

Ex. 79: Petra Bachratá: Mystic Garden.[365] This example presents several cross-fading relationships between individual instrumental gestures and tape gestures, merging their onsets and terminations or their continuant phases.

4.3. Contrapuntal gesture interaction.

In electroacoustic music, and particularly mixed music, we can observe relationships between musical materials, such as gestures, phrases, etc. which are similar to those known from the traditional music theory and are based on the counterpoint. Although the concepts of counterpoint were developed by conventional compositional praxis, their relationship-building potential for creating connections between musical structures and events in acousmatic music has already been recognized. Listening and study of electroacoustic pieces from different decades show that these methods have been intuitively or intentionally applied in simpler or more complex ways in many electroacoustic compositions.

Combinations of two or more gestures in such a way that they establish a relationship between themselves while retaining their own individuality, will be called **contrapuntal interactions** or **contrapuntal relationships**. According to various ways of creating these interactions, we may distinguish following categories of contrapuntal interactions:

1. Repetitive interaction – the instrumental gesture is repeated in the electronics or vice versa.

Ex. 80: Petra Bachratá: Reflections.[366] The contrapuntal relationship between gestures in marimba and tape is created by constant repetition and "re-combination" of accelerating and decelerating patterns of gestures.

Ex. 81: Mario Mary: Aarhus.[367] Although there is big contrast between violin and very low tape, the connection between both of them is based mainly on rhythmic

[365] Bachratá 2007. 2:06-2:36. p. 3-4, measures 32-39.
[366] Bachratá 2005. 4:48-5:05. p. 5.

repetition of one note in a similar pattern. (Possible analysis of this example would be also on the rhythmic level.)

Ex. 82: Isabel Soveral: Heart.[368] Fast guitar gesture is repeated as an echo in the tape. Tape is the rhythmic repetition of the instrument.

2. Imitative interaction – the electroacoustic gesture is some kind of imitation of the gesture in instrument or vice versa.

Ex. 83 and 84: Jonathan Harvey: Advaya.[369] These two examples represent mutual imitations between cello and tape gestural articulations.

Ex. 85: Petra Bachratá: Reflections.[370] In this example marimba gesture is imitated by tape with the same pitch structure. Very tight contrapuntal relation between these two gestures creates kind of "reflection" of one another.

Previous three examples present the imitative gestural interaction with emphasized contrapuntal character. However, sometimes there may be situations, where gestures although being in imitative relationship, they will sound more separated in time (imitating gesture starts almost at the moment of termination of previous gesture); their coexistence in simultaneity may be represented by very short period of time. This is the case of following three examples:

Ex. 86: Chris Cree Brown: Sound Cylinders.[371] Gesture in tape is an echo of the gesture in flute.

Ex. 87: João Pedro Oliveira: Cassiopeia.[372] This is another example where instruments are imitating the tape. Fast tape gestures in the beginning of the example are imitated by the string gestural articulations.

Ex. 88: Petra Bachratá: Luminiscencia.[373] In this example there are two imitations – tremolo flute gesture is imitated by tape with the same pitch and rhythmic structure and the breath sound flute gesture is imitated by tape.

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[367] Mary, Mario. 2000. *Aarhus*. Unpublished author's recording. 8:25-8:41. Mary, Mario. 2000. *Aarhus* for violin and tape. Unpublished author's manuscript. p. 8.
[368] Soveral 2001. Second beat: 3:09-3:12. p. 12.
[369] Advaya 1993-1994. 6:26-6:32, p. 10; 6:37-6:45, p.10
[370] Bachratá 2005, 5:14-5:20. p.5.
[371] Brown 1996-1997. 1:48-1:57. p. 3.
[372] Oliveira 2008. 5:57-6:14. p. 15, measures 82-83.
[373] Bachratá, Petra. 2006. *Luminiscencia*. Unpublished author's CD recording. 2:53-2:58. Bachratá, Petra. 2006. *Luminiscencia* for flute and tape. Unpublished author's manuscript. p. 3, 2:59-3:03.

3. Canonic interaction – one gesture is followed by another, imitating or replicating its rhytmical and/or pitch structure. (*rhythm related and/or pitch related*)

Ex. 89: Karlheinz Stockhausen: Kontakte.[374] In this example canon is created between tape sound, bongo-tom-toms, and piano gestural movement. The rhythmical structure of the first "voice" (tape) is freely imitated and replicated in other two "voices" (percussion and piano).

Ex. 90: Jonathan Harvey: Advaya.[375] In this example there are two layers of gestural articulation, which in a moment create canonic relationship. First one is the rhythmic cello gestural articulation composed of pizzicato and fingernail pizzicato, belly-hit, behind bridge-produced percussive sound combined with distorted accelerando gestures produced by hard pressure of the bow on the string, second one is the grating tape sound with resonance, that in certain point (approximately in the middle of the example) replicates for a moment the cello rhythmic structure/patterning from the beginning and again transforms into the grating sound with resonance. The timbre of tape sound is derived from the timbre of cello sound.

Ex. 91: Rajmil Fischman: Los Dados Eternos.[376] In this example oboe imitates and replicates the structure of the gestural articulation of the tape – low sound and whispered sound with different pulsation (in comparison to the low sound gesture in oboe has diminished pulsation, comparing with the whispering sound it has augmented pulsation).

4. Canonic interaction with loop – conjunction of instrumental and tape gestures, which are related by constant repetition – "looping gestures".

Ex. 92: Petra Bachratá: Reflections.[377] Looping gestures in both marimba and electronics create a kind of "round canon".

Ex. 93: Isabel Soveral: Heart.[378] Similar example, where tremolando gesture loops between guitar and tape. (guitar-tape-guitar).

Ex. 94: Mario Davidovsky: Synchronisms No. 9.[379] Fast gestures in violin and

[374] Stockhausen 1959-60. 12:18-12:54. p. 14.
[375] Harvey 1994
[376] Fischman 1991. 2:53-3:06. p. 9.
[377] Bachratá 2005. 2:08-2:21. p. 2.
[378] Soveral 2001. First beat: 0:37-0:41. p.1.
[379] Davidovsky 1988. 7:36-7:45. p. 18-19, measures 202-206.

tape have looping character. (tape-violin-tape-violin-tape-violin).

5. Proportional interaction – one gesture "imitates" the structure of another one but with proportional change. This proportional imitation can involve rhythm alone, pitch alone, or both of them. For example, one gesture may imitate the rhythmic pattern/duration of another one by augmentation or diminution of its duration/rhythmic values, without change of the pitch structure. Another situation will be observed when one gesture will imitate another one by pitch change or intervalic manipulation without change of the rhythmic pattern/durational values. The last situation will be represented by relationship between two gestures where one will be imitation of another one with proportional change of both pitch and rhythmic structure.

Ex. 95: Isabel Soveral: Heart.[380] Relationship between guitar ascending gesture and tape gesture is in proportional relationship. The tape gesture is a diminution of durational values between pitches of guitar gesture.

These first five categories are using contrapuntal techniques typical for the instrumental music and their frequent and waste application in music combining instruments and electroacoustic sounds shows that they can be very efficient in creating interactive relationships even between gestures of different nature in mixed music.

Some composers have been searching the ways how to create a detailed model for counterpoint, which would be specific for pure electroacoustic - acousmatic music.

> Can we establish a truly contrapuntal method of working in the continuum?[381]

Trevor Wishart tried to find solutions for establishing concept of contrapuntal relationships in acousmatic music, which is not dependent of a lattice structure, by analyzing the concepts of counterpoint in conventional music and comparing them in the multi-dimensional continuum. The condition of feeling a musical experience as contrapuntal is that except of mere coexistence of musical streams,

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[380] Soveral 2001. Second beat: 0:15-0:20. p. 8.
[381] Wishart 1996, p.115

> they have to relate to one another or interact in some way during the course of their separate development.[382]

Then, according to Wishart, there can be established two criteria for recognition of contrapuntal structure:

architectural principle which supplies points of reference in the progression of musical material – concept of transformation from one timbral or sound-morphological area to another (comparable to the traditional progression from one key to another) and

dynamic principle, which determines the nature of the motion - gestural evolution and interaction between separate streams (comparable to traditional note-against-note counterpoint related to interplay of harmonic consonance-dissonance and rhythmic coordination).[383]

Wishart further examines sound events in their horizontal and vertical organization, more precisely the horizontal and vertical organization of four main morphological gestural archetypes (which he examines on the example of articulation of vibrato) ***– stable, unstable, leading-to* and *leading-from*,** from which the sound-events are constituted. Horizontal examination allows observing the use of mentioned four main gestural archetypes, sequences of individual gestures or average rate of gestural activity. Vertical observation on the other hand allows to study occurrence of mentioned types of gestures from moment to moment, marking blocks of time in which equal gestures occur and considerate gestures in various parts over short periods of time. Comparing gestures in different parts of the sound event we may recognize their similarity (homogeneous gestures) or their differences (heterogeneous gestures). Comparing the behaviour of gestures in the individual parts and between parts of the sound events, Wishart recognizes 6 types of vertical gesture ordering – parallel (synchronized), semi-parallel (the same gestural logic but not in a synchronous way), independent – homogeneous or heterogeneous, interactive and triggering.[384]

It is necessary to note that in the recognition of the four main morphological archetypes of gesture, Wishart doesn't attempt to include parametric separation, and in considerations of the vertical and horizontal criteria for gesture ordering, the gestural

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382 Ibid., p. 116
383 Ibid.
384 Schematic picture of these vertical orderings of gesture has been presented in chapter 2.2.

structure is independent of the timbral characteristics of the sound itself. Articulation of the sound material through the counterpoint of gestures allows to create subtle architecture for development and evolution of music.

Although Wishart makes these studies examining the case of voice vibrato gestural articulation, we can imagine, that they may be applied also to another types of gestures as more general criteria. Following these concepts, and perceiving mixed music along the concepts of continuum and streaming,[385] we may examine the contrapuntal relationships between gestures of distinct nature and similarly distinguish different horizontal and vertical relations among them. This all leads to the establishment of following gestural relationships:

6. Counterpoint between homogeneous gestures – counterpoint between similar gestures according to their similar morphology.

Ex. 96: Karlheinz Stockhausen: Kontakte.[386] Presented example demonstrates contrapuntal relationship between morphologically homogeneous gestures.

Ex. 97: Bernard Parmegiani: Jazzex.[387] In this case there is a contrapuntal relationship between morphologically and timbrally similar gestures in percussion and electronics.

7. Counterpoint between heterogeneous gestures – counterpoint of different gestures considering their different morphology and/or timbre.

Ex. 98: Karlheinz Stockhausen: Kontakte.[388] This example presents contrapuntal relationship between morphologically and timbrally heterogeneous gestures in piano, percussion and tape.

Ex. 99: Bernard Parmegiani: Jazzex.[389] Contrapuntal relationship is achieved by combination of morphologically and timbrally very distinct gestures in ensemble and electronics.

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[385] Bregman 1994, Wishart 1996
[386] Stockhausen 1959-60. 33:41-34:06. p. 37-38.
[387] Parmegiani 1966. 3:41-3:59.
[388] Stockhausen 1959-60. 13:59-14:30. p. 16.
[389] Parmegiani 1966. 5:56-6:30

Ex. 100: Bernard Parmegiani: Jazzex.[390] In this example layers of distinct gestural articulations (differently evolving in time) in double bass, trumpet, saxophone and tape create contrapuntal relationship.

8. Triggering relationship – where one gesture initiates the start or abrupt termination of another gesture or potentiates the change of its behaviour. For example the gesture in electronics is triggered off by the instrumental gesture and vice versa.

Ex. 101: João Pedro Oliveira: Cassiopeia.[391] Orchestral gesture in this example provokes the onset of the tape gesture.

Ex. 102: Petra Bachratá: Reflections.[392] This example demonstrates serie of triggering relationships between tape and marimba, where one gesture potentiates the onset of another gesture "in a chain". This accumulation of triggering gestural relationships helps to develop an energetic evolution of the musical discourse in presented part.

Ex. 103 and 104: Petra Bachratá: Mystic Garden.[393] In the first example tape gesture triggers the onset of the piano gesture. The second example is an opposite of the first, where piano gesture initiates the onset of tape gesture.

Ex. 105: Denis Smalley: Clarinet Threads.[394] In this example fast tape gesture at the end of the example initiates the abrupt termination of the sustained sound in clarinet.

These first five examples (ex.101-105) are presenting the triggering interaction according to the morphological concepts (onset potentiating of one gesture by morphological character of another gesture, or initiation of termination of existing gesture by the sudden onset of another gesture, etc.). This type of contrapuntal interaction may be considered ***"triggering interaction by potentiations between morphologies".***

Another type of "architectural interactions" is shown in next two examples, where triggering relationships between instrumental and electroacoustic gestures are created along the concepts of timbral transformations – ***"triggering interaction by timbral transformation***":

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[390] Ibid. 11:45-12:23.
[391] Oliveira 2008. 0:24-0:39. p. 3, measures 3-4.
[392] Bachratá 2005. 2:44-2:59. p. 3.
[393] Bachratá 2007. 2:57-3:02. p. 4-5, measures 44-45; 3:02-3:13. p.5, measures 45-48.
[394] Smalley 1985. 6:02-6:20. p. 5-6.

Ex. 106: Bruno Maderna: Musica su due dimensioni.[395] Tape gesture triggers the onset of the flute gesture. In this case the timbral transformations between very distinct gestures is more sudden.

Ex. 107: Rajmil Fischman: Los Dados Eternos.[396] Oboe gesture triggers the gesture in tape by more continuous timbral transformation, when the sustained pitch at the end of the oboe gesture transforms gradually into the screaming sound (still derived from the same oboe pitch) and continues as the door creaking and revolving sound disappearing in the whispering.

9. Counterpoint through gesture division – is often observed relationship between gestures, when the course of one gesture is divided into two or several parts, where one/some part is done by instrument and another part/s by tape.

The simplest example of this gestural division is situation when gesture starts in instrument and ends in tape or vice versa:

Ex. 108: Petra Bachratá: Mystic Garden.[397] Gesture starts in ensemble (composed of piano, flute and accordion sound) ends in tape.

More complex contrapuntal interactions through gestural division are shown in next examples, where one larger gesture is composed of several "alternations" between instrumental and electroacoustic sounds:

Ex. 109: Jean-Claude Risset: Passages.[398]

Ex. 110: Petra Bachratá: Luminiscencia.[399]

Ex. 111 and 112: João Pedro Oliveira: Cassiopeia. [400]

Ex. 113: Petra Bachratá: Mystic Garden.[401]

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395 Maderna 1958. 8:55-9:00.
396 Fischman 1991. 6:50-7:06. p.15.
397 Bachratá 2007. 1:23-1:26. p. 3, measure 21.
398 Risset 1982. Part 1. 5:41-5:47. p. 12, second system.
399 Bachratá 2006. 3:23-3:33. p.4.
400 Oliveira 2008. 3:15-3:36. p. 9, measures 44-49; 9:15-9:27. p. 23-24, measures 135-137.
401 Bachratá 2007. 8:04-8:12. p.12, measures 121-123.

4.4. Gestural relationships based on morphologic-semanic characteristics.

The previous subchapters were analyzing gestural relationships form the point of view of different gestural properties, from the viewpoint considering gestures as whole gestalts or from the perspective of contrapuntal organization of gestures. As presented in the summary of chapter 3, gesture is determined by moving from one point to another, has its own specific path in time and space and it has to do with energy. According to these features, we may identify different relationships between gestures based on their morphologic-semantic characteristics, such as direction or energy.

4.4.1. Direction.

With notion of gesture (and in fact all music) as *"motion in time"*, we become aware of a wide variety of motion types. As motion implies a direction, we may recognize different directional types of motion. Perhaps the most complex theory of motion may be seen in the Smalley's spectromorphological theory,[402] where he recognizes six main motion types - linear, curvilinear, unidirectional, bi/multidirectional, reciprocal and centric/cyclic. The schematic picture is presented in Figure 33.[403] As these categories have a very wide application on different levels of musical structure, they can be applied also to the gesture, precisely to its external motion contour.

We will analyze gestural relationships from the viewpoint of two types of 'direction':

- direction in pitch field
- direction as evolution in time (direction in duration field)

The direction of motion in external acoustic space (architectural space) and spatial relationships will be examined in chapter 4.5.

[402] chapter 1.4.1.
[403] Smalley 1986

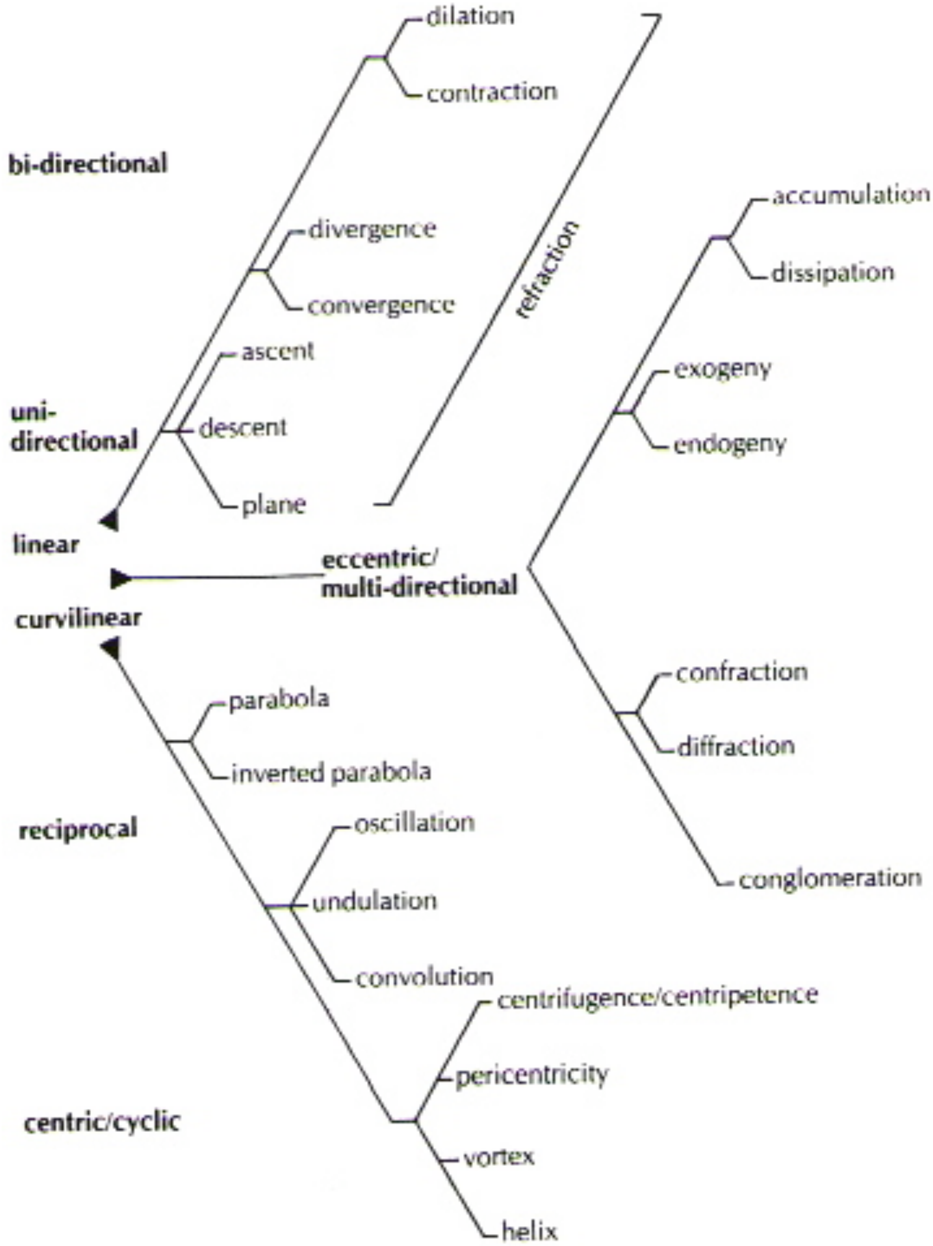

Figure 33. Motion typology, by Smalley[404]

[404] Smalley 1986, p.74

A. Direction in pitch field.

From study of gestural relationships concerning the similarity or difference in their direction in pitch space, we can distinguish 2 main types of motion:

Similar, when gestures move in the same direction.

Different, when gestures move in different directions.

According to the character of the direction of these motion types – *line/curve*, relations to certain *"central reference"* (pitch/frequency of a sound) and other manipulations of gestures in their direction (such as *stretching/contracting* their "path") we can combine these criteria into classifying following interactive gestural models:

1. Linear interaction – interaction by linear motion (motion along straight line) is observed in relationships, where two gestures are moving together in a direct, straight and undeviating way.

a. By similar direction of motion (unidirectional) – two (or more) gestures are moving linearly in the same direction.

Ascendent – two gestures are moving in the same direction ascending in the frequency range.

Ex. 114: Denis Smalley: Clarinet Threads.[405] Clarinet glissando and tape glissando have the same direction ascending in the frequency range.

Ex. 115: Chris Cree Brown: Sound Cylinders.[406] Flute and tape move in the same ascendent direction with different intervalic step.

Ex. 116: João Pedro Oliveira: Cassiopeia.[407] Instrumental gesture performed by fast staccato articulations in violins and tape gesture have the same ascendent direction.

Ex. 117: Jonathan Harvey: Advaya.[408] Cello glissando is related to the tape gliding sound by their similar ascending direction.

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[405] Smalley 1985. 1:08-1:11. p. 1.
[406] Brown 1996-1997. 6:46-6:52. p. 11.
[407] Oliveira 2008. 14:28-14:33. p. 33 measure 203.
[408] Harvey 1994. 3:12-3:22. p. 5.

Descendent – two gestures are moving in the same direction descending in the frequency range.

Ex. 118: Isabel Soveral: Heart.[409] Guitar glissando and tape resonant gesture have the same direction descending in the frequency range.

Plane – two gestures are moving in the same direction without significantly changing the pitch/frequency.

Ex. 119: Karlheinz Stockhausen: Kontakte.[410] This example represents plane linear relationship between piano, tom-tom tremolo and tape gesture.

b. By different direction of motion (bi/multidirectional) - two or more gestures are moving together by linear motion in different direction.

Convergent – gestures are moving in different direction – starting further and ending closer to each other considering their pitch/frequency.

Ex. 120: Mario Davidovsky: Synchronisms No.9:[411] In this example fast violin gesture, which starts in higher register is descending in the register to end up "closer" to the fast tape gesture moving in middle register.

Divergent – gestures are moving in different directions starting closer and ending further in their pitch/frequency in relation to each other.

Ex. 121: Petra Bachratá: Reflections.[412] Marimba trill is in divergent relationship with the first fast ascendent gesture and second trilling glissando in tape, which completes the marimba trill gesture by its virtual ascendent motion. (The relationship between the instrumental gesture (marimba trill) and the second tape gesture as its virtual continuation represents interaction, that is explained later as a virtual divergence.)

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409 Soveral 2001. First beat: 2:46-2:48. p. 5.
410 Stockhausen 1959-60. 2:51-2:59. p. 4.
411 Davidovsky 1988. 6:24-6:27. p. 14-15, measures 165-167.
412 Bachratá 2005. 2:19-2:25. p. 3.

Ex. 122: Petra Bachratá: Mystic Garden.[413] In this example there is more complex interaction: the flute trilling gesture is in a convergent-divergent relationship with the gesture composed of piano string glissando and its virtual continuation in tape, more precisely flute trill is intersected by another gesture that is composed of piano string glissando and its tape glissando continuation. The relationship between these two gestures till the moment of their intersection is convergent (glissando is moving closer to the flute trill), after the intersection has divergent character (glissando is moving further from the flute trill).

Reciprocal - the motion of one gesture in one direction is balanced by reciprocal motion of another gesture in opposite direction. Condition of this relationship is to hear the direction of the first gestural motion to be able to evaluate the following gesture character of direction as reciprocal. This is the difference from the first two relationships, when we perceive the convergence or divergence best in simultaneity. Another example of reciprocal interaction may be seen on the example of one gesture with ascendent and descendent phase divided between instrument/ensemble/orchestra and electronics.

Ex. 123: Mario Davidovsky. Synchronisms No.9.[414] Very clear example of reciprocity of motions in two gestures. Fast ascendent tape gesture is balanced by descendent violin gesture.

Ex. 124: Denis Smalley: Clarinet Threads.[415] There are two cases of reciprocal interaction in following example. In first case very slight ascending frequency of first air-sound clarinet gesture is balanced by the slight descending character of timbrally similar tape gesture. Second case is short fast ascendent tape gesture simulating "bird-sound" and its compensation by short descendent clarinet gesture.

Ex. 125: Jean-Claude Risset: Passages.[416] Ascendent motion of percussive tape gesture is balanced by descendent motion in flute.

Ex. 126: João Pedro Oliveira: Cassiopeia.[417] The large ascendent-descendent gesture is composed of both orchestral and electroacoustic sounds. Perceptually, the

[413] Bachratá 2007. 4:43-4:53. p. 8, measures 71-73.
[414] Davidovsky 1988. 4:11-4:13. p. 10, measures 105-107.
[415] Smalley 1985. 3:26-3:30. p.
[416] Risset 1982. Part 2. 0:00-0:05. p. 16, first system.

initiation of the ascendent part and the termination of the descendent part is perceived more in tape while the continuation of the ascendent part and transition to the descendent part is perceived more in orchestra.

Ex. 127: Panayiotis Kokoras: Morphallaxis.[418] In this example descending pulsating gestural articulation in tape is balanced by ascending gesture in flute (tongue-ram run) and cello tremolo-glissando.

Ex. 128: Chris Cree Brown: Sound Cylinders.[419] This is example of reciprocity in imitative ("tail to head" imitation) relationship. Descendent gesture in flute is transformed to ascendent gesture in tape.

Ex. 129: Petra Bachratá: Mystic Garden.[420] Ascendent tape gesture in the beginning of the example is compensated by opposite motion of the flute gesture.

Ex. 130: Isabel Soveral: Heart.[421] Ascendent motion of guitar glissando is compensated by descendent motion in tape gesture. (After the most present reciprocal relationship between guitar and tape, the example continues with several reciprocal motions in tape).

Often we may observe combination of all these gestural relationships (convergent, divergent, reciprocal) between instrument and electronics, as it is demonstrated in the next example:

Ex. 131: Isabel Soveral: Heart.[422]

2. Curvilinear interaction – interaction by curvilinear motion (motion along a curved path/line) is seen in situations, when two gestures are moving together in a line but in a certain moment the course of their movement changes the angle and the direction. Gestures in curvilinear relationship may also have similar direction, when initially linear gestures change their direction and this continuation is again in the same direction. Or, gestures with initially linear motion change their direction in such a way that they continue in different directions.

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[417] Oliveira 2008. 9:15-9:27. p. 23-24, measures 135-137.
[418] Kokoras 2008. 4:45-4:58. p. 22-23, measures 88-91.
[419] Brown 1996-1997. 4:14-4:23. p. 7.
[420] Bachratá 2007. 8:46-8:55. p. 13-14, measures 132-133.
[421] Soveral 2001. Second beat: 0:36-0:47. p. 9.
[422] Ibid. First beat: 1:35-1:47. p. 3.

Ex. 132: Bruno Maderna: Musica su due dimensioni.[423] Ascending flute gesture and tape glissando have linear relationship until the flute gesture changes the direction and descends in the pitch space.

Ex. 133: Denis Smalley: Clarinet Threads.[424] Sustained long clarinet pitch changes its direction by influence of several tape gestures with triggering potential, which results into destabilizing the clarinet pitch and change of its course - ending by ascending glissando.

Ex. 134 and 135: Denis Smalley: Clarinet Threads.[425] In following two examples clarinet and tape glissando relate by curvilinear motion. Initially sustained pitch in clarinet and linear motion in tape gesture move their direction and continue in a divergent relationship.

There are certain gestural relationships, standing between linear and curvilinear interaction, when instrumental gesture is completed in tape by simultaneous movement in different directions. We call this model situation ***interaction by "virtual bi/multidirectional" motion***. In this case, direction manipulation of instrumental gesture by creating its electroacoustic "virtual" continuation allows formation of musical events which are impossible to perform just by the instrument (for example, flute can't play a glissando in two direction, etc.).

Ex. 136 and 137: Petra Bachratá: Luminiscencia.[426] These two examples show relationship by "virtual divergence", where flute gesture continues in tape simultaneously ascending and descending in the frequency range. In the first example flute trill continues in tape but with simultaneous ascending and descending movement in the frequency range. In the second example high flute frullato transforms into a whistle tone on the same pitch which continues in tape as an echo with simultaneously ascending and descending pitch. Manipulation of the instrumental sound in tape allows virtual divergent completion of the instrumental gesture.

[423] Maderna 1958. 12:08-12:13.
[424] Smalley 1985. 8:42-9:00. p. 8.
[425] Ibid. 1:11-1:33, p. 1; 0:00-0:10. p. 1.
[426] Bachratá 2006. 0:32-0:40. p. 1; 3:23-3:33. p. 4.

3. Interaction by manipulation of direction in pitch field

a. By contraction - one gesture is the contraction of another gesture in relation to its pitch structure or frequency width.

Ex. 138: João Pedro Oliveira: Labirinto.[427] In this example cello gesture is later imitated by tape with contraction of the frequency width.

b. By expansion - one gesture is the expansion of another gesture in relation to its pitch structure or frequency width.

Ex. 139: Jean-Claude Risset: Passages.[428] While tape and flute gestures have similar ascendent character of their motion, tape gesture is the expansion of flute gesture in the pitch field, or in other words flute gesture is the contraction of the tape gesture in the pitch field. The interval width between first and last pitch of the gesture is contracted/expanded in relation to each other.

Ex. 140: Petra Bachratá: Reflections.[429] Tape descendent glissando is expansion of descendent glissando on marimba pipes considering the relation of their interval widths.

Many of these previous models may be applied also in relation to some central reference point (which may be for example certain pitch or frequency of the sound). In this case the connections will be represented not by relations between gestures itself (as it is for example in case of convergent and divergent relationships) but between gestures and the "central point". From this perspective, we may recognize:

4. Centric interaction:

a. Centripetal – motion toward the centre. For example, gestures with similar linear motions of ascendent/descendent character, different motions with convergent character moving towards the "centre".

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[427] Oliveira, João Pedro. 2001. *Labirinto*. In CD: João Pedro Oliveira – Maelström. Phone-edition, Portugal 2010, Track 2: 15:12-15:27. Oliveira, João Pedro. 2001. *Labirinto* for string quartet and tape. Unpublished author's manuscript, measures 285-290.

[428] Risset 1982. Part 1: 7:16-7:22. p. 14, first system.

[429] Bachratá 2005. 5:38-5:44. p.6.

Ex. 141: Jonathan Harvey: Advaya.[430] In this example simultaneous distorted glissandos in cello and tape are moving in the same direction towards the pitch (A#). This pitch has a role of a central point of reference and the motion in both cello and tape is directed towards this centre.

b. Centrigufal – motion away from the centre. For example, gestures with similar linear motions of ascendent/descendent character, different motions with divergent character moving away from the "centre".

Ex. 142: Isabel Soveral: Heart.[431] Guitar and tape gesture both starting on the same pitch (E3 flat) move away from this pitch – guitar by descendent fast articulation, tape by very short descendent glissando of resonant type.

c. Pericentral – relationships by gestural motions around the central point of reference.

Ex. 143: Panayiotis Kokoras: Morphallaxis.[432] In a course of this example the same gestural articulation composed of tremolando sounds in hand drum and tape, later together with similar articulation in cello and flute with some accentuations, moves always around the same frequency/pitch.

Ex. 144: Petra Bachratá: Reflections.[433] Similar gestural articulations in marimba and tape are moving around the same frequency range. Perceptually we perceive this relationship as pericentral – there is a feeling of some center and the motion around this center.

B. Direction as an evolution in time (direction in durational field)

Since motion is characterized not only by its path in space, but also by its behaviour in time we may consider the direction also as an evolution in time (direction in duration field), which will be expressed by different time contours. According to

[430] Harvey 1994. 8:50-9:14. p. 13.
[431] Soveral 2001. First beat: 0:42-0:44. p. 1.
[432] Kokoras 2008. 6:57-7:24. p. 33-35, measures 129-138.
[433] Bachratá 2005. 2:08-2:20. p. 2.

Wishart's three levels of time properties of motion:[434] first order time property (speed types – slow, medium speed and fast speed), second order time properties (speed changes through time – acceleration/deceleration[435]), third order time property (the way in which second order time property changes through time) and his six classes of motion (time-contours): constant, accelerating, decelerating, irregular, accelerating-decelerating and decelerating-accelerating, applied on the gestural level, we may recognize following gestural relationships:

1. Interaction by constant speed – gestures relate to each other by similar constant speed of their motion (slow, medium or fast).

Ex. 145: Bernard Parmegiani: Jazzex.[436] In this example saxophone, trumpet and electroacoustic gestural articulation are related by the same character of their fast speed movement.

2. Interaction by irregular speed – both instrumental and electroacoustic gestures have irregular - changing speed.

Ex. 146: João Pedro Oliveira: Abyssus Ascendens ad Aeternum Splendorem.[437] In this example different instrumental gestures in orchestra and tape relate by their constant speed changes.

3. Interaction by acceleration – gestures are simultaneously or "contrapuntally" accelerating in speed.

Ex. 147: Petra Bachratá: Luminiscencia.[438] This is example of accelerating relationship between lip-pizzicato flute gesture and tape gesture of similar timbre.

Ex. 148: Petra Bachratá: Mystic Garden.[439] Following example demonstrates interaction between piano gesture articulated by acceleration of one note and 2 tape

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[434] Chapter 3.1.3.

[435] the equivalent from instrumental music would be the accelerando/ritardando, which refer mostly to the change of the tempo. However, as in electroacoustic music we often can't talk about tempo as it is understood in traditional sense, therefore the terms acceleration/deceleration seem to be more appropriate in our applications.

[436] Parmegiani 1966. 3:59-4:09.

[437] Oliveira, João Pedro. 2005. *Abyssus Ascendens ad Aeternum Splendorem*. Unpublished author's recording, 8:15-10:06. Oliveira, João Pedro. 2005. *Abyssus Ascendens ad Aeternum Splendorem* for piano, orchestra and electronic sounds. Unpublished author's manuscript, measures 133-158.

[438] Bachratá 2006. 0:55-0:59. p. 1.

gestures with the same accelerating characteristics (first tape gesture simultaneous with the piano gesture timbrally derived from the piano sound and second tape gesture as the continuation of acceleration of the first one with more extended timbral transformation).

Ex.149: (19) Tristan Murail: Desintegrations.[440] Ensemble and tape accelerates simultaneously from separate eight-note articulations till tremolo articulation and fast repeated groups of notes in piano, tremolo articulation in low strings (vlc, cb), percussion (tam-tam and guiro) and tape low sound and sound derived from the percussion sound.

4. Interaction by deceleration – two gestures are simultaneously or "contrapuntally" decelerating in speed.

Ex. 150: Karlheinz Stockhausen: Kontakte.[441] In this example percussion (bamboos) gesture irregularly decelerates in speed simultaneously with more regularly decelerating gesture in tape.

Ex. 151: Karlheinz Stockhausen: Kontakte.[442] Following example demonstrates decelerating relationship between ensemble (piano, marimba and small percussion – tom-toms, African wood drums, cowbells) and tape irregular gestural articulations of distinct timbral qualities. The whole large gesture is perceived not only as deceleration but also as a continual loss of density, where initial very fast articulations in both media (ensemble, tape) gets slower and slower till its end in random impulses of individual instruments and tape sounds.

Ex. 152: Petra Bachratá: Reflections.[443] In next example although the timbre of marimba gesture and tape gesture is different, both gestures relate by similar decelerating character of their motion. Continuous regular deceleration of marimba trill is combined with more irregular deceleration of tape sound.

5. Combined types of interaction – different combinations of accelerating and decelerating gestures or even combinations of accelerations and decelerations in one gesture. For example simple acceleration-deceleration or deceleration-acceleration

[439] Bachratá 2007. 4:53-4:59. p.8, measures 73-75.
[440] Murail 1989. 10:24-10:35. p. 38.
[441] Stockhausen 1969-60. 18:42-18:48. p. 21.
[442] Ibid. 26:43-27:24. p. 30, XIIIC
[443] Bachratá 2005. 7:30-7:38. p. 8.

relationship, or one large combined gesture may be also composed of several parts of accelerating or decelerating character, where some parts are done by instrument and another ones by the electronics.

Ex. 153: Tristan Murail: Desintegrations.[444] Course of this example presents three decelerating gestures composed of ensemble and tape sound – first two shorter and the last longer with more evident deceleration.

Ex. 154: Petra Bachratá: Reflections.[445] Two regularly accelerating gestures in marimba (played by right and left hand) are combined with irregularly decelerating gesture in tape.

Ex. 155: Petra Bachratá: Reflections.[446] This example is relating two desynchronized decelerating marimba gestures with accelerating gesture in tape.

6. Interaction by manipulation of time will be represented in relationships where one gesture will be contracted or stretched in comparison to another one.

a. Interaction by time contraction

Ex. 156: Jean-Claude Risset: Passages.[447] In following example the durational pattern of flute gesture is contraction of durational pattern of ascending tape gesture.

Ex. 157: Denis Smalley: Clarinet Threads.[448] Length between pulses in clarinet gestural articulation of one note is contracted in tape gesture.

Ex. 158: Petra Bachratá: Reflections.[449] Example of two short gestures, where marimba gesture is contraction of tape gesture in time.

b. Interaction by time expansion

Ex. 159: Jonathan Harvey: Advaya.[450] Simple example of duration expansion between two gestures. Tape glissando is more than twice as long in duration comparing to cello glissando.

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[444] Murail 1989. 10:35-11:12. p. 39-40.
[445] Bachratá 2005. 3:18-3:25. p. 3.
[446] Ibid. 3:18-3:25., p. 3.
[447] Risset 1982. Part 1: 8:05-8:13. p. 15, first and second system.
[448] Smalley 1985. 7:58-8:05. p. 7.
[449] Bachratá 2005. 0:28-0:31. p. 1.
[450] Harvey 1994. 3:12-3:22. p. 5.

Ex. 160: Chris Cree Brown: Sound Cylinders[451]. In this example flute gesture is durational expansion of tape gesture.

Ex. 161: Chris Cree Brown: Sound Cylinders.[452] Descending tape gesture is imitated by flute with time expansion.

Ex. 162: Petra Bachratá: Mystic Garden.[453] Crescendo-decrescendo type of gesture in accordion (air sound) is imitated by tape gesture of associated timbre with expanded duration.

Ex. 163: Chris Cree Brown: Sound Cylinders.[454] In this example first flute glissando gesture is imitated in tape with the duration expansion, second flute glissando gesture is imitated in tape with duration contraction.

Sometimes we may observe combination of models by contraction/expansion in both pitch and time, as it is in the following example:

Ex. 164: Jean-Claude Risset: Passages.[455] Next example is combination of expansion in pitch field and duration field. Tape ascending gesture is directions expansion of flute gesture in pitch field (interval between first and last pitch of the gesture) and also in duration field (duration of flute gesture).

Combination of different directional models presented above will allow creation of numerous derivations of interactive relationship, for example, combination of accelerating and decelerating gestures with convergent or divergent direction of the movement, combination of two accelerating or decelerating gestures in different unidirectional relationships, etc.

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[451] Brown 1996-1997. 0:53-1:03. p. 2.
[452] Ibid. 8:00-8:14. p. 12-13.
[453] Bachratá 2007. 0:12-0:19. p. 2, measures 3-4.
[454] Brown 1996-1997. 7:29-7:41. p. 12.
[455] Risset 1982. Part 1: 7:16-7:22. p. 14, first system.

4.4.2. Energy.

We have considered gestures as "motion in time and space" and described different gestural relationships according to the motion characteristics in space and time. Any motion will be related with feeling of energy.

Variations in speeds of gestures and combinations of different models of temporal directional motion relationships will influence the way, how the gestures will be perceived. Slow speed motions and decelerating motions may appear as having less energy, or decreased energy, fast motions and accelerating motions may evoke feeling of cumulated or increased energy. Motions of middle speed and acceleration-deceleration motions may appear as having maintained or culminating energy. Also time contraction and expansion may evoke different sense of energy, when contraction may be experienced as more 'localized' energy and the expansion as more 'diffused' energy.

We may feel the different amount of energy related not only with the motion characteristics, but also with the loudness (intensity) of gestures. The loudness trajectory might influence our perception of energy in a similar way as the changes in speed do. We may feel increasing loudness as having more energy as decreasing loudness, similarly the maintained intensity may be generally perceived as kept energy.

Amount of energy of one gesture may potentiate or trigger the onset of another gesture, speed up or slow down its continuation or termination. Energy will not disappear but transform or convert into other form, such as for example loss of energy potential in decreasing loudness of one gesture may convert into kinetic energy of another gesture and speed up its time contour. According to the energetic character of the gestures, we recognize following energetic relationships:

1. Interaction by constant/maintained energy – relationship between gestures with no significant changes in character of motion, intensity, velocity or spectral density are present.

Ex. 165: Karlheinz Stockhausen: Kontakte.[456] Combination of static piano, tom-tom and tape tremolo gesture represents relationship by constant energy (no changes in motion, intensity or velocity are present).

Ex. 166: Rajmil Fischman: Los Dados Eternos.[457] Another example of relationship with constant energy: Although there is rhythmic motion in oboe and tape gestural activity, no evident changes in general intensity or velocity are present and the whole is perceived as maintaining the same level of energy.

Ex. 167: João Pedro Oliveira: Cassiopeia.[458] In the course of following example loud general instrumental gestural activity created by accentuated repetition of one note and fast gestures in piccoli, fast repetition of group of notes in harp together with tremolo-type of gestural articulation and fast gestures derived from the flute sound in tape maintains its energy with no significant motion, velocity or intensity change. (The change of the fast groups of accentuated repeated notes to fast group of notes of distinct pitches is not perceived in this case as a change of energy).

Ex. 168: Petra Bachratá: Luminiscencia.[459] Whistling gestures in flute and tape in very soft loudness (ppp) without change of motion, timbral or velocity character are perceived as constant energy.

2. Interaction by increased energy – different gestural relationships related to increased intensity (crescendo) or velocity (acceleration) or related with a thickening of spectral density.

Ex. 169: Denis Smalley: Clarinet Threads.[460] Increasing energy of clarinet gesture (crescendo) transforms into high initial energy of gesture in tape.

Ex. 170: Petra Bachratá: Reflections.[461] Another way of this model relationship is represented by situation when two gestures are relating by simultaneous increase of energy, as it is demonstrated in this example of marimba and tape gesture with simultaneous crescendo.

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[456] Stockhausen 1959-60. 2:51-2:59. p. 4.
[457] Fischman 1991. 8:18-8:32. p.18.
[458] Oliveira 2008. 8:27-8:45. p. 21-22, measures 126-127.
[459] Bachratá 2006. 6:32-7:02, p.7.
[460] Smalley 1985. 0:28-0:50. p. 1.
[461] Bachratá 2005. 8:21-8:28. p. 9.

3. Interaction by decreased energy – different gestural relationships related to decreased intensity (decrescendo) or velocity (deceleration) or related with a spreading of spectral density.

Ex. 171: Jonathan Harvey: Advaya.[462] Grating cello gesture together with electroacoustic gesture decrease their energy by decreasing their intensity and timbral transformation into sustained cello pitch and soft tape sound.

Ex. 172: João Pedro Oliveira: Cassiopeia.[463] Initial acumulated energy of the attack composed of vibraphone, gong and low sound in tape decreases during the decay phase composed of lower tape sound and percussion decelerating gesture in gong until it almost disappears in the resonance.

Ex. 173: Karlheinz Stockhausen: Kontakte.[464] Sense of decreasing energy between percussion and tape gestures is caused by fluent passage from high gestural activity to random impulses.

4. Interaction by transformed/converted energy – relationships between gestures where one certain character or "type of energy" of one gesture converts or transforms into other "type of energy" of another gesture. For example static energy of one gesture converts to kinetic energy of another gesture, decreasing energy of decelerating or decrescendo gesture will transform to increasing energy of crescendo or accelerating gesture, many earlier characterized triggering relationships will be perceived as transformations of energy between gestures, etc.

Ex. 174: Petra Bachratá: Reflections.[465] In this example energy of the very short tape gesture transforms into kinetic energy of marimba gesture.

Ex. 175: Petra Bachratá: Mystic Garden.[466] Short attack gesture in tape converts its energy into the chain of kinetic gestural motions in piano, accordion and flute.

Ex. 176: Rajmil Fischman: Los Dados Eternos.[467] Energy of the oboe melodic gesture ending with the crescendo on the last pitch transforms into the energy of screaming derived from this pitch and following creaking gesture in tape.

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[462] Harvey 1994. 8:50-9:14. p. 13.
[463] Oliveira 2008. 0:03-0:15. p. 3, measure 1.
[464] Stockhausen 1959-60. 7:21-7:27. p. 9.
[465] Bachratá 2005. 6:58-6:59. p. 7.
[466] Bachratá 2007. 2:57-3:02. p. 4-5, measures 44-45.
[467] Fischman 1991, 6:50-7:06, p.15.

Ex. 177: Jean-Claude Risset: Passages.[468] This example presents continuous transformation of energy from tape gesture to flute gesture (tape-flute-tape-flute). The moment of intensity decrease of one gesture transforms into intensity increase of next gesture. Continuous merging of one gesture into another one doesn't allow disappearance of energy.

Ex. 178: Denis Smalley: Clarinet Threads.[469] Increasing intensity of first air gesture in clarinet potentiates the start of the tape gesture; energy doesn't disappear with decay of this gesture, but converts into the kinetic energy of next fast gesture in tape and short glissando in clarinet. The decrease of energy in one gesture causes rebirth of energy in the next gesture.

Ex. 179: Bruno Maderna: Musica su due dimensioni.[470] Initial attack in tape loses energy during its decay, but this loss is compensated by conversion into kinetic energy of the flute gesture.

Ex. 180: Panayiotis Kokoras: Morphallaxis.[471] This example demonstrates continuous transformations and conversions of energy between the gestural articulations in ensemble and tape. Decelerations transforms into accelerations, attack provokes another attack, kinetic energy of one gesture is converted into kinetic energy of another gesture or into cumulated energy of attacks, etc.

Ex. 181: Tristan Murail: Desintegrations.[472] In this example decreasing energy of the initial attack in tape and piano transforms into kinetic energy of gestural movements in ensemble and tape.

5. Combination of previous models

Ex. 182: Petra Bachratá: Mystic Garden.[473] Increasing energy of ensemble fast gestural activity (continuous adding of fast instrumental gestures in piano, accordion and flute with crescendo) reaches its peak in attack-phase of gesture in tape, which decreases its energy during the decay-phase.

[468] Risset 1982. Part 2: 4:22-4:37. p. 22-23.
[469] Smalley 1985. 3:26-3:30. p. 3.
[470] Maderna 1958. 8:55-9:00.
[471] Kokoras 2008. 2:40-3:10. p. 13-15, measures 51-60.
[472] Murail 1989. 2:53-3:34. p. 16-17.
[473] Bachratá 2007. 3:54-4:10. p. 6-7, measures 59-62.

Ex. 183: João Pedro Oliveira: Cassiopeia.[474] In this example initially localized energy of the percussion solo gestural articulation increases by continuous addition of gestural articulations in all orchestral instruments (fast runs, glissandi in different directions) in crescendo together with increased motion activity in tape and after reaching its peak - “most dense part of the sound” starts to decrease by continuous disappearance of the instrumental and tape gestures in general decrescendo.

Ex. 184: Karlheinz Stockhausen: Kontakte.[475] In the course of this example increasing energy of general crescendo trajectory, composed of accumulation of crescendo-decrescendo tremolo gestures in ensemble and electronics reaches the maximum point in the beginning of descending tape gesture and disperses into the separate impulses at the end of this complex tape gesture.

From compositional point of view, we can imagine that variations of energy sensations – feelings of different energetic relationships by constant, maintained, increased or decreased, localized or diffused, accumulated, transformed or converted energy, by manipulating different characteristics of gestural relationships (or if applied more generally in relationships between any musical structures), will participate on constitution of tension-relaxation sensations, that are important aspects for creation of perceptually balanced musical discourse.

4.5. Spatial models of gesture interaction.

In Chapter 3.1.2 we were relating the movements to external (architectural) acoustic space. If we consider that gesture is “*reflected in spatial trajectory*”[476] – it has its “spatial behaviour”, caused by certain types of trajectories, we can identify wide variety of these trajectories - gestural movements in space – which we call spatial gestures. In fact,“*any directed aspect of a motion may be considered a spatial gesture*.”[477]

[474] Oliveira 2008. 3:15-3:36. p. 9-10, measures 44-49.
[475] Stockhausen 1959-60. 16:42-17:36. p. 19-20.
[476] Smalley 1986, p.91
[477] Wishart 1996, p.231

In pure acousmatic music, the waste number of different spatial movements has been described in Wishart's and Smalley's writings.[478] Imagination of any virtual acoustic space with different set ups of loudspeakers, allows composers to create a numerous types of spatial gestures due to their different direction of motion, such as for example straight line, curves, circular, cyclical, symmetric, asymmetric and their categories (for example, considering the motion symmetry, gestures may preserve linear frame or central symmetry or symmetry within rotating frame). All these gestural models may be combined and build up different spatial relationships, according to their type of movement, directions, distance in space, etc.

However, with music combining instruments and electroacoustic sounds, many of these possibilities would be more hypothetical than practical. First of all, in case of fixed electroacoustic sounds, the most common is the use of stereo setup and fixed position of the performer. During the performance, it is possible to spatialize the instrumental sound also, nevertheless this is more rare than usual situation. Performances involving "live-electronics" are more opened for different types of experimenting with sound in space, however it may be quite difficult to maintain well balanced and "not too artificial" instrumental sound.

The way gestures will move in space will influence the way they will be perceived. For example, gesture moving in a straight line from right to left will sound different from the same gesture moving circularly around the listener. Interactions of musical structures with space by spatial manipulations can result in morphological transformations, which we will perceive through different changes, such for example changes in spectral richness or spectral contour. Spatial articulation therefore functions as a morphological determinant, which brings spatiomorphology in a closed relationship with spectromorphology. In this perspective, according to Smalley, sound diffusion becomes "*a fragile art, which will affect both musical substance and structure*".[479]

Since these spatial aspects are already beyond the scope of our research and it is impossible to encompass all the complexity involved in the subject of spatialization, for practical purposes of interaction between gestures, we will distinguish here just few

[478] Smalley 1986, 1997, Wishart 1996
[479] Smalley 1986

models of spatial relationships between instrumental and electroacoustic gestures as the most elementary categories:

1. Independent relationship – where both gestures act independently in space.
In a simple basic stereo condition it can be for example one gesture localized in right, another in left.

2. Interactive relationship – where both gestures interact with each other through the direction of their motion – for example in convergent or divergent way.
In **convergent interactive relationship** gestures initially placed in right and left are during the time moving closer to each other and their end is perceived in the central axis.
In **divergent interactive relationship** gestures starting close to each other, perceived for example in central axis – in the middle are during time getting more distant from each other – one more to left, one more to right.

3. Triggering relationship will represent spatial interaction, when one gesture will potentiate the movement of the other gesture, for example arrival of one gesture at particular location will cause sudden movement and departure of another gesture from its location. The arrival and departure locations may be the same or different. Important is that one gesture movement causes the change in location of another movement. (For example one gesture moving fast from right to left in the moment it arrives to the left causes that the gesture which was initially at left will move to the right.)

Summary of all models of gesture interaction presented in this chapter is in the Appendix.

CONCLUSIONS

Although there are many ways by which the interaction in mixed music can be done, this research has focused on the gesture interaction or more precisely musical gesture interaction. Without a big effort, I would not be able to integrate the enormous scope of this subject into coherent and quite comprehensive thesis. The nature of the study depends always on many questions we try to answer, so does the discussion. I could have concentrated my work exclusively in terms of searching of a proper definition of musical gesture, which would be a little redundant decision, since these kind of attempts have been quite substantially done in several master or doctoral dissertations, probably most broadly in very interesting dissertation of André Ricardo de Sousa. Or I could have framed my investigation in terms of analysis and description of different types of gestures found in mixed electroacoustic compositions or musical works in general, but this approach, in my opinion, also has been quite extensively taken in Hatten's concepts of musical gestures in classical music or in the concept of semiotic temporal units defined by the team of François Delalande. Rather, I have chosen to explore the broad phenomenon of musical gesture interaction, without specific regard just to one or two perspectives. The main idea of my multilevel or let's say multi-perspective focus was first to present different approaches to gesture, to show gesture as a more or less complex phenomenon with strong potential for articulating musical material and even more for interacting materials of different nature. The summary of different attitudes to gesture with the possible definition of what gesture is or might be, served as basis for some decisions, which were made in analytical part of the research approaching the musical interaction. The hierarchical potential involved in gesture and gestural articulation of musical material enabled to recognize different "levels" of gestures from very short structural "sound fragments" to larger gestalt forms and to establish different models of their relationships.

It is clear that gesture is not just a movement, or just a meaning. It is surely not just the connection of different parameters in a whole. However, I am convinced that although we hear gestures primarily as complex gestalts - the whole ensemble and totality of properties, for finding points of contact between two gestures each one based on different primal concepts, one on lattice, another on continuum, at some point it will be exactly the individual gesture properties and their evolution, which will turn our attention to understand interaction, either in process of analysis or in process of composition. Certainly if composer "interacts" two materials (instrumental and electroacoustic), he will not concentrate always in all the sound characteristics at once, but will pick up and develop those, he will find interesting and useful in "this or that" moment of composition. So will the analyst, while analyzing a piece of music. Here, for example the concept of gesture-figure finds its practical application – we decompose gestures to their figural articulations, in our case this was more loosely applied to pitch, duration/rhythm, timbre and loudness, and we realize how gestures are related. Sometimes we will perceive more the rhythmic relation than the pitch or timbre relationships, in another part we may strongly feel the timbral connections and forget how the musical gesture is organized in time and sometimes there will be moments when we might realize all these connections at once. Comparison of these individual gesture properties in both domains, instrumental and electroacoustic, leads us to finding relations between them. The tripartite model of structure, on the other hand, seems to have revealed interesting ways of interaction between gestures as whole gestalts. In another level of focus some of the organizational principles of counterpoint have been applied. In the beginning of this research I intuitively felt there was a huge potential in the contrapuntal organization of musical material in instrumental and electroacoustic music for building a coherent musical discourse. In fact, many composers have been using these techniques, so it was worth to look at them from a closer perspective. Analysis of gesture relationships from the spectromorphologic-semantic perspective revealed numerous ways of interaction, where gestures could be differently related by their directional tendencies, either in pitch field or considering direction as time evolution; and by amount of energy or "energetic" behavior involved in the relationship. Application of spatial criteria has been left in more theoretical discussion, since none of the spatial models of interaction between gestures could have been practically demonstrated, although it was possible to imagine them and create some basic theoretical models.

I would like to complete that my viewpoint in this investigation was not a perspective of an analyst who analyses different works to understand how those function in particular cases, but the approach of a composer who analyzed different mixed works with the aim to find the "potential" relations and interactions, useful not only as analytical models but as compositional models for me, as well as possible models for any other composer, who deals or wants to deal with this music.

Different personal perspectives and attitudes, departing from the classified relationships and exploring them further and "beyond", are presented in eight pieces in a second part of this dissertation. It is notable from examples presented in the analytical Chapter IV that many of the models classified in this dissertation have been applied in three compositions written for instruments and electroacoustic sounds - Reflections, Luminiscencia and Mystic Garden. Furthermore, in two of these compositions (Luminiscencia and Reflections) the different interactions between instrumental and electroacoustic parts helped to emphasize the contrast between the real – vivid and the ethereal – imagined, each one is some type of mirror reflection of the other one or the electroacoustic element acts like a phantasm of the instrument. Mystic Garden, on the other hand represents complex fusion of the two worlds into a world of imagination – "music of colours, tones and delicious fragrances". This piece particularly attempts to activate all senses of perception in a listener (transmodal perception) - while certain sounds evoke a sense of touch or a smell, or even a taste, others have strong potential to be perceived as images and the whole body may be interlinked.

Generalization and extension of interactive gestural models and their relation to other structuring processes in music, such as texture, is demonstrated in several of my works, either instrumental or electroacoustic. In some of my pieces, such as Eyes wide shut or Mystic Garden, an intimate relationship between gesture and texture has been explored. In these pieces the superimpositions of many small gestures interacting among themselves helped to create kind of "moving textures" and boosted the texture with a dramatic charge. It is the combination of these "gestured" textures and their balance that gave sense of a form to these pieces and helped to create moments of tensions and relaxations, so important aspects from the listening perspective. However, the form in these two pieces is shaped differently – while in Mystic Garden it is achieved more continuously, in Eyes wide shut the form is shaped in its sections. The sudden interruptions and abrupt changes in mood of these sections help to create constant surprise for the listener. In other pieces, such as Vozes de Aço and Somewhere... where the rainbow ends..., invention of new ways of playing and use of these techniques to create various original "textured" gestures, facilitated the musical discourse to move fast but delicately from very clear pitched gestural articulations to more noise-based gestures or "gestured" textures and perhaps participated on creation of original continuities and connections. Some of the previous compositional strategies have been applied also in the piece Subjective risk... no alternative. Moreover, the exploration of extended instrumental techniques and combinations of timbres with very different nature in timbrally unusual conglomeration of sounds, often gesturally articulated; and their integration into the harmonic structure has been a leading feature of fabrication of musical material in this particular piece.

Nunataq is the only piece that doesn't use instruments and is created from almost solely synthesized sounds. This piece with probably most emphasized gestural aspect of the music demonstrates numerous interactions between gestures on various levels and the inter-connection between gesture and texture in a very complex way. Layers of smaller constantly moving gestures created from delicate internal textural sculpting of sounds and their subtle or more complex interactions participated in creation of large miscellaneous gestures from which the whole complex textures are constituted. Moreover the whole piece may be considered a wide-spread gesture that starts with an attack and through different inner articulations moves towards its decay and disappearance (texture → gesture → gesture → texture → gesture). This contributed to very vigorous and unpropitiating character of musical discourse. Furthermore, “unreal synthetic” electronic sounds imitating the nature of environmental and ambiental sounds (water, ice, rocks, air flows, thunders) and sound-metaphors for other images and phenomena (darkness, clouds, mist, fear, mythic creatures, but also tranquility and peace of mind) and their contextualization in sufficiently narrative musical discourse helped to turn the “imagined unreal world of myth” into more “real world” in moment of perception. Finally, Nunataq is my personal aural perceiving of something I could not experience in real, but had a very strong vivid image in mind. It is like a sound photograph, trying to catch the magic, catch and “freeze” the unique imaginary moment of mind and it might well be a glimpse of a story... sound story of life. Listener is offered a world of dream he may or might not get involved, but in the moment of deep involvement he may experience a world, which isn’t so unreal, as it seems.

In the second part of my dissertation through my pieces, I showed some ways how the researched models have been extended and taken beyond and outside their theoretical or analytical frame under my personal compositional perspective. Analytical reflexion would lose its sense without encompassing the capacity and ability to be moved further and taken ahead outside the limits.

All the different ways, by which two or more gestures may create interactive relationships, presented on numerous models and categories that resulted from my research and analysis, illustrate useful and interesting aspects that may be considered as one of the possible perspectives for analysis of music, which combines such distinct worlds as the instrumental and electroacoustic, or even music in general. Awareness of these relationships as one of efficient compositional techniques in mixed music with possible generalization to other musical genres or just pure electroacoustic or pure instrumental music, and their application under personal perspectives may help composer to create dynamic and variable events in the musical discourse. In my personal opinion, composition act lies somewhere in between the intuition and intention, freedom and consciousness. Intuition and on the same time strong sense for structure and form are not incompatible. On the opposite, the balance between freedom with no fear to rely on intuition together with awareness of possible ways of structuring musical material and their conscious use is exactly where the essence of a sincere musical expression should be placed. From this perspective in a course of composition, we may not always consciously use the models suggested above, but surely in certain moments we can and will intentionally turn to them.

I don't think my perspective is the only possible and right one; nevertheless it is the one that interests and fascinates me. As it was said in first chapters, it is on us "how" we decide to listen and "what" we will focus on while listening, doesn't matter if we are "situated" in a process of analysis or in composition.

Coming back to the Ferneyhough's citation from the beginning of this dissertation: *"Art is about questioning how things fit together, it is not about making them fit together better"*, on the way of finding and questioning how things "fit together", we might find the essence, that makes music what it is... the magic universe of endless potential to be explored...

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Part II. COMPOSITIONS (scores and recordings)

"How the spirit rules over everything...!, Nono once wrote to me. Yes – whatever is to touch the heart must come from above. Otherwise it is the more stuff of notes, a body without a soul. This was how Beethoven formulated it. This only leaves the question: where is "above"...?"

Helmut Lachenmann

1. Compositions for instruments and electroacoustic sounds:

Reflections

Luminiscencia

Mystic Garden

2. Electroacoustic composition:

Nunataq

3. Instrumental compositions:

Vozes de Aço

Somewhere... where the rainbow ends...

Eyes wide shut

Subjective risk... no alternative...

MODELS OF GESTURE INTERACTION:

I. Elementary models of gesture interaction

A. Gesture interactions by pitch/frequency similarity or difference

1. Fusion by merging identical pitch/frequency – unisonic interaction
2. Fusion by similarity of frequency:
   Fusion in low frequency range
   Fusion in middle frequency range
   Fusion in high frequency range
3. Contrast by distinction of frequency
4. Interaction by fluctuation of the frequency widths
5. Noise-based interaction

B. Gesture interaction based on temporal organization

1. Synchronic interaction
   Regular
   - unirhythmic
   Irregular
   - syncopated
2. Asynchronic interaction
   Regular
   Irregular
   Polyrhythmic
3. Proprotional temporal interaction by reduction or multiplication of duration or temporal pattern
4. Interaction by textural grouping
5. Atemporal interaction
6. Temporal sonic surrealism

C. Gesture interaction by loudness trajectories

1. Crescendo interaction
2. Decrescendo interaction
3. Interaction by intersections and cross-overs in loudness trajectories
4. Combinations of previous models

D. Gesture interaction according to the timbral characteristics (similarity/difference)

1. Timbral fusion
   Interaction by timbre-reproduction
   Interaction by timbre-derivation
   Interaction by timbre-association
2. Timbral contrast – *Interaction by timbre dissociation*

II. Gesture interaction based on tripartite model of structure (onset-continuant-termination)

1. Interaction by attack
2. Interaction by iteration
3. Resonance interaction (attack-decay)
4. Inversed resonance interaction (inversed attack-decay)
5. Combination of resonance and inversed resonance interaction
6. Cadential interaction - interaction by gradual termination
7. Interaction through cross-fading

III. Contrapuntal gesture interaction

1. Repetitive interaction
2. Imitative interaction
3. Canonic interaction
4. Canonic interaction with loop
5. Proportional interaction
   Rhythm
   Pitch
   Rhythm and pitch
6. Counterpoint between homogeneous gestures
7. Counterpoint between heterogeneous gestures
8. Triggering interaction
   - *Triggering interaction by potentiations between morphologies*
   - *Triggering interaction by timbral transformation*
9. Counterpoint through gesture division

IV. Gesture interaction based on morphologic-semantic characteristics

A. Direction

a. Direction of motion in pitch field

1. Linear interaction
   By similar direction of motion
   - *ascendent*
   - *descendent*
   - *plane*

   By different direction of motion
   - *convergent*
   - *divergent*
   - *reciprocal*
2. Curvilinear interaction
3. Interaction by manipulation of the direction in pitch field
   By contraction
   By expansion
4. Centric interaction
   Pericentral
   Centripetal
   Centrifugal

b. Direction as time evolution – direction in duration field

1. Interaction by constant speed
2. Interaction by irregular speed
3. Interaction by acceleration
4. Interaction by deceleration
5. Combined types:
   Interaction by acceleration-deceleration
   Interaction by deceleration-acceleration
6. Interaction by manipulation (stretching/contracting) of time
   By contraction
   By expansion

B. Energy

1. Interaction by constant/maintained energy
2. Interaction by increased energy
3. Interaction by decreased energy
4. Interaction by transformed/converted energy
5. Combination of previous models

V. Spatial models of gesture interaction

1. Independent relationship
2. Interactive relationship
3. Triggering relationship

Reflections

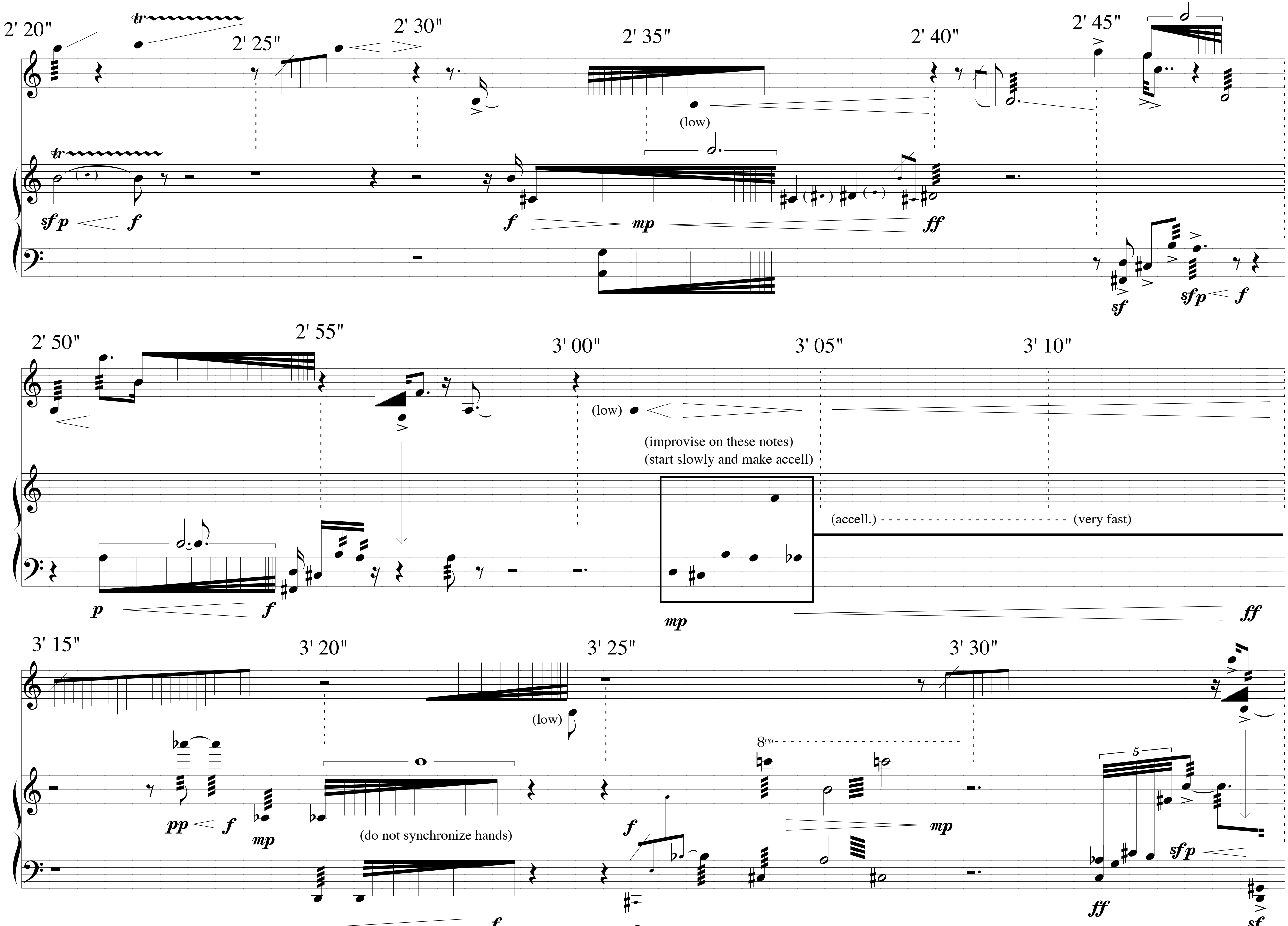
for Pedro Carneiro

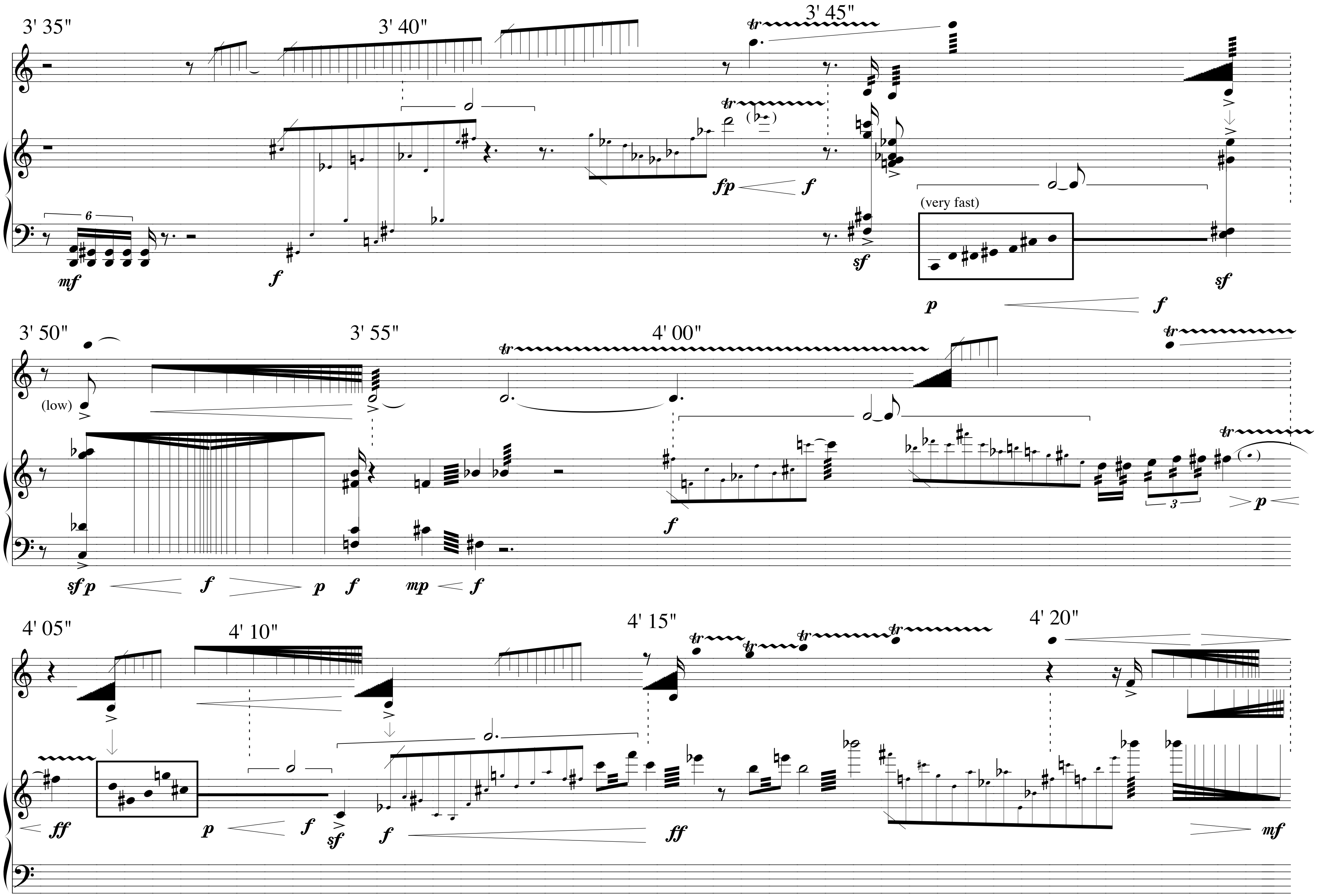
Petra Bachratá

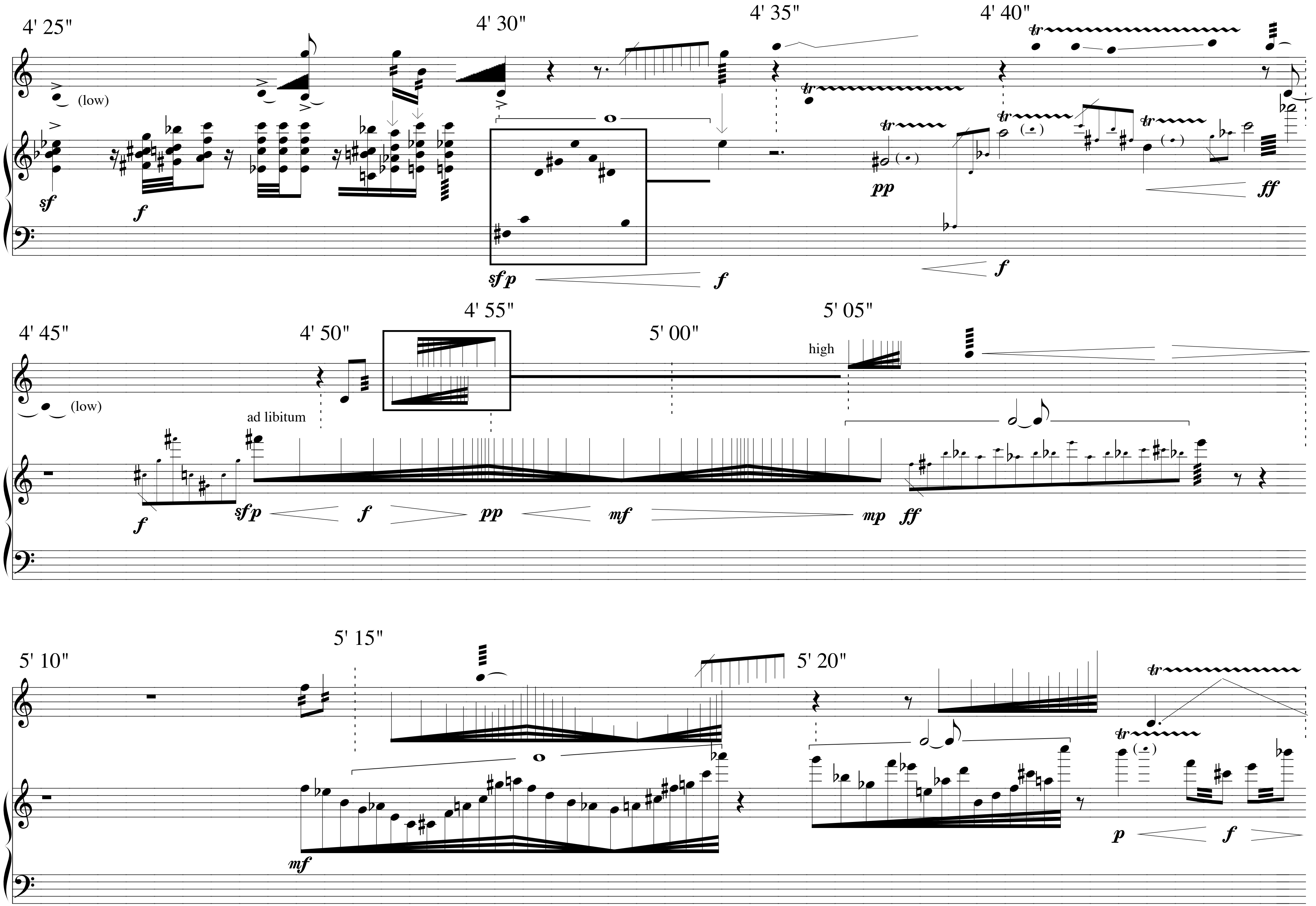
2004

♩ = 60

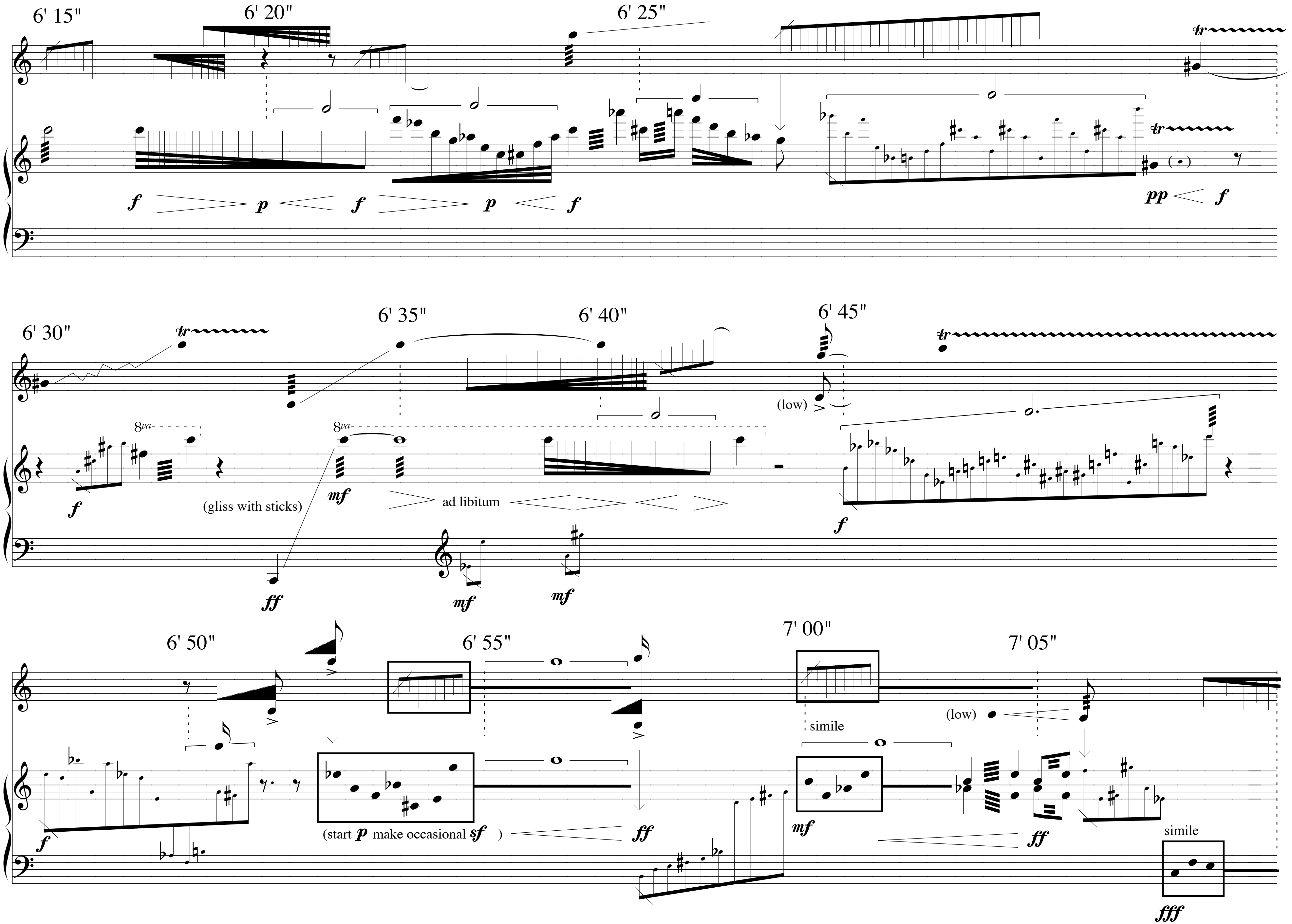

1' 10"
1' 15"
1' 20"
1' 25"
(low)
1' 30"
(low)
1' 35"
1' 40"
1' 45"
1' 50"
1' 55"
2' 00"
(low)
2' 05"
(use multiple glissandi)
2' 10"
2' 15"


2' 20"
2' 25"
2' 30"
2' 35"
2' 40"
2' 45"
(low)
2' 50"
2' 55"
3' 00"
3' 05"
3' 10"
(low)
(improvise on these notes)
(start slowly and make accell)
(accell.) (very fast)
3' 15"
3' 20"
3' 25"
3' 30"
(low)
(do not synchronize hands)

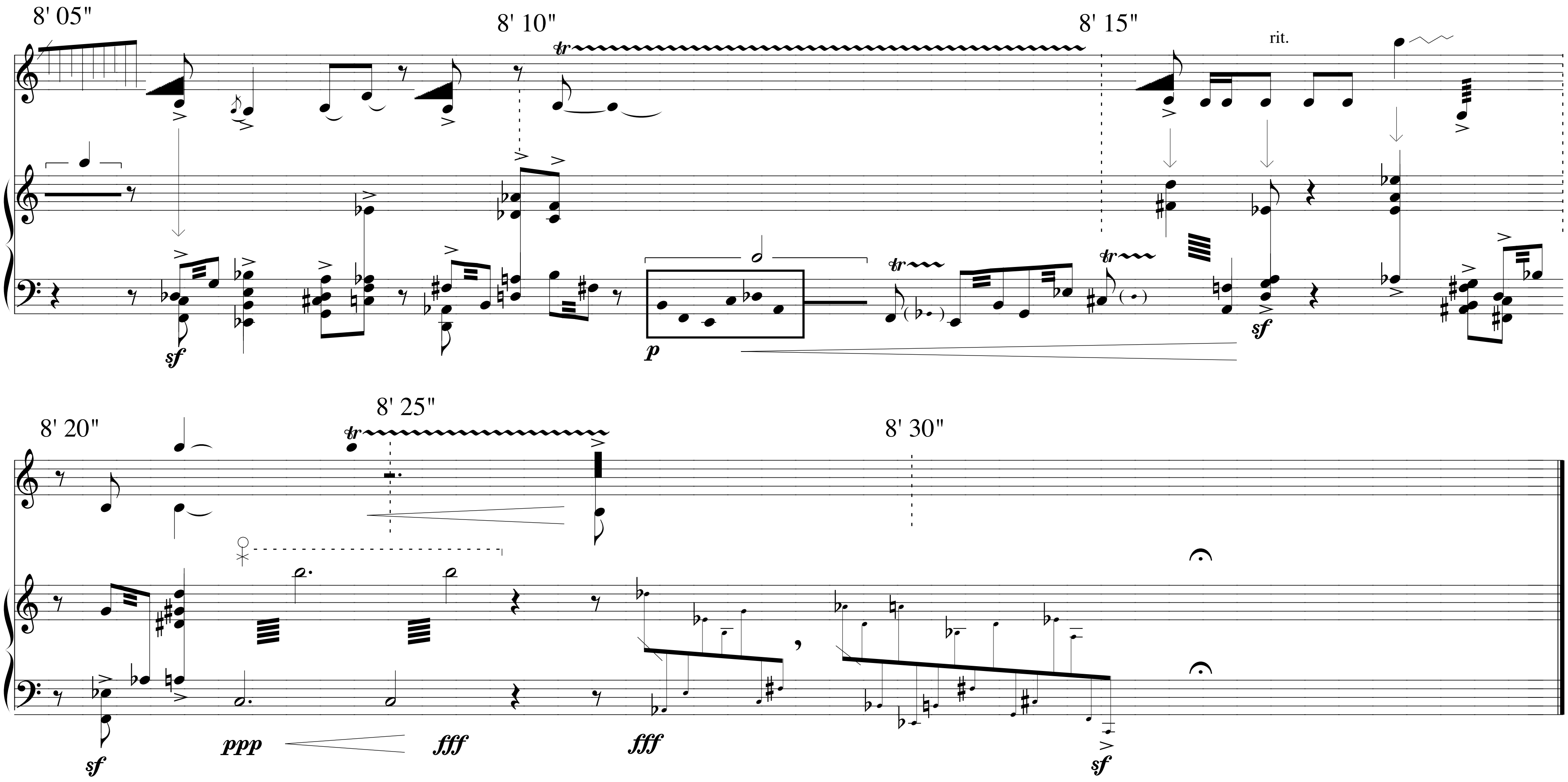

3' 35"
3' 40"
3' 45"
(very fast)
3' 50"
(low)
3' 55"
4' 00"
4' 05"
4' 10"
4' 15"
4' 20"


4' 25"
(low)
4' 30"
4' 35"
4' 40"
4' 45"
(low)
ad libitum
4' 50"
4' 55"
5' 00"
5' 05"
high
5' 10"
5' 15"
5' 20"


5' 25"
5' 30"
5' 35"
5' 40"
(low)
(gliss on pipes)
5' 45"
5' 50"
5' 55"
6' 00"
6' 05"
6' 10"


6' 15"
6' 20"
6' 25"
6' 30"
6' 35"
6' 40"
6' 45"
(low)
(gliss with sticks)
ad libitum
6' 50"
6' 55"
7' 00"
7' 05"
simile
(low)
(start p make occasional sf)
simile

7' 10"
7' 15"
7' 20"
7' 25"
tr
(low)
fff
sf
p
ff
p
ff
sf
sf
p
ff
7' 30"
7' 35"
7' 40"
7' 45"
ff
pp
f
fp
f
sf
pp
f
7' 50"
7' 55"
8' 00"
ff
sf
sfp
ff

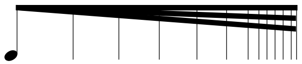

8' 05"
8' 10"
8' 15"
rit.
sf
p
sf
8' 20"
8' 25"
8' 30"
sf
ppp
fff
fff
sf

Reflections

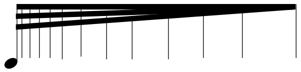
marimba and tape

Petra Bachratá

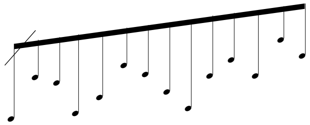
2004



accelerando

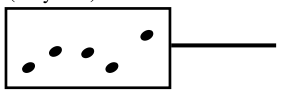


ritardando

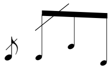


All runs have to be played as fast as possible.

(very fast)



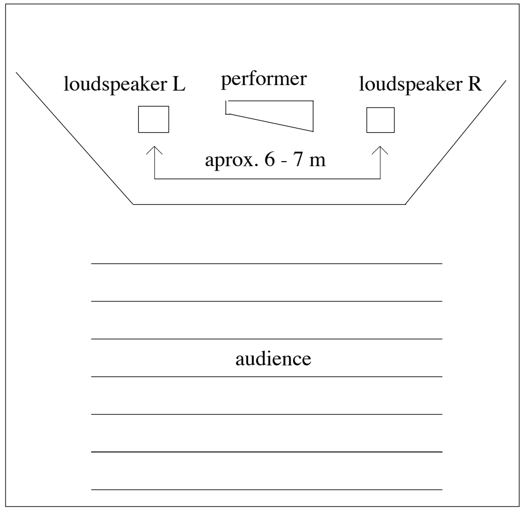
The notes in the box have to be played very fast and can be played in any order (improvising). In case a different interpretation is desired, is indicated in the score.



Appoggiaturas are always played very fast and before the beat or division of the beat, except when indicated.

Gently hit the edge of the key with the stick (not the head) of the mallet.

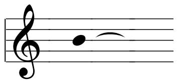
stage setup



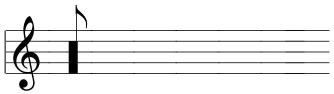
The tape part is notated approximately. For practical reasons, some effects in the tape are not notated. There are divisions of 5 seconds for better orientation. All moments, when the performer has an attack at the same time with the tape, are indicated with arrows ↓

The score indicates the time in the tape part for rehearsal purposes, or in case performer wishes to use a chronometer.

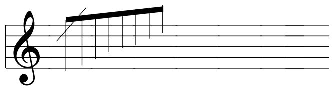
Tape notation:



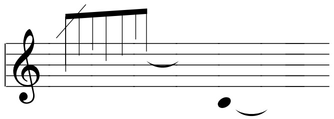
long sound (indeterminate duration), usually with a slow attack



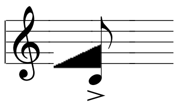
cluster-type sounds



indeterminate pitch sounds



The tie at the end of the sounds indicates either an effect of prolongation (reverberation or echo) or an effect of feedback or repetition (rhythmically and melodically imprecise) of the previous sounds.



fast crescendo sound ending with an attack

Luminiscencia

flute and tape

Petra Bachratá

2006

Explanation of signs:

quarter tone up

three quarter tones up

quarter tone down

three quarter tones down

aeolian sound

aeolian sound with flutter tongue

flutter tongue

trill with flutter tongue. Trilling note is indicated in parenthesis

lip pizzicato

accellerando

ritardando

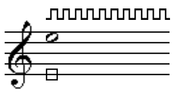
breath tone

f s sh breath tone with whispered consonant

singing

play with flutter tongue and sing the same note

smorzato vibrato

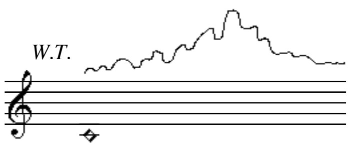


smorzato vibrato and singing the lower note

wide vibrato

quarter tone up vibrato

quarter tone down vibrato



Whistle-tone. Line indicates approximate contour of pitches

Tape notation:

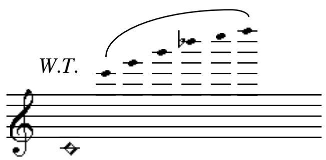
Notated values and pitches are approximate.

The tie after the note represents the continuation of the sound, some feedback or echo effect with no precise value.

× noise sounds

Other notations relates to the flute notation.

If the piece is to be played with chronometer, the time is indicated in the score. Tape starts only at 0' 20".



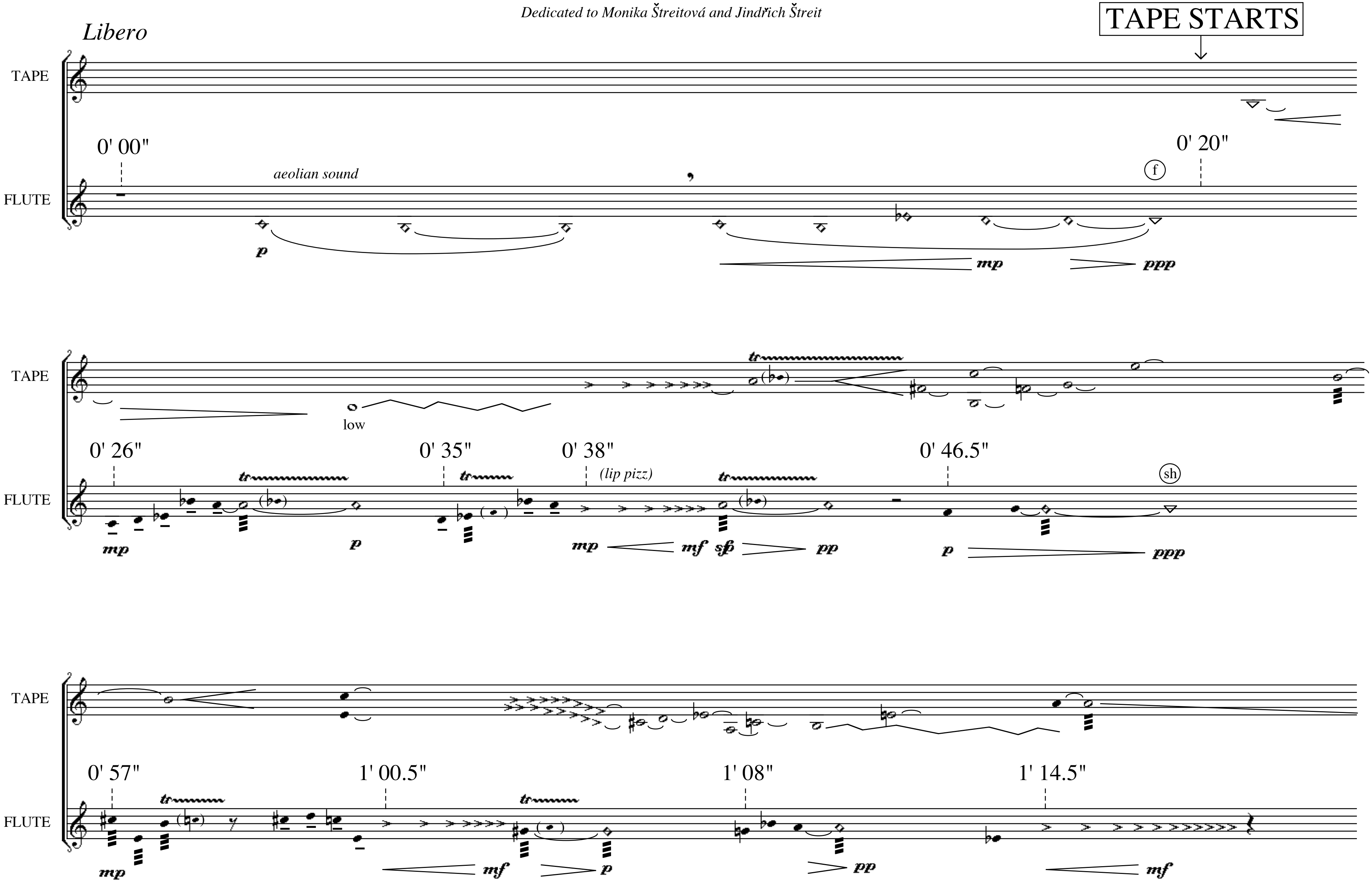
Whistle-tone with indication of pitches to be heard

LUMINISCENCIA

for flute and tape (2006)

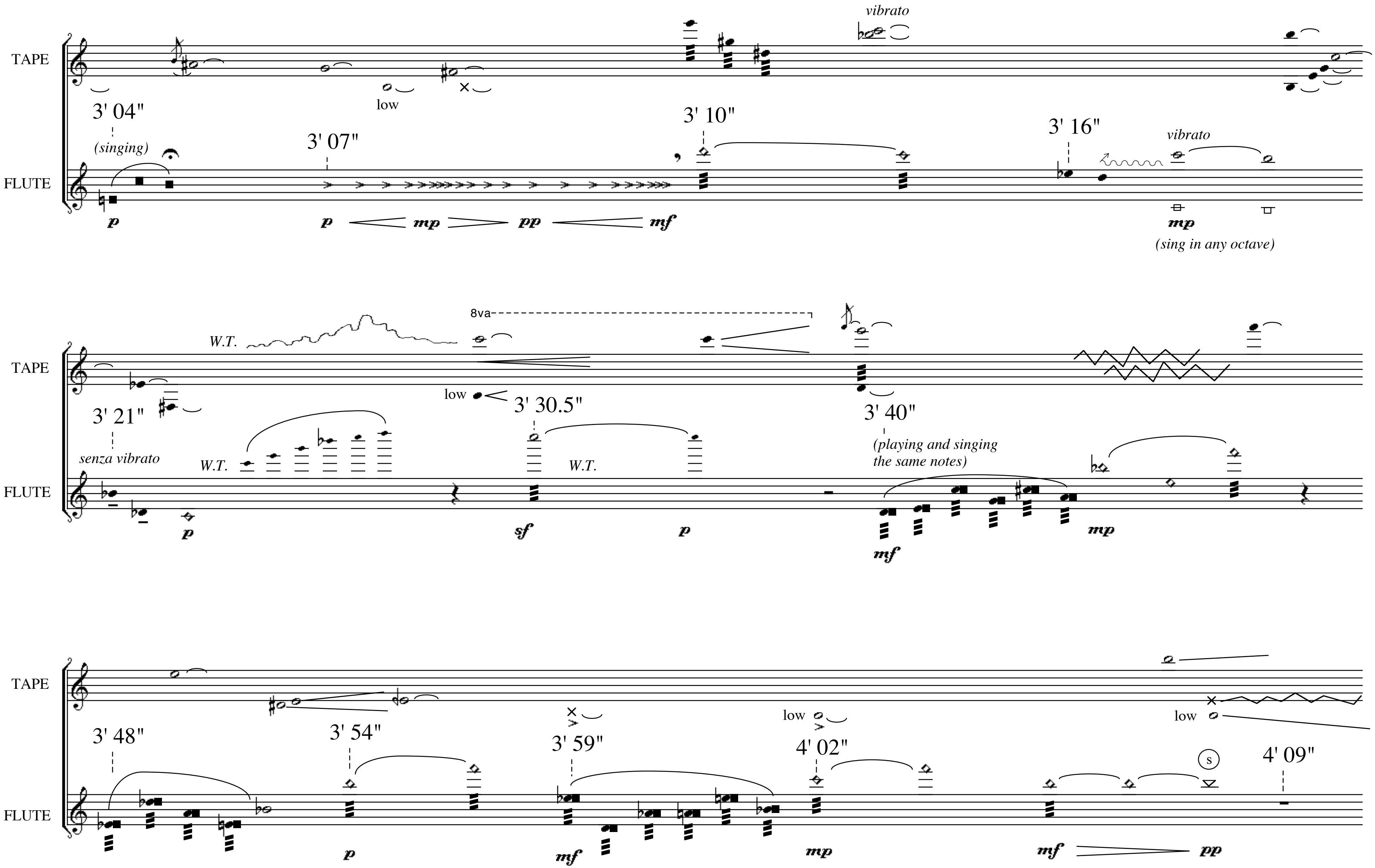
Dedicated to Monika Štreitová and Jindřich Štreit

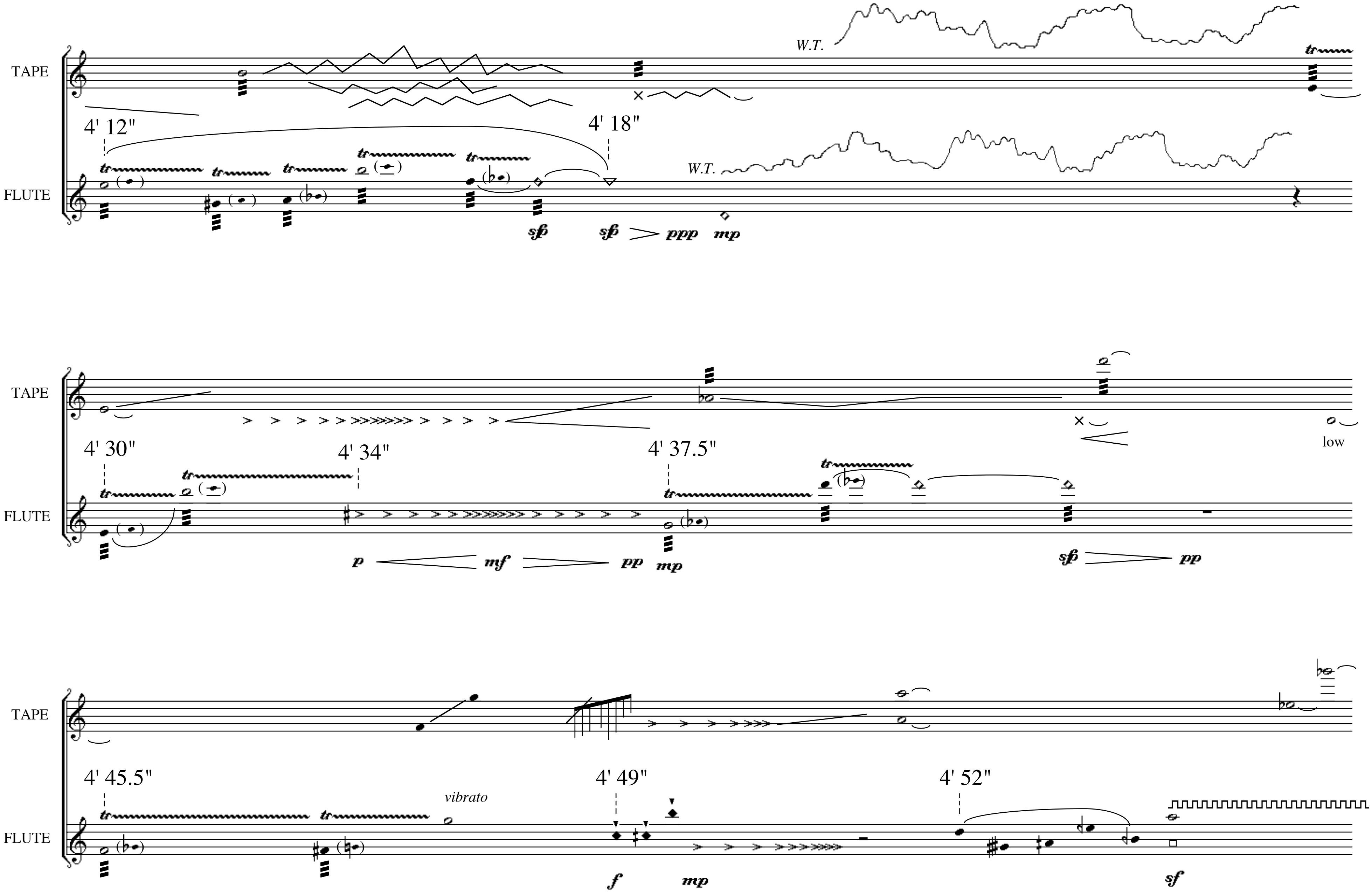
Petra Bachratá
(b. 1975)

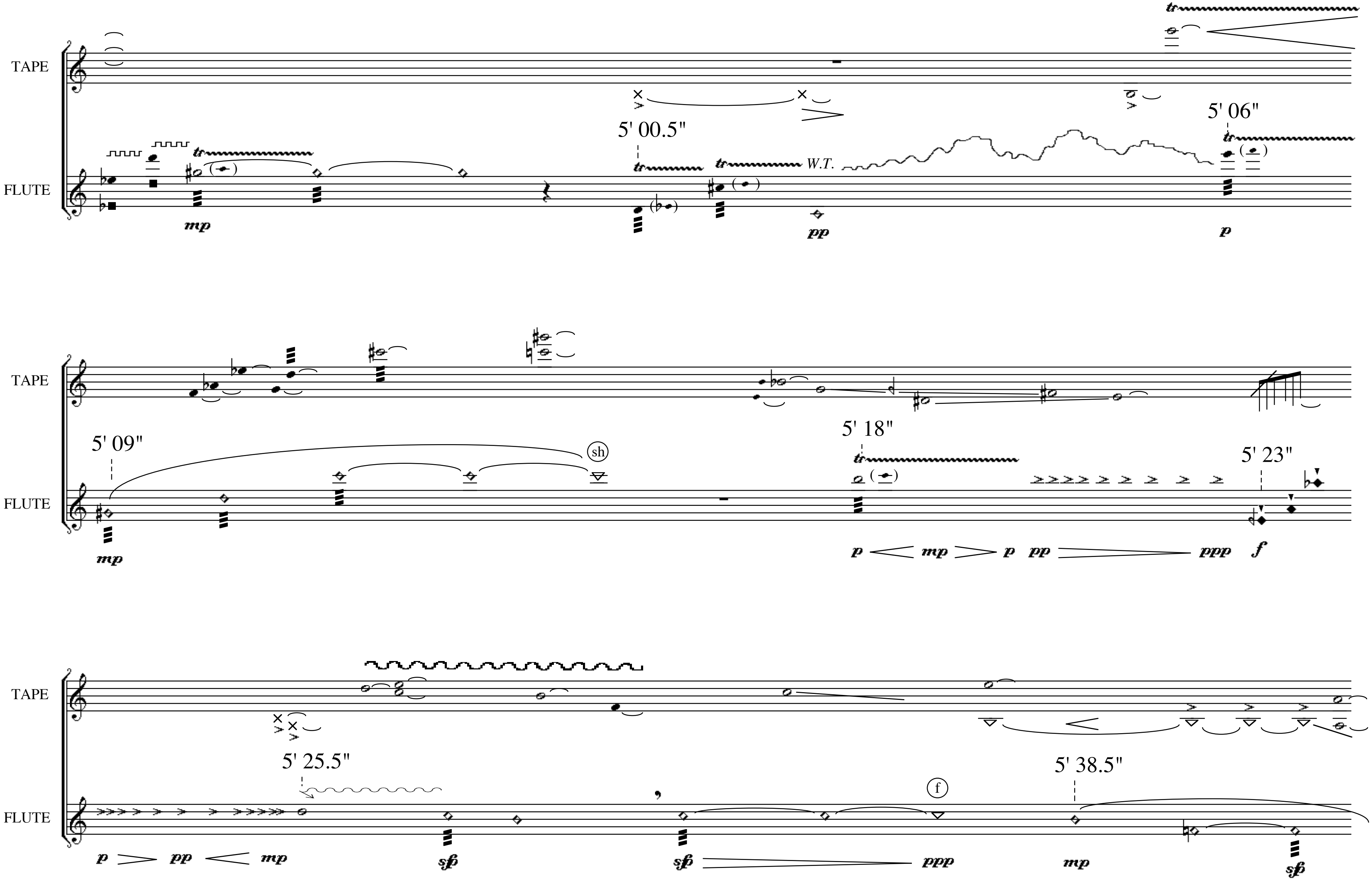


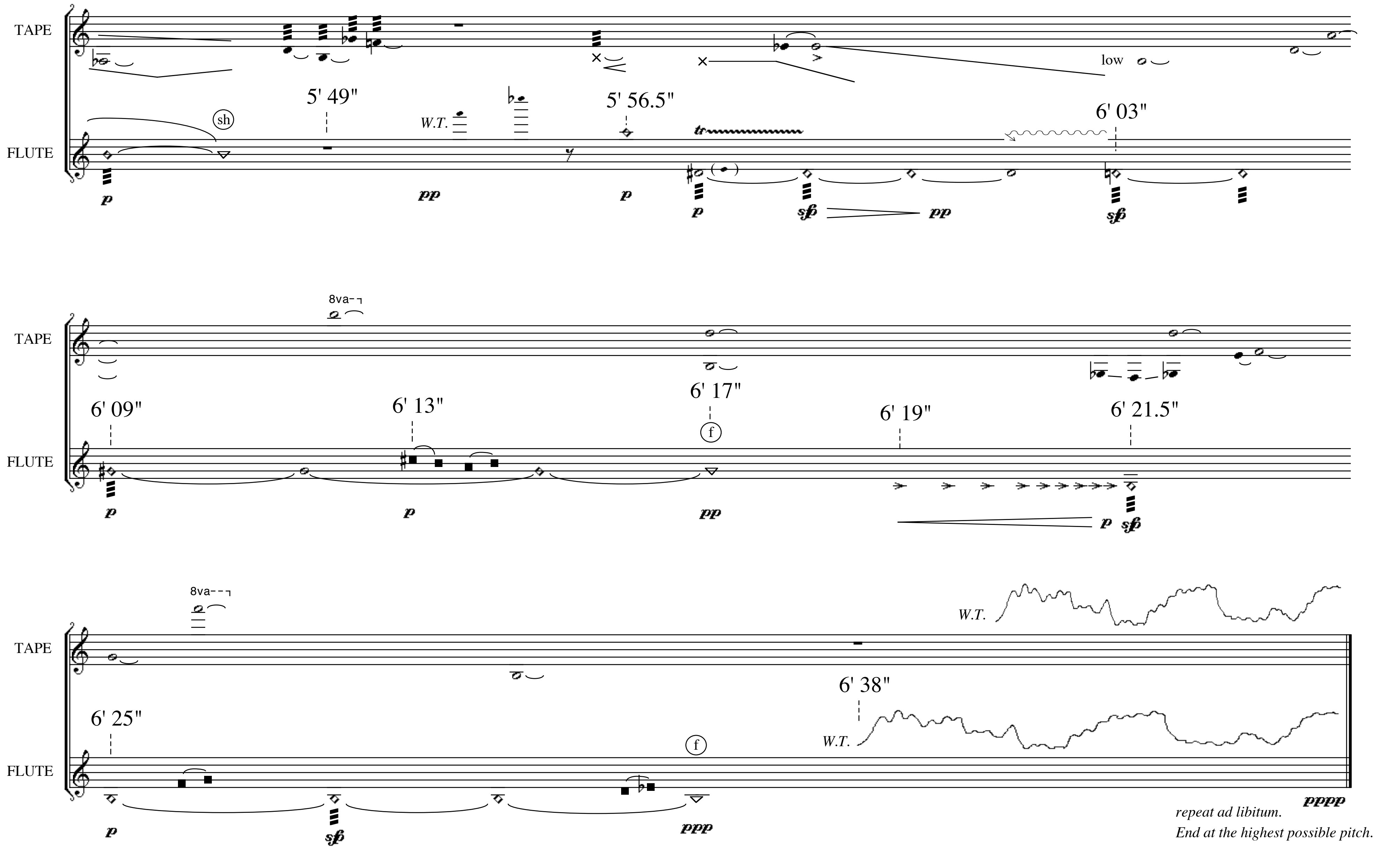

TAPE
FLUTE
mf
(singing)
f
1' 30"
(singing)
1' 37"
s
1' 41.5"
1' 46"
p
TAPE
FLUTE
tr
sh
ppp
1' 53"
mp
p
mp
(singing)
f
1' 58"
tr
sfp
TAPE
FLUTE
tr
mp
2' 02"
2' 06"
p
mf
mp
f
sfp
pppp


TAPE
FLUTE
2' 12"
W.T.
2' 22"
low
2' 27"
2' 31"
pp p pp mp mf ff
2' 39"
2' 42"
2' 46"
mf p f pp p sfp mf
low
2' 52"
vibrato
2' 57"
senza vibrato
2' 59"
mp mf p sfp ppp
B♮
D♯


TAPE
FLUTE
vibrato
low
3' 04"
(singing)
3' 07"
3' 10"
3' 16"
vibrato
p
mp
pp
mf
(sing in any octave)
W.T.
8va
low
3' 21"
senza vibrato
W.T.
3' 30.5"
W.T.
3' 40"
(playing and singing
the same notes)
sf
3' 48"
3' 54"
3' 59"
4' 02"
low
low
s
4' 09"


TAPE
FLUTE
W.T.
4' 12"
4' 18"
W.T.
sfp
sfp
ppp
mp
TAPE
FLUTE
4' 30"
4' 34"
4' 37.5"
low
p
mf
pp
mp
sfp
pp
TAPE
FLUTE
4' 45.5"
vibrato
4' 49"
4' 52"
f
mp
sf


TAPE
FLUTE
tr
mp
5' 00.5"
W.T.
pp
5' 06"
p
5' 09"
sh
mp
5' 18"
p mp p pp ppp
5' 23"
f
5' 25.5"
p pp mp
sfp
sfp ppp
f
5' 38.5"
mp
sfp


TAPE
FLUTE
sh
5' 49"
W.T.
pp
5' 56.5"
p
tr
low
6' 03"
sfp
8va
6' 09"
6' 13"
6' 17"
f
6' 19"
6' 21.5"
6' 25"
6' 38"
ppp
pppp
repeat ad libitum.
End at the highest possible pitch.

Mystic Garden

for flute/bass flute, accordion, piano and electronics

Petra Bachratá

2007

Mystic Garden

Petra Bachratá
2007

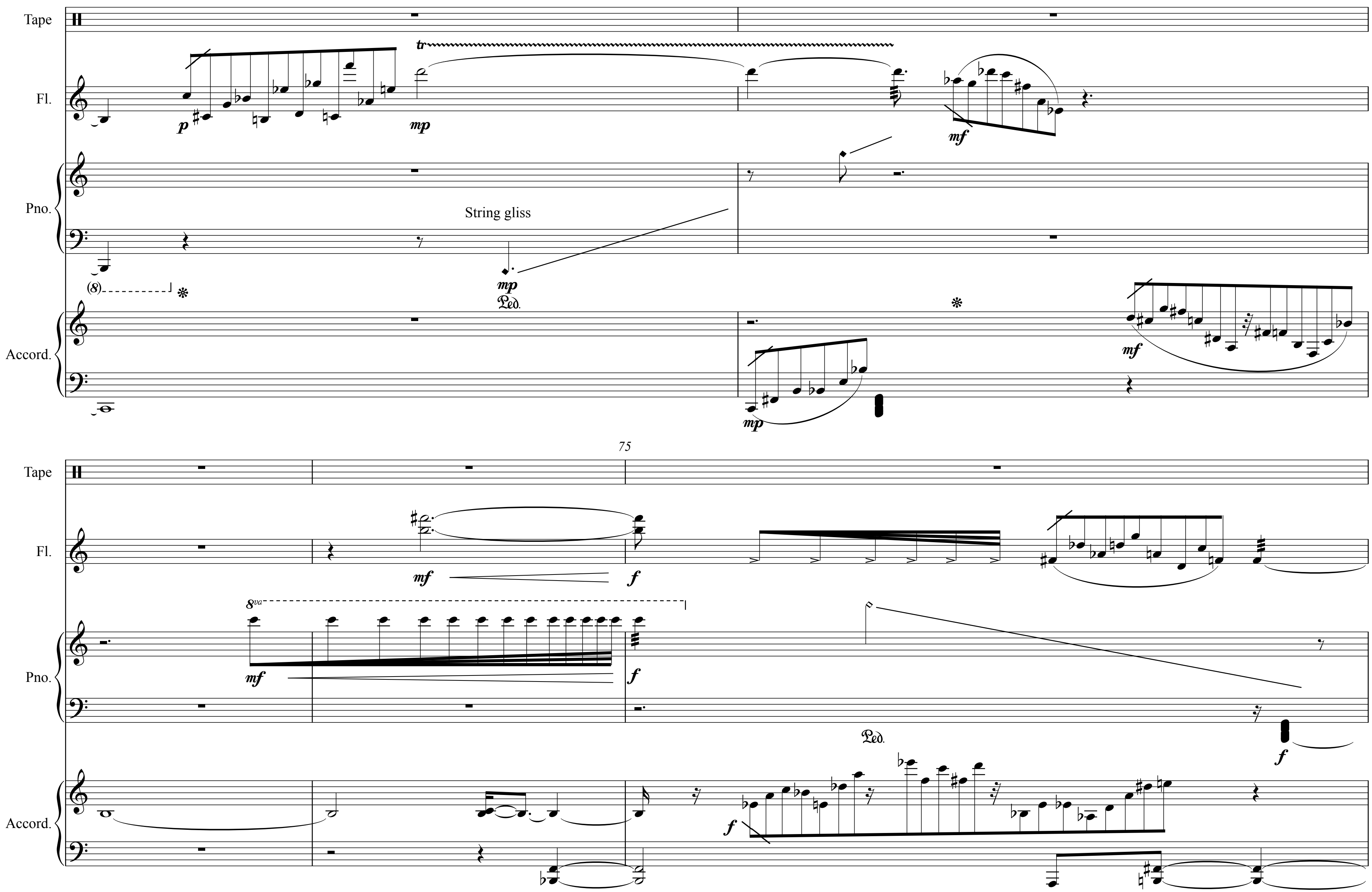

Tape
Fl.
Pno.
Accord.
25
30
35
8va
8vb
mf
mp
fff
sf
mp < f
ppp
ff
sfp < mf
p < mf
tr


40
Tape
Fl.
Pno.
Accord.
8va
8vb
mf
p
mp
f
ff
3
tr
(tr)

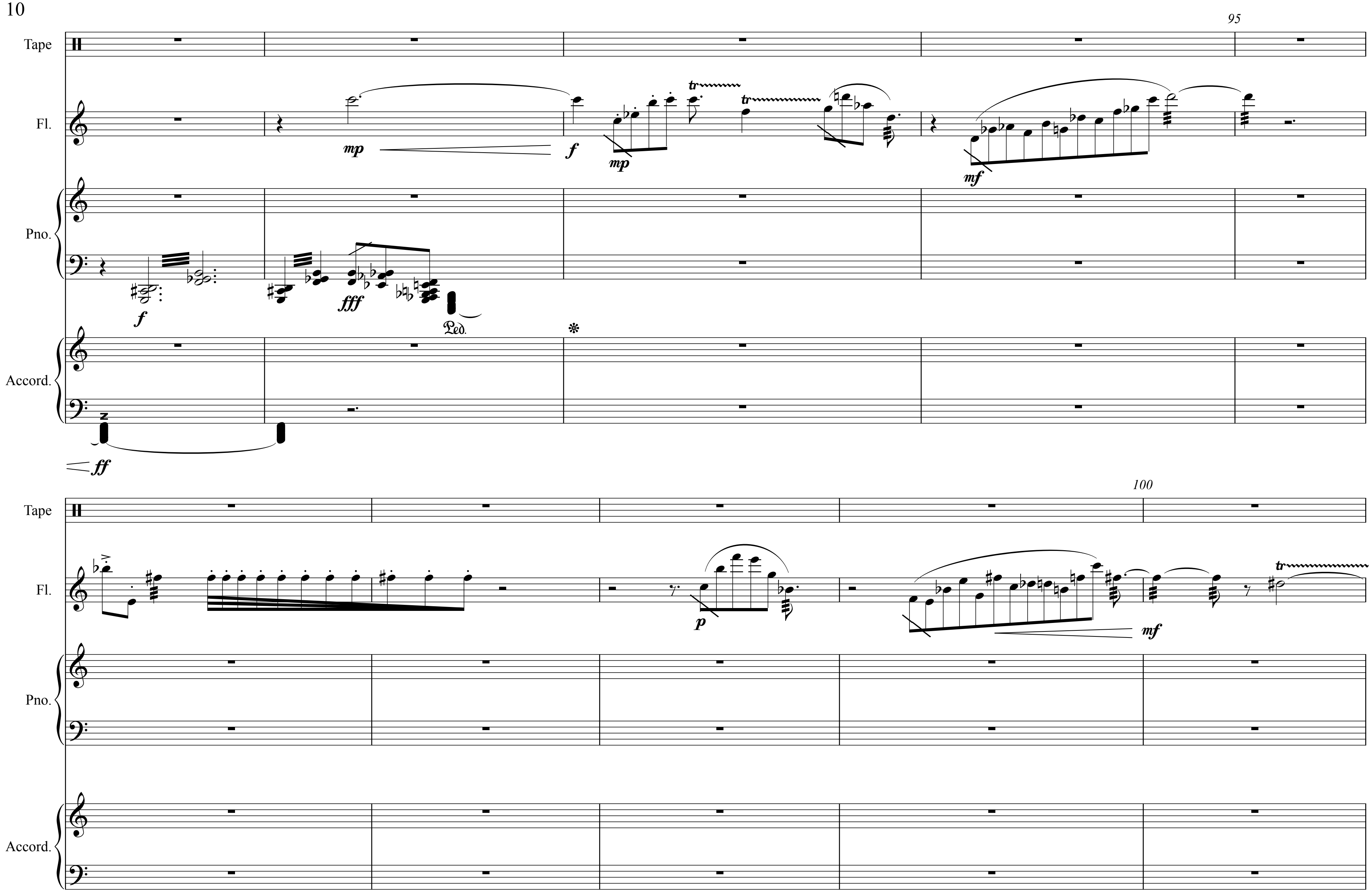

45
Tape
Fl.
Pno.
Accord.
mp
mf
f
p
50
tr
8va
mp
f
mf
fff
Ped.
mp
mf

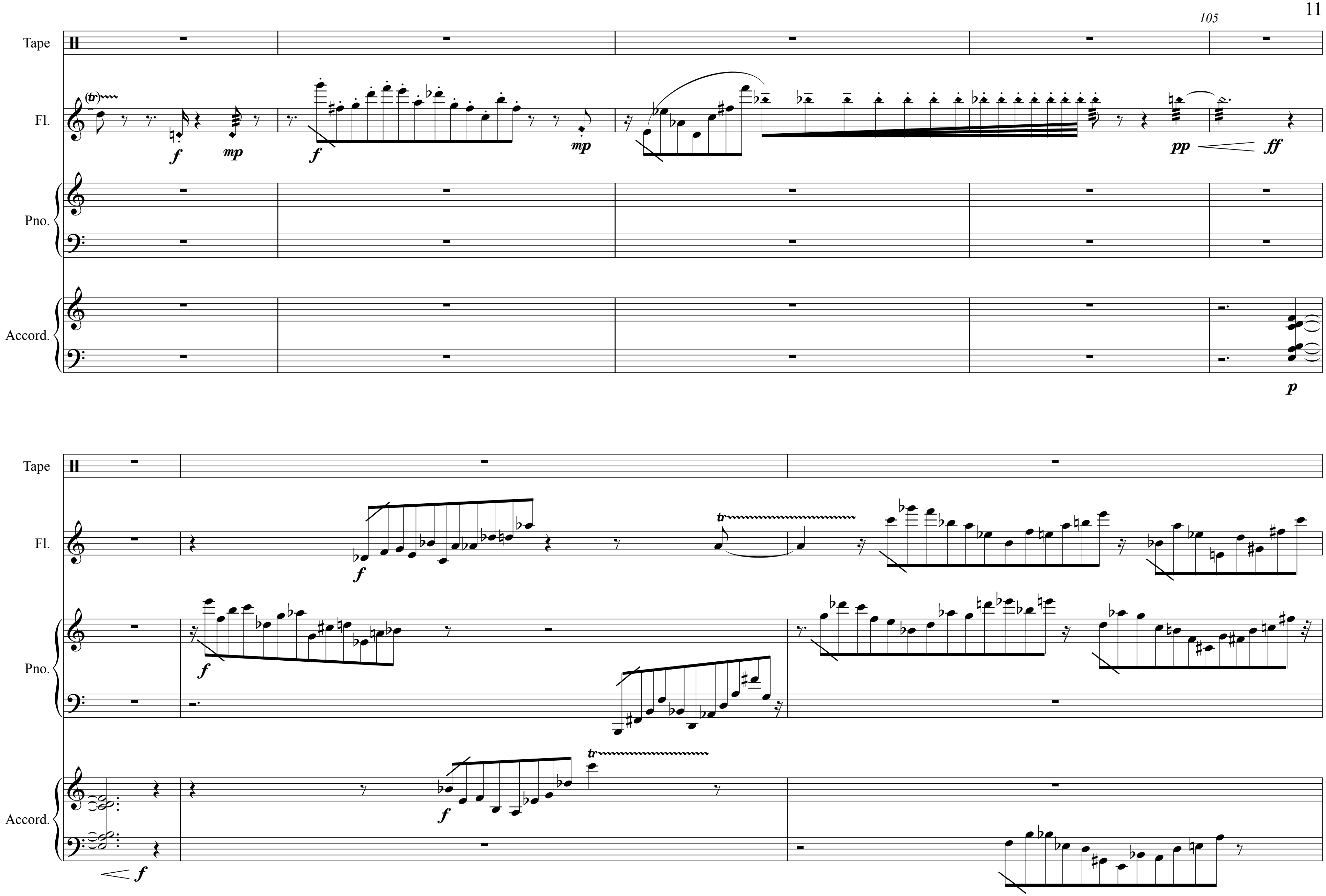

55
Tape
Fl.
Pno.
Accord.
60
Tape
Fl.
Pno.
Accord.
tr
mf
f
ff
mp
Ped.


65
70
Tape
Fl.
Pno.
Accord.
String gliss
mp
mf
f
fff
p
tr
8vb


Tape
Fl.
Pno.
Accord.
tr
p
mp
mf
f
String gliss
(8)
Ped.
8va
75

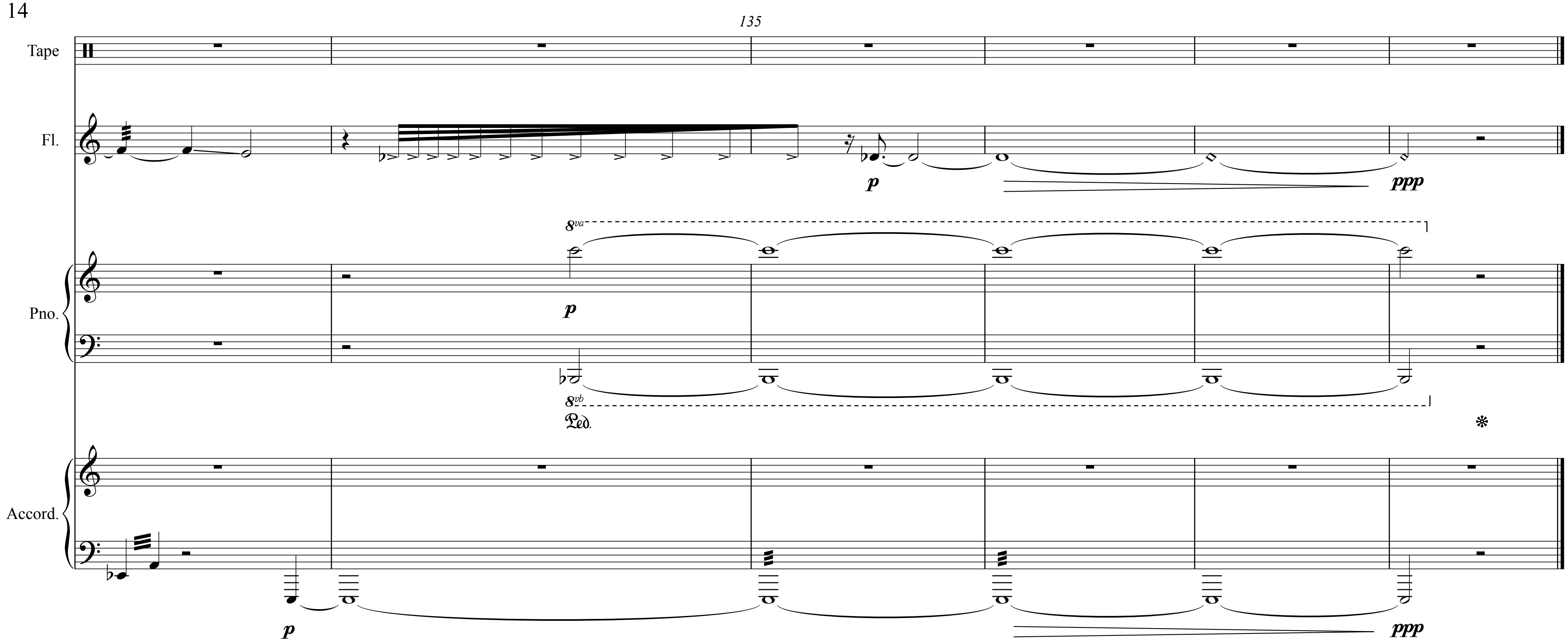

80
Tape
Fl.
mp
mf
p
p
ff
8va
Pno.
f
8vb
Ped.
Accord.
mp
f
ff
pp
f
p
sf
p
85
90
Tape
Fl.
p
mf
tr
f
p
Pno.
p
mf
f
8va
p
8vb
Ped.
Accord.
sfp
f
sfp
ff
mf
p


95
Tape
Fl.
Pno.
Accord.
mp
f
mp
mf
fff
Ped.
ff
100
Tape
Fl.
Pno.
Accord.
p
mf
tr


105
Tape
Fl.
Pno.
Accord.
(tr)
f
mp
f
mp
pp
ff
p
Tape
Fl.
Pno.
Accord.
f
tr
f
f
tr
f


110
115
Tape
Fl.
Bass Flute
Pno.
Accord.
120
Tape
Fl.
Pno.
Accord.


125
Tape
Fl.
Pno.
Accord.
ch ch ch simile
tr
Ped.
130


135
Tape
Fl.
Pno.
Accord.
p
ppp
8va
8vb
Ped.
p
ppp

Subjective risk... no alternative

Petra Bachratá

2007

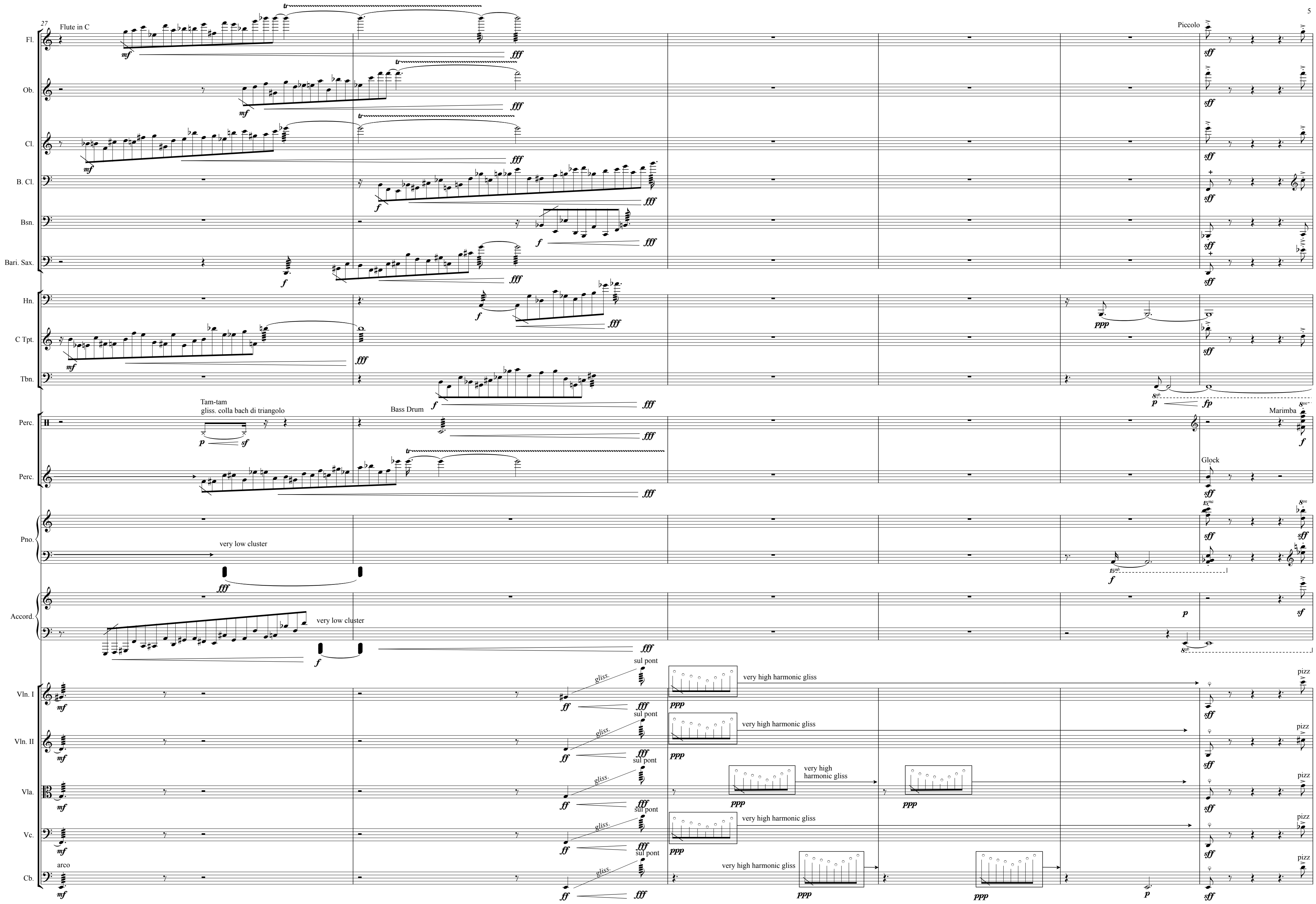
Commissioned by Melos Ethos Festival

Subjective risk... no alternative

Petra Bachratá
2007


9
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Perc.
Perc.
Pno.
Accord.
Vln. I
Vln. II
Vla.
Vc.
Cb.
Tam-tam
Maracas
girare
Triangle
Bass Drum
Tam-tam
Triangle, S. Cymbal
Glock
Maracas
Tambourine
very high cluster
string gliss.
string pizz
arco
arco
pizz
pizz
pizz
pizz
pizz
arco


18
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Perc.
Perc.
Pno.
Accord.
Vln. I
Vln. II
Vla.
Vc.
Cb.
Vibraphone
Tam-tam
gliss colla bach di triangolo
Maracas
girare (rit.)
Triangle
Tam-tam
Bass Drum
Bass Drum
Marimba
use same notes and make accelerando
cresc
gliss on the strings
use same notes and make accelerando
cresc
very low cluster
arco
sul pont
arco
sul pont.
arco
pizz
pizz.
cresc

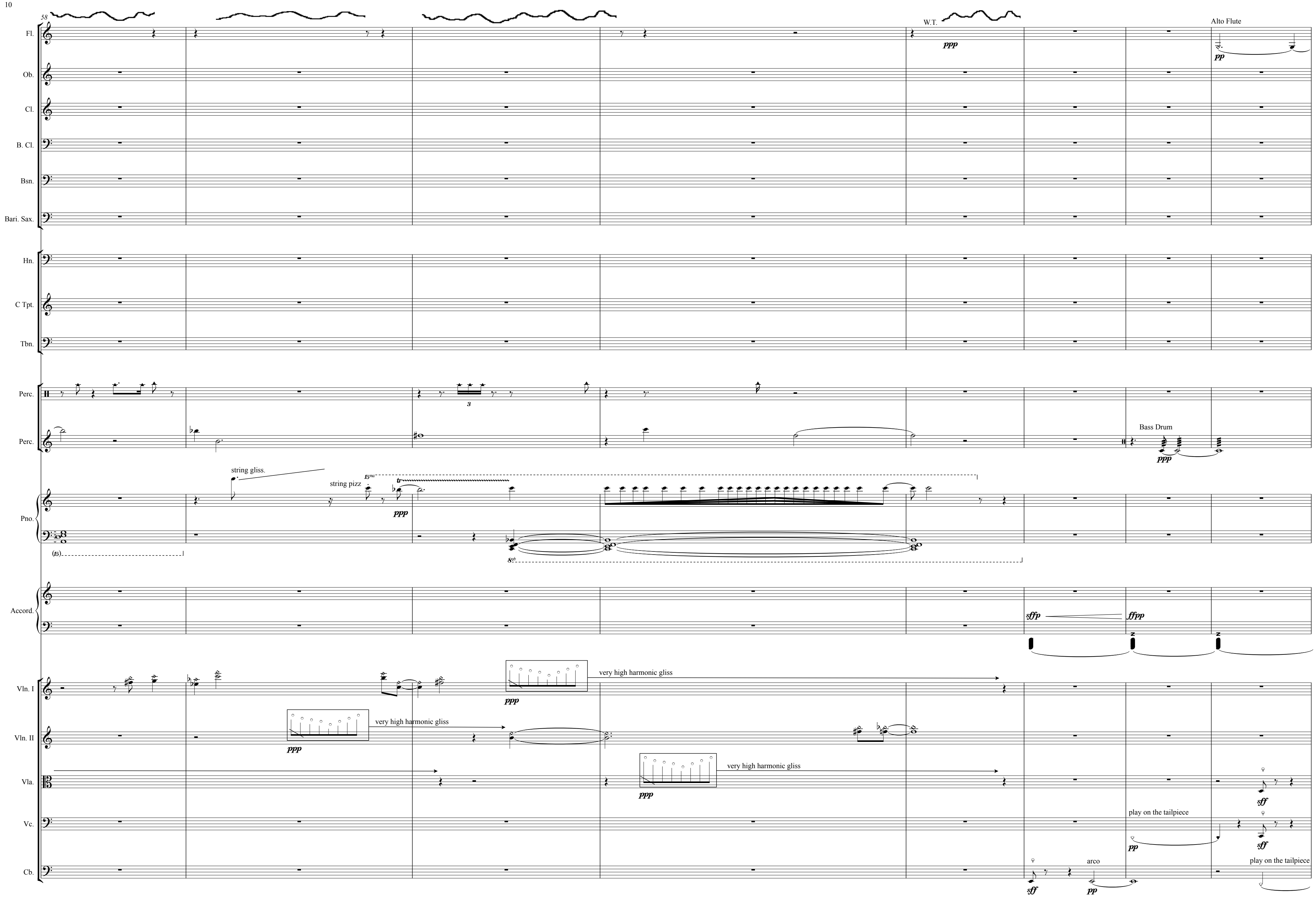

27
Flute in C
Piccolo
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Tam-tam
gliss. colla bach di triangolo
Bass Drum
Marimba
Glock
Perc.
Perc.
very low cluster
Pno.
very low cluster
Accord.
sul pont
gliss.
very high harmonic gliss
very high
harmonic gliss
pizz
arco
Vln. I
Vln. II
Vla.
Vc.
Cb.


33
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Perc.
Perc.
Pno.
Accord.
Vln. I
Vln. II
Vla.
Vc.
Cb.
sff
pp
poco sf
high string gliss
string pizz
arco
mp


36
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Perc.
Perc.
Glock
Pno.
Accord.
low cluster
Vln. I
Vln. II
Vla.
Vc.
Cb.
simile
pizz
arco


42
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Perc.
Perc.
Pno.
Accord.
Vln. I
Vln. II
Vla.
Vc.
Cb.
Flute in C
cresc
harmon sord.
Tam-tam
Vibraphone
fast pipe gliss
Bass Drum
Glock
Triangle
very low cluster
string gliss
arco
cresc.


49
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Perc.
Perc.
Pno.
Accord.
Vln. I
Vln. II
Vla.
Vc.
Cb.
Piccolo
Flute in C
W.T.
W.T.
Triangle
string pizz
very high harmonic gliss
very high harmonic gliss.
sff
pp
sfppp
p
ppp


58
Fl.
W.T.
ppp
Alto Flute
pp
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Perc.
3
Perc.
Bass Drum
ppp
string gliss.
string pizz
ppp
Pno.
Accord.
sffp
ffpp
Vln. I
ppp
very high harmonic gliss
Vln. II
ppp
very high harmonic gliss
Vla.
ppp
very high harmonic gliss
sff
Vc.
play on the tailpiece
pp
sff
Cb.
sff
arco
pp
play on the tailpiece

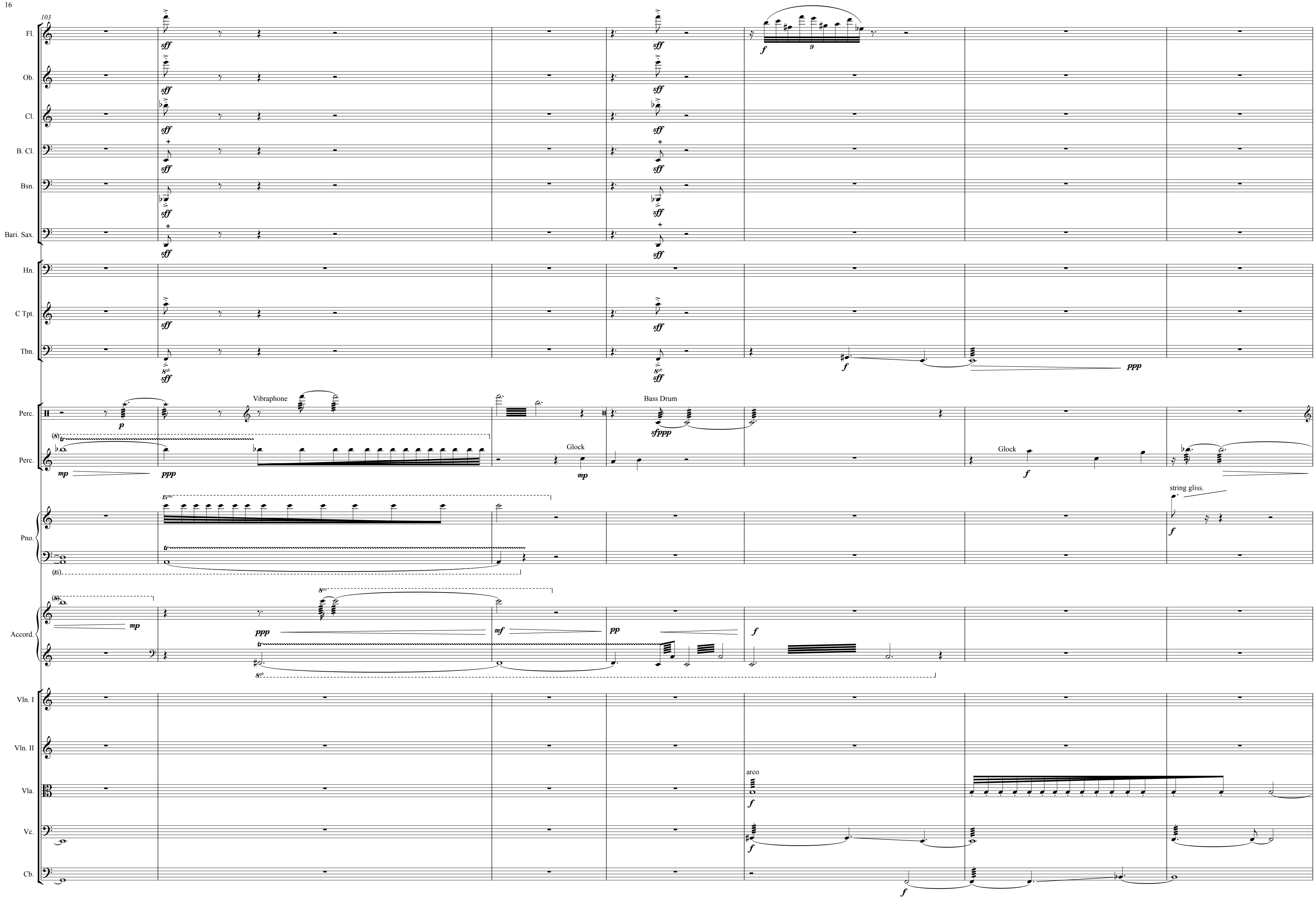

66
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Perc.
Perc.
Pno.
Accord.
Vln. I
Vln. II
Vla.
Vc.
Cb.
tongue ram
Tam-tam
gliss. colla bach di triangolo
Bass Drum
airsound
arco
move freely from sul pont. to sul tasto
arco
play on the tailpiece
arco
sul pont.
arco
play on the tailpiece
arco
sul pont.
arco
move freely from sul pont. to sul tasto


72
Fl.
lip pizz
Ob.
Cl.
B. Cl.
bisbigliando
fast and iregular
Bsn.
Bari. Sax.
bisbigliando
fast and iregular
Hn.
C Tpt.
Tbn.
Perc.
Marimba
Perc.
Pno.
Accord.
Vln. I
Vln. II
Vla.
move freely from sul pont. to sul tasto
simile
Vc.
arco
arco
sul pont.
sul pont.
Cb.
sul pont.
arco
sul pont.

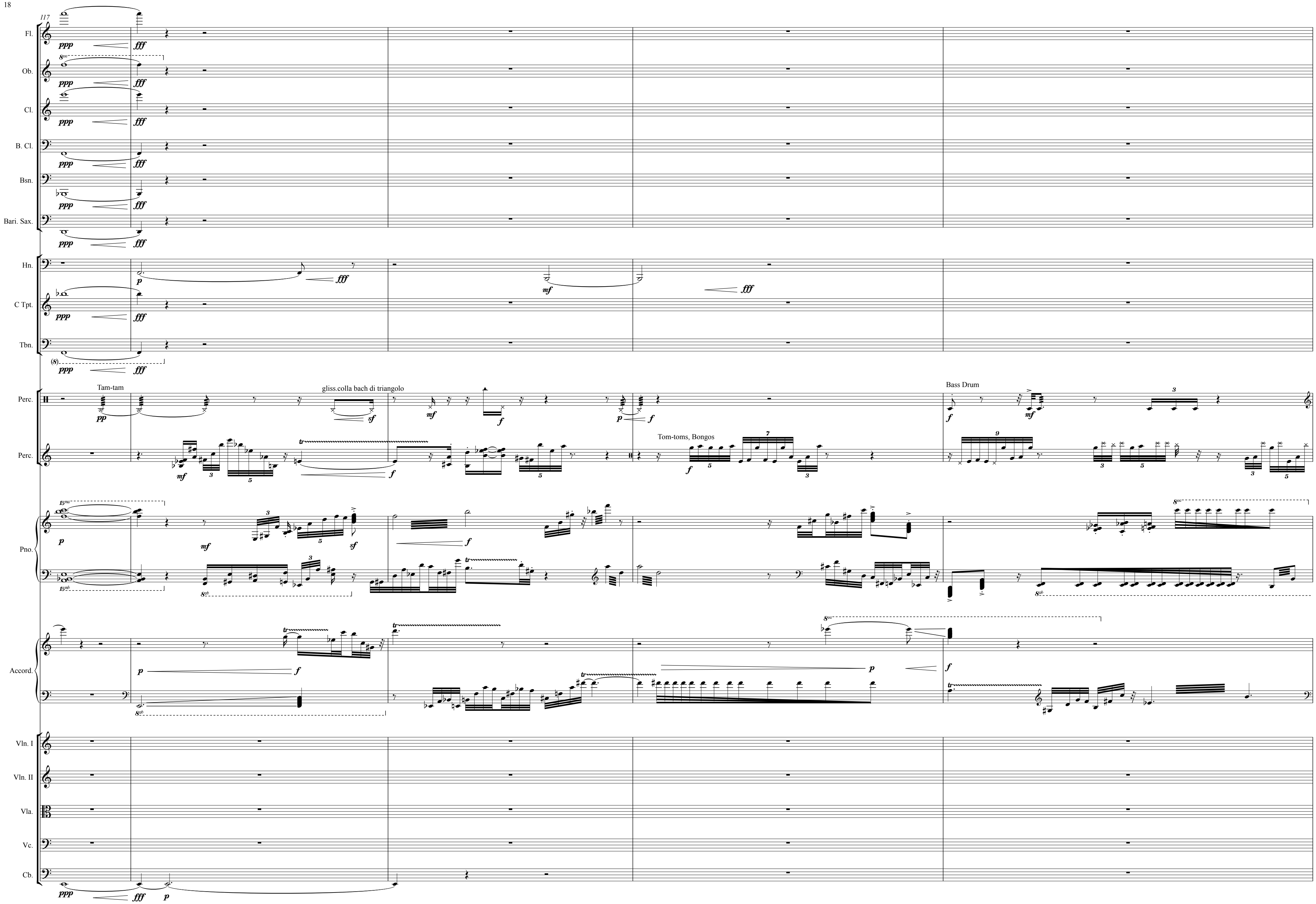

79
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Tam-tam
gliss. colla bach di triangolo
Perc.
Perc.
Tam-tam
Pno.
Accord.
Vln. I
Vln. II
arco
move freely from sul pont. to sul tasto
Vla.
arco
move freely from sul pont. to sul tasto
arco
Vc.
arco
arco
Cb.


85
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Perc.
Perc.
Pno.
Accord.
Vln. I
Vln. II
Vla.
Vc.
Cb.
move freely from sul pont. to sul tasto
arco
arco
move freely from sul pont. to sul tasto
arco
arco
arco
ord.
ord.


93
Piccolo
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Perc.
Glock
Triangle
Perc.
Marimba
Pno.
very high cluster
Accord.
Vln. I
Vln. II
Vla.
Vc.
Cb.
pizz
arco

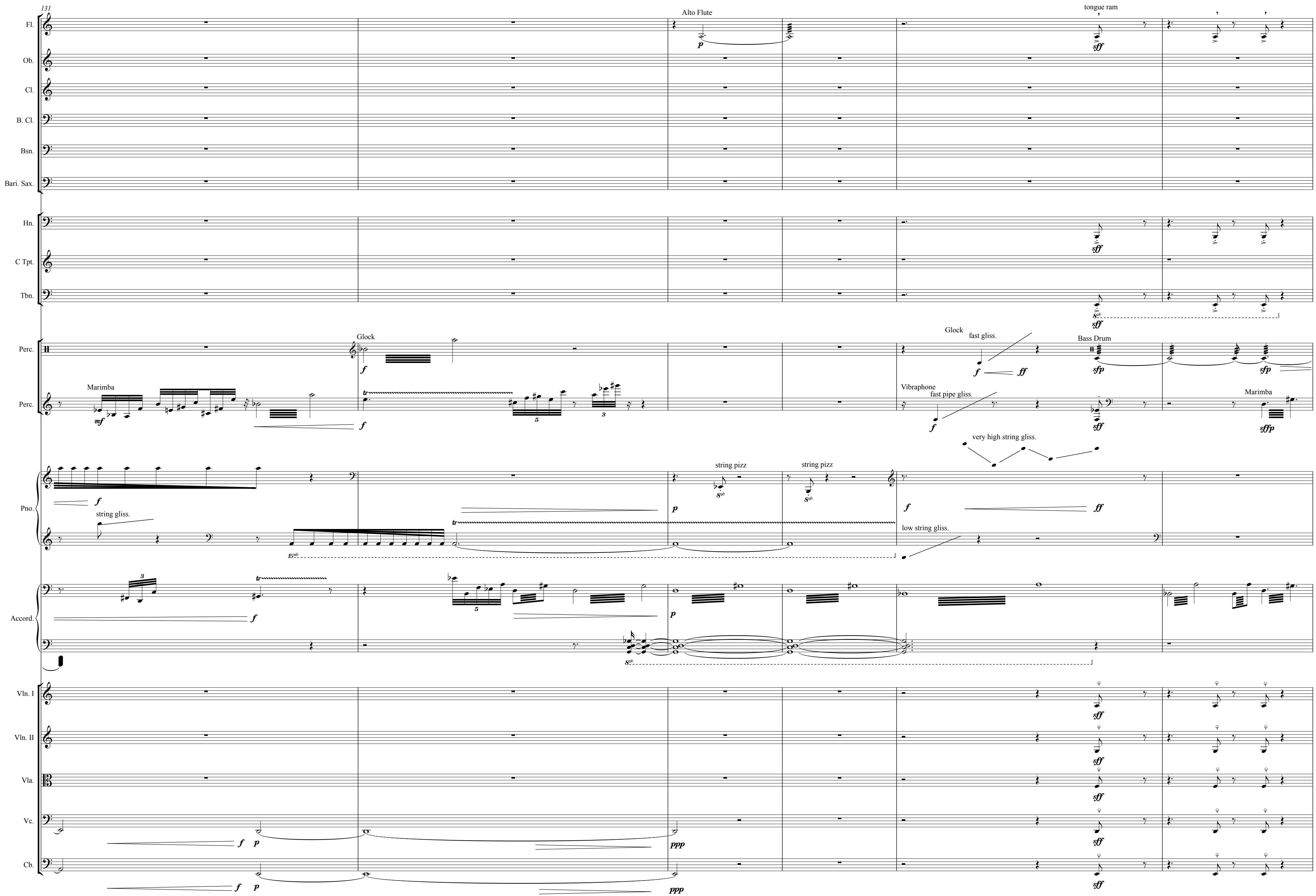

103
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Perc.
Vibraphone
Bass Drum
Perc.
Glock
Glock
Pno.
string gliss.
Accord.
Vln. I
Vln. II
Vla.
arco
Vc.
Cb.


110
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Tam-tam
Bass Drum
Glock
Perc.
Marimba
Vibraphone
Perc.
Pno.
Accord.
Vln. I
Vln. II
Vla.
Vc.
Cb.
pizz
arco


117
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Perc.
Tam-tam
gliss.colla bach di triangolo
Bass Drum
Perc.
Tom-toms, Bongos
Pno.
Accord.
Vln. I
Vln. II
Vla.
Vc.
Cb.


122
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
fff
Perc.
Vibraphone
Glock
S.cymbal
Triangle
Claves
Wood Blocks
Perc.
Triangle
Tam-tam
gliss.colla bach di triangolo
gliss.colla bach di triangolo
Pno.
string gliss.
string gliss.
Accord.
Vln. I
Vln. II
Vla.
Vc.
arco
Cb.


127
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Bass Drum
Perc.
Bongos, Tom-toms, S.Cymbal
Triangle
Glock
Perc.
Pno.
Accord.
Vln. I
Vln. II
Vla.
Vc.
Cb.


131
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Perc.
Perc.
Pno.
Accord.
Vln. I
Vln. II
Vla.
Vc.
Cb.
Alto Flute
tongue ram
Glock
Marimba
Glock
fast gliss.
Bass Drum
Vibraphone
fast pipe gliss.
Marimba
very high string gliss.
string pizz
string pizz
string gliss.
low string gliss.


137
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Perc.
Glock
Temple Blocks
Bongo
Wood Blocks
Perc.
Bongo
Marimba
Pno.
Accord.
(agitative irregular cresc-decresc.)
Vln. I
pizz
Vln. II
pizz
Vla.
pizz
Vc.
pizz
arco
Cb.
pizz
arco

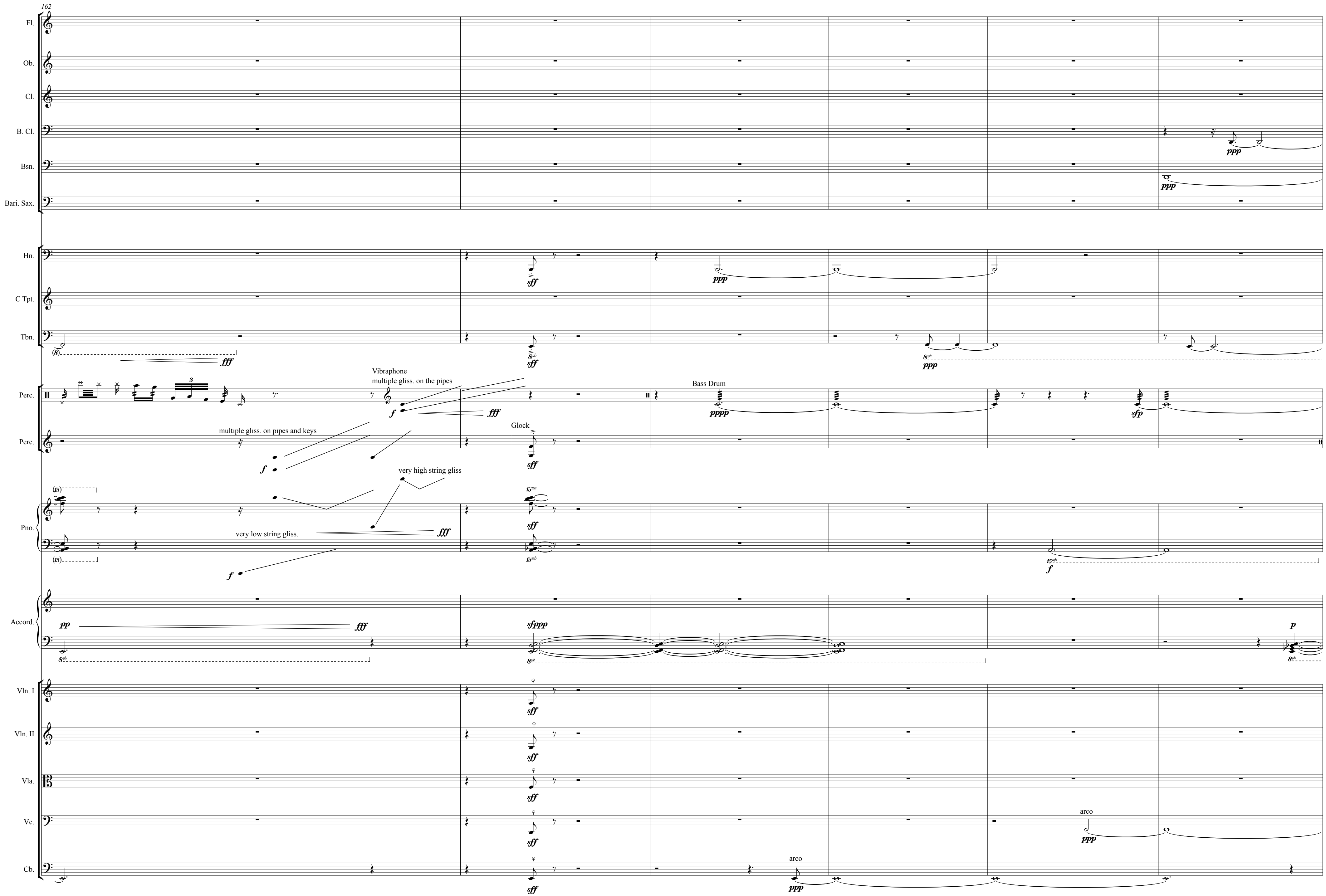

142
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Perc.
Perc.
Pno.
Accord.
Vln. I
Vln. II
Vla.
Vc.
Cb.
Flute in C
Triangles, S.cymbals
Tam-tam
gliss.colla bach di triangolo
Vibraphone
multiple pipe gliss.
Bass Drum


146
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Perc.
Perc.
Pno.
Accord.
Vln. I
Vln. II
Vla.
Vc.
Cb.

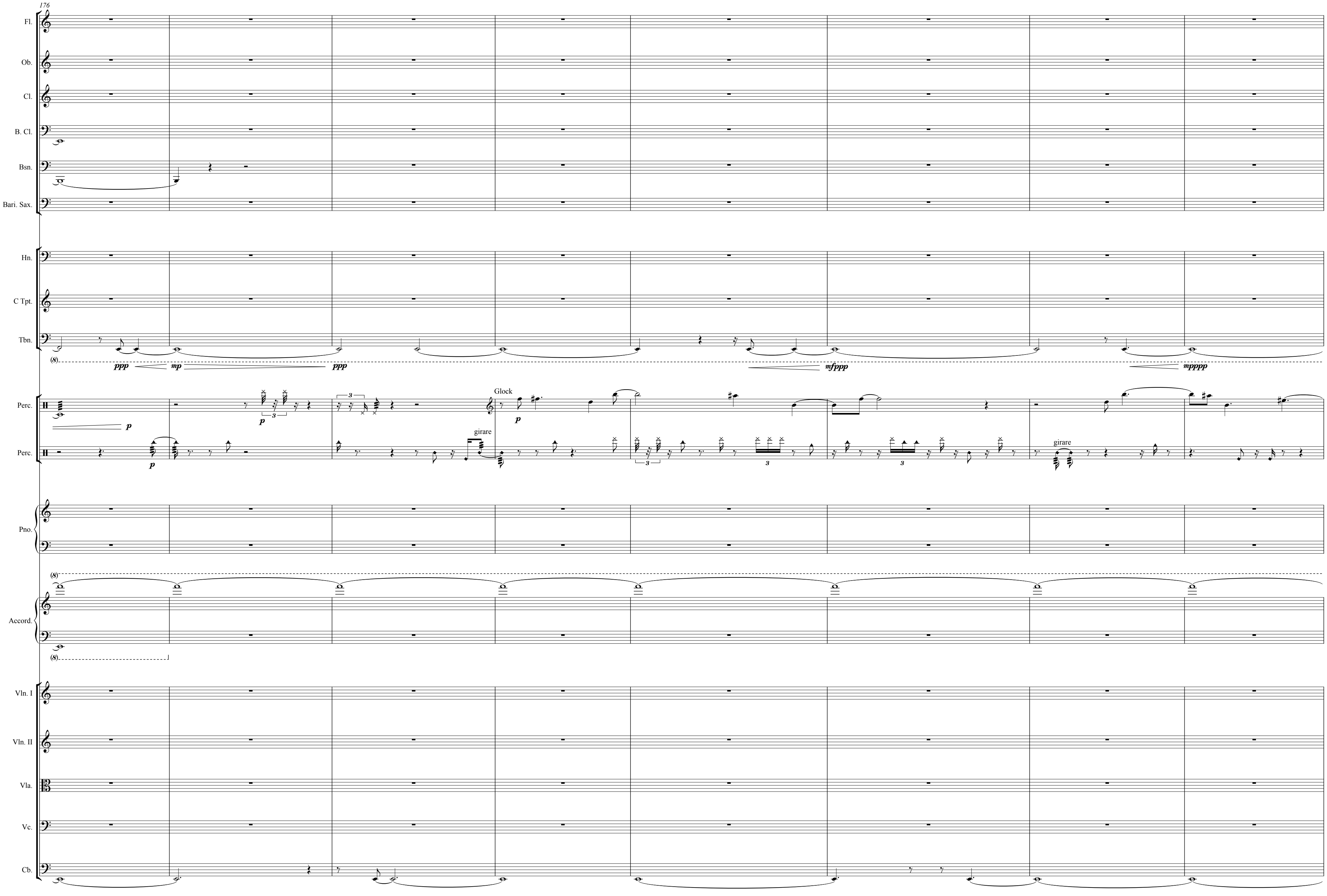

151
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Perc.
Triangle, S.cymbal
Perc.
Glock
Pno.
Accord.
Vln. I
Vln. II
Vla.
Vc.
Cb.

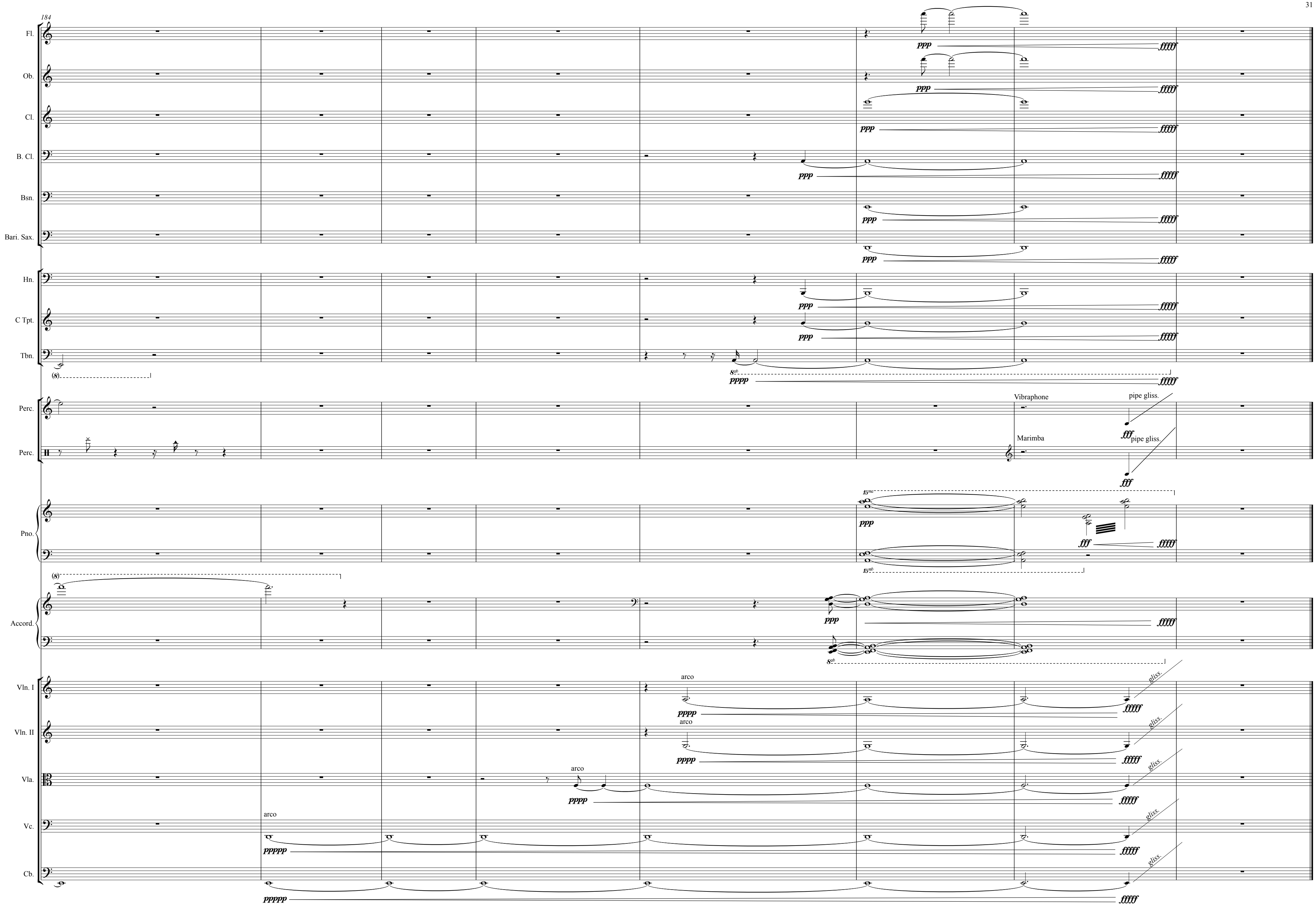

155
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Perc.
Claves
Triangle
Marimba
Perc.
Pno.
Accord.
Vln. I
Vln. II
Vla.
Vc.
Cb.


158
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Perc.
Perc.
Pno.
Accord.
Vln. I
Vln. II
Vla.
Vc.
Cb.
Triangle, S.cymbal
Tambourine
Maracas
Tom-toms, Bongos
Glock
Marimba
middle register
very high register
continual gliss. on the strings, make "waves"
start in the very low register
improvise - make irregular belowshake, vibrato, cresc. and decresc. on the cluster, cluster may change in the time (don't make pauses)
simile
arco
simile
arco
arco


162
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Perc.
Perc.
Pno.
Accord.
Vln. I
Vln. II
Vla.
Vc.
Cb.
Vibraphone
multiple gliss. on the pipes
multiple gliss. on pipes and keys
Glock
Bass Drum
very high string gliss
very low string gliss.
arco
arco


168
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Perc.
Perc.
Pno.
Accord.
Vln. I
Vln. II
Vla.
Vc.
Cb.
Piccolo
Bass Drum
Vibraphone
Triangle, S. Cymbal
Vibraphone
very low cluster
arco
sul pont.
arco
sul pont.
arco
sul pont.
arco
sul pont.
arco
arco


176
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
ppp
mp
ppp
mfppp
mpppp
Perc.
p
Glock
p
girare
Perc.
p
girare
Pno.
Accord.
Vln. I
Vln. II
Vla.
Vc.
Cb.


184
Fl.
Ob.
Cl.
B. Cl.
Bsn.
Bari. Sax.
Hn.
C Tpt.
Tbn.
Perc.
Perc.
Pno.
Accord.
Vln. I
Vln. II
Vla.
Vc.
Cb.
Vibraphone
pipe gliss.
Marimba
pipe gliss.
arco
arco
arco
arco
gliss.
gliss.
gliss.
gliss.
gliss.

Vozes de aço

flute solo
(piccolo/flute/bass flute/voice)

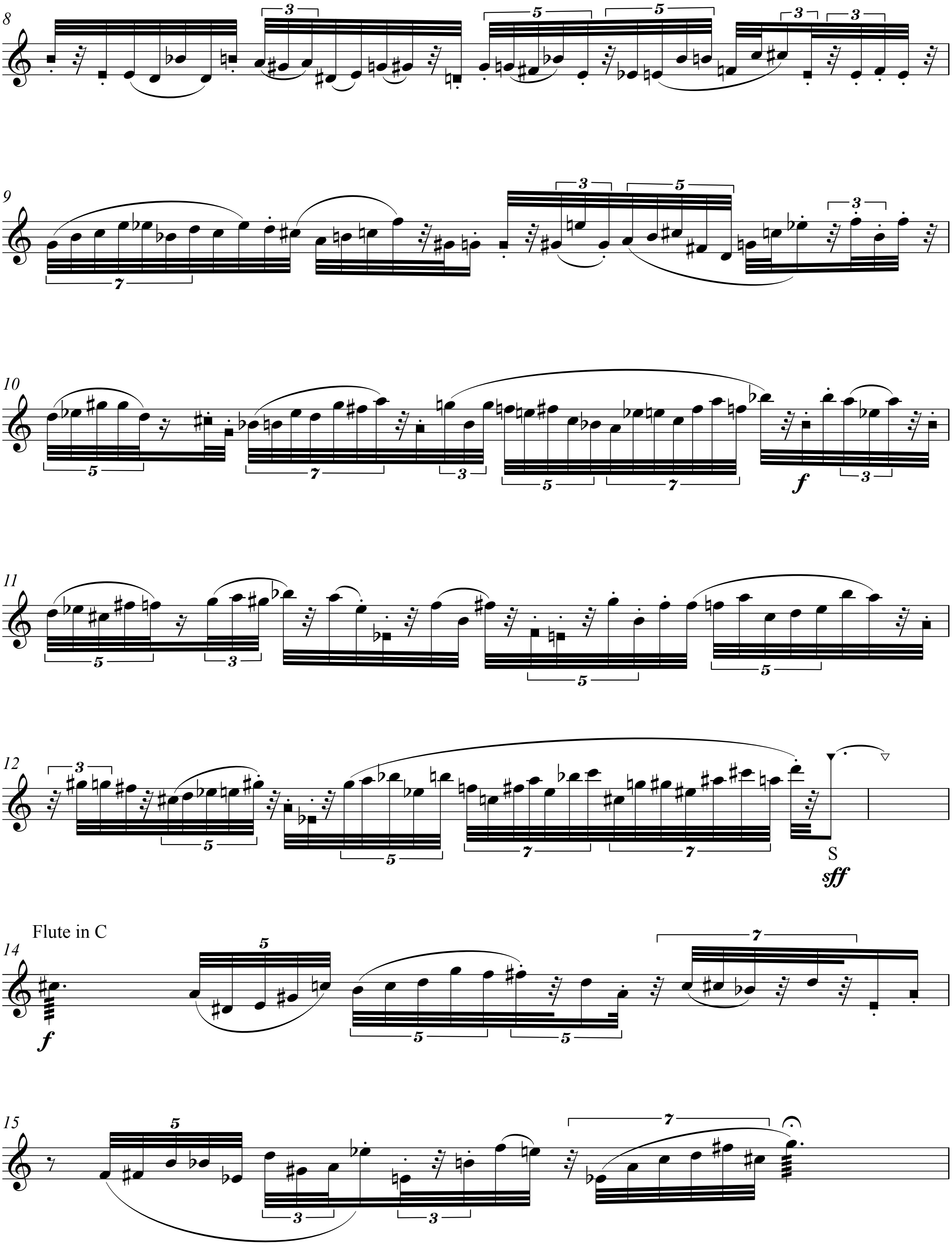
Petra Bachratá

2008

Vozes de aço

dedicated to Monika Streitová and Jindrich Streit

Petra Bachratá
2008


Flute in C
S

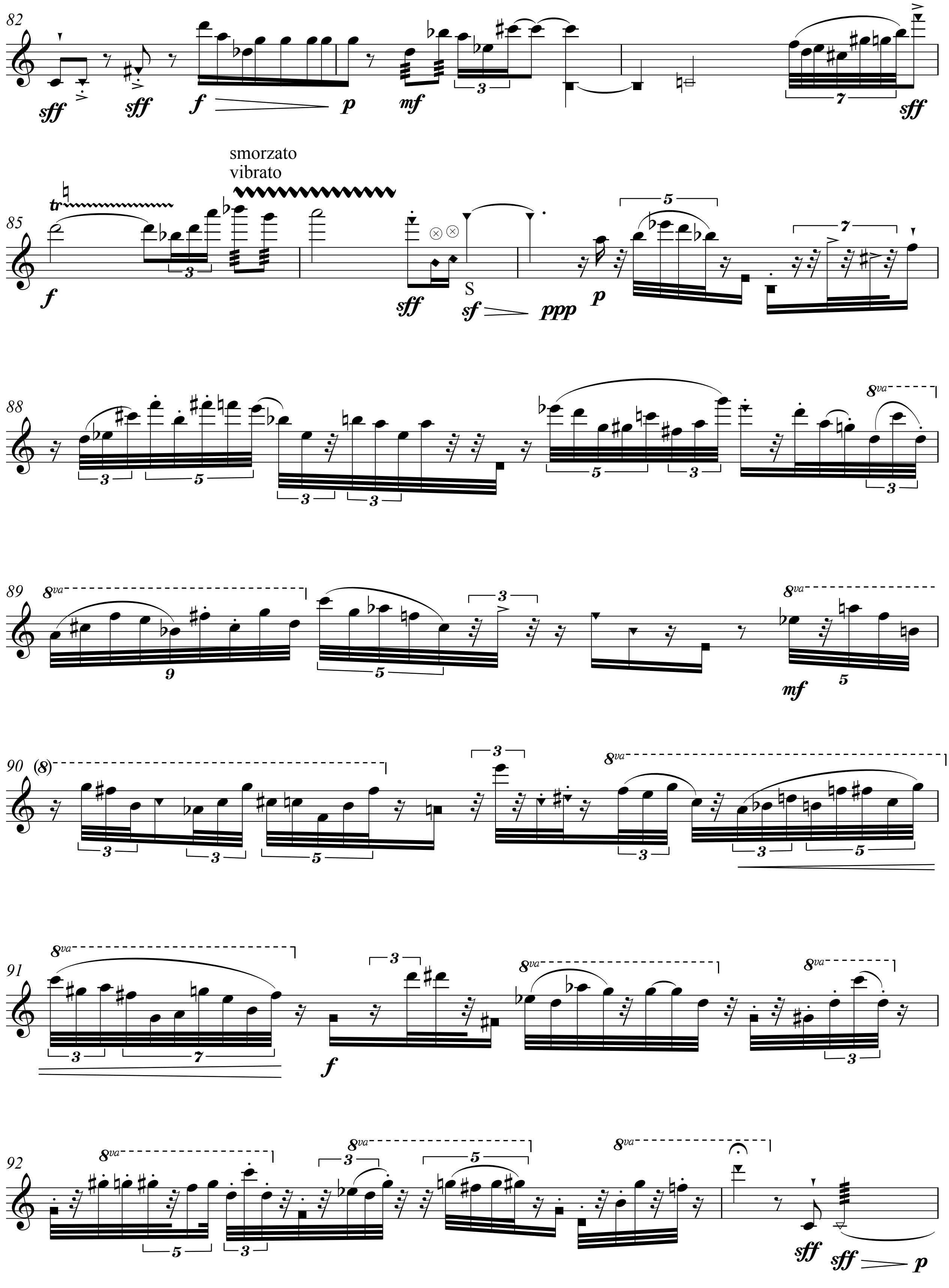

mp
mf
tr
f
tr

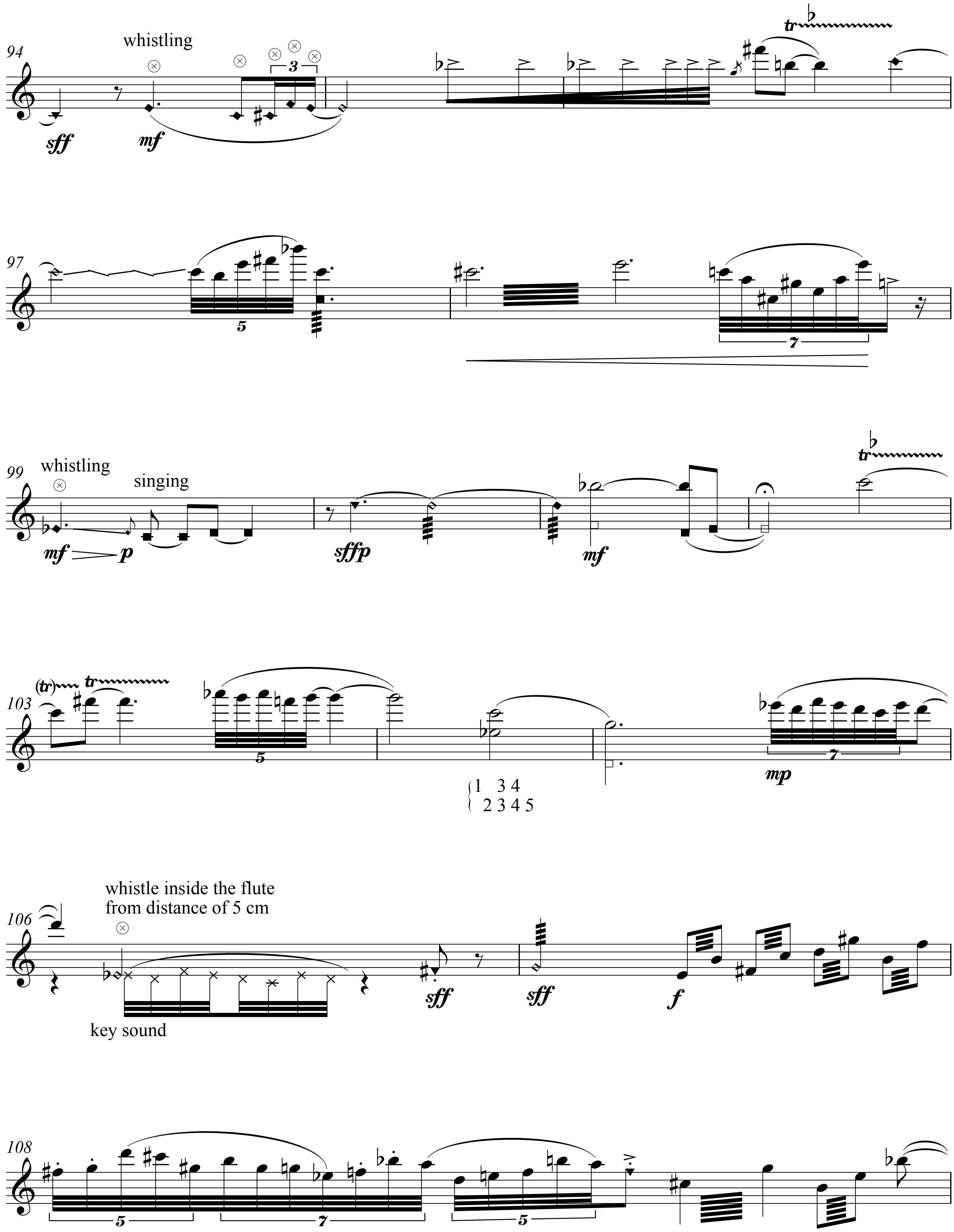

24
tr
mp
sff
26
cresc.
27
28
f
29
mf
cresc.
30
ff
sff
sff
normal breath
p


Bass flute
tongue ram
W.T.
W.T.
aeolian sound
lip pizz.

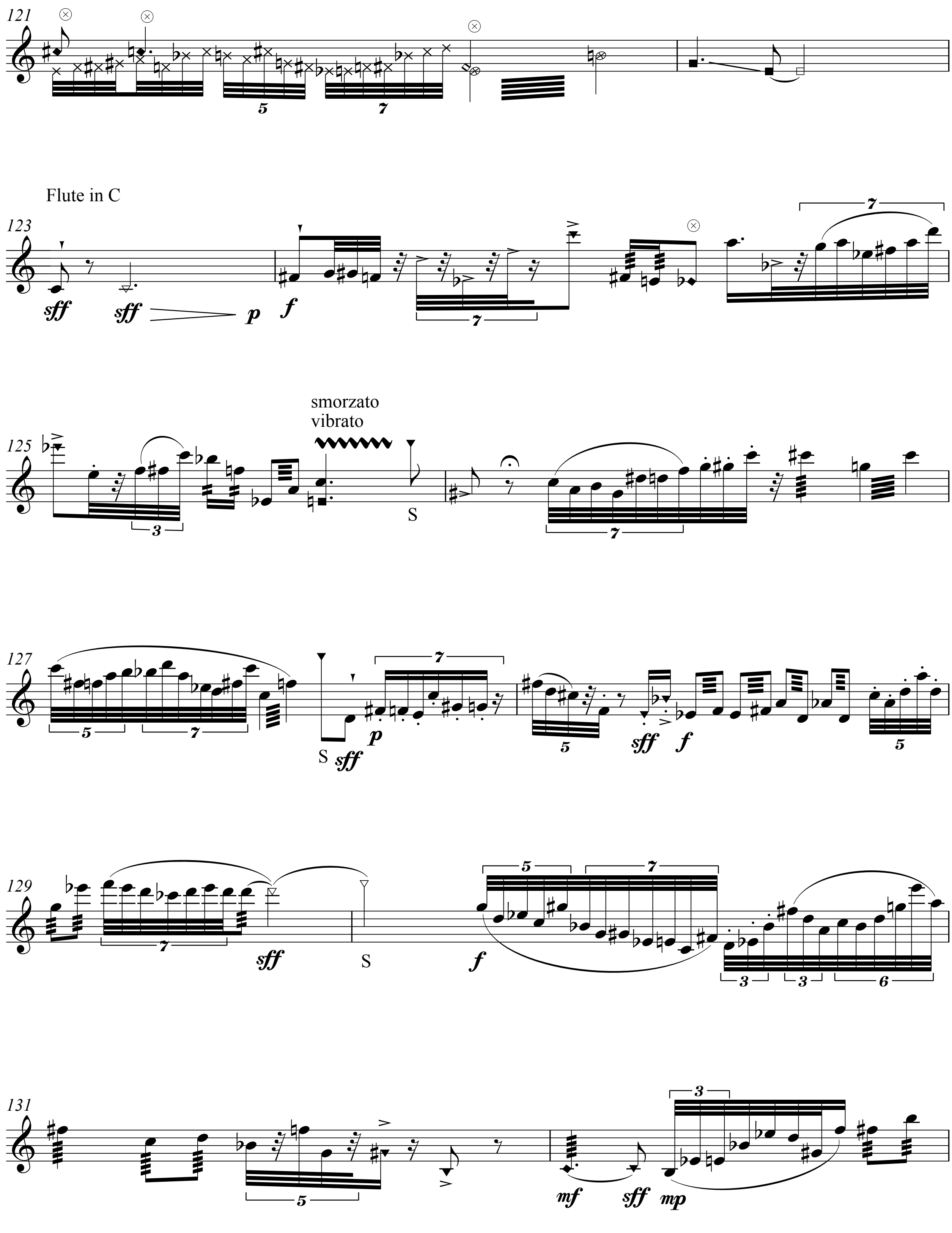
smorzato
vibrato
1 2 3
2 3 B 5
1 2 3
2 3 4 5
S
CH
CH S
1 3 4⑤
2 3 4 5
1 3 4
2 3 B 5
1 2 3 4
2 5
1 2 3 4 5
2 3 4 5
1 2 4
2 3 4 5


W.T.
(transition from multiphonic to whistle tone should be fluent)
pp
p
sffp
ff
mf
sff
f
ppp
mp
tr


82
sff
sff
f
p
mf
3
7
sff
85
tr
smorzato
vibrato
3
f
sff
S
sf
ppp
5
7
p
88
3
5
3
3
5
3
8va
3
89
8va
9
5
3
8va
mf
5
90
(8)
3
3
5
3
8va
3
3
5
91
8va
3
7
3
f
8va
8va
3
92
8va
5
3
8va
3
5
8va
sff
sff
p


94
whistling
sff
mf
97
99
whistling
singing
mf
p
sffp
mf
103
mp
1 3 4
2 3 4 5
106
whistle inside the flute
from distance of 5 cm
key sound
sff
sff
f
108


S
whistle inside the flute from distance of 5 cm
Key sound


Flute in C
smorzato
vibrato
S


133
sff
sff
mp
135
f
mf
sff
S
F S
mf simile
F T HA HA S
139
S
F
HA
mf
143
mp
F T
sff
mp
S
HA F HA
simile
S
T T T
S
F HA
144
p
148
pp
S
HA
S
p

Eyes wide shut

flute/piccolo/alt flute, oboe, clarinet/bass clarinet, violin, viola, cello, piano and percussions

Petra Bachratá

2008

Eyes wide shut

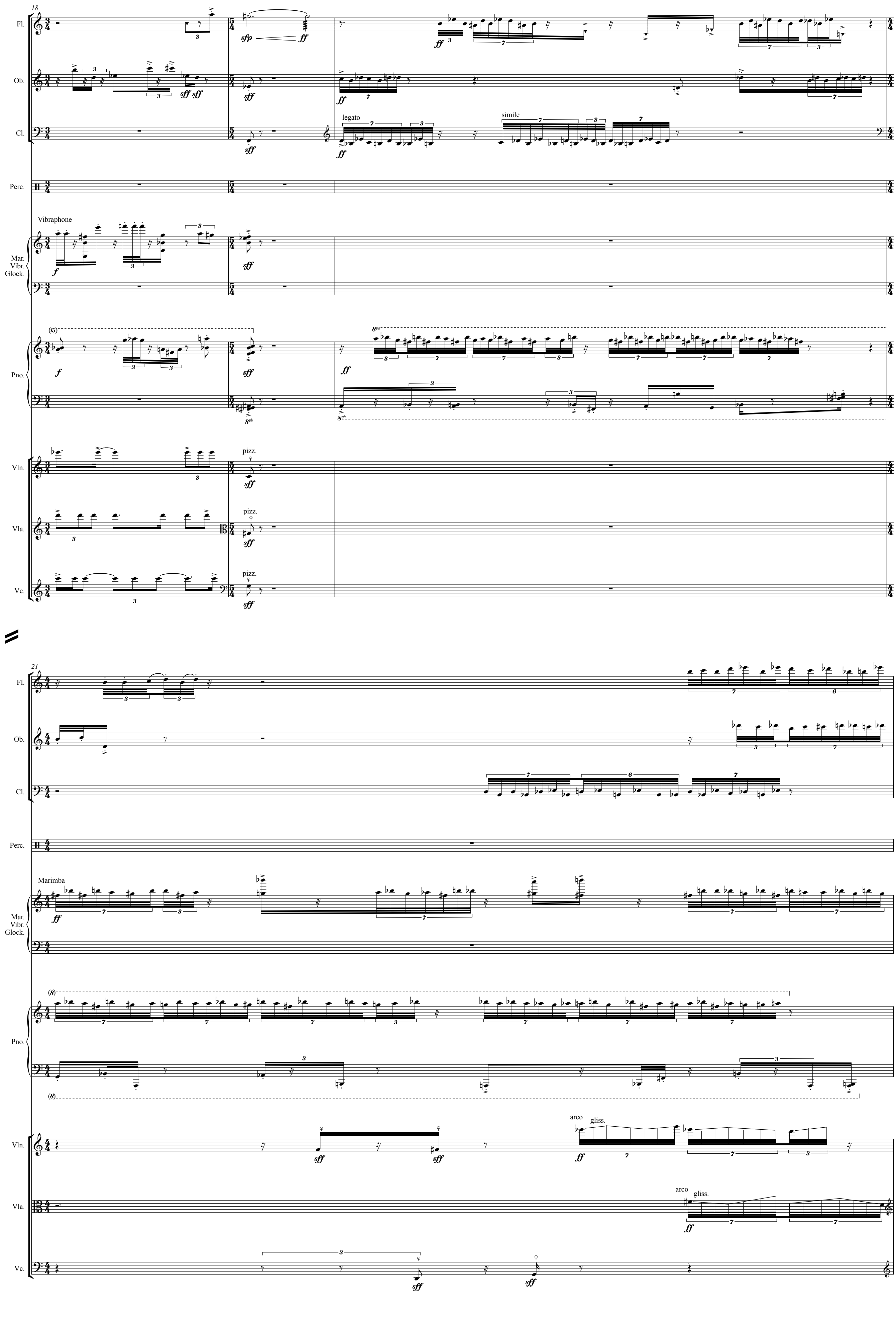
dedicated to Quasars ensemble

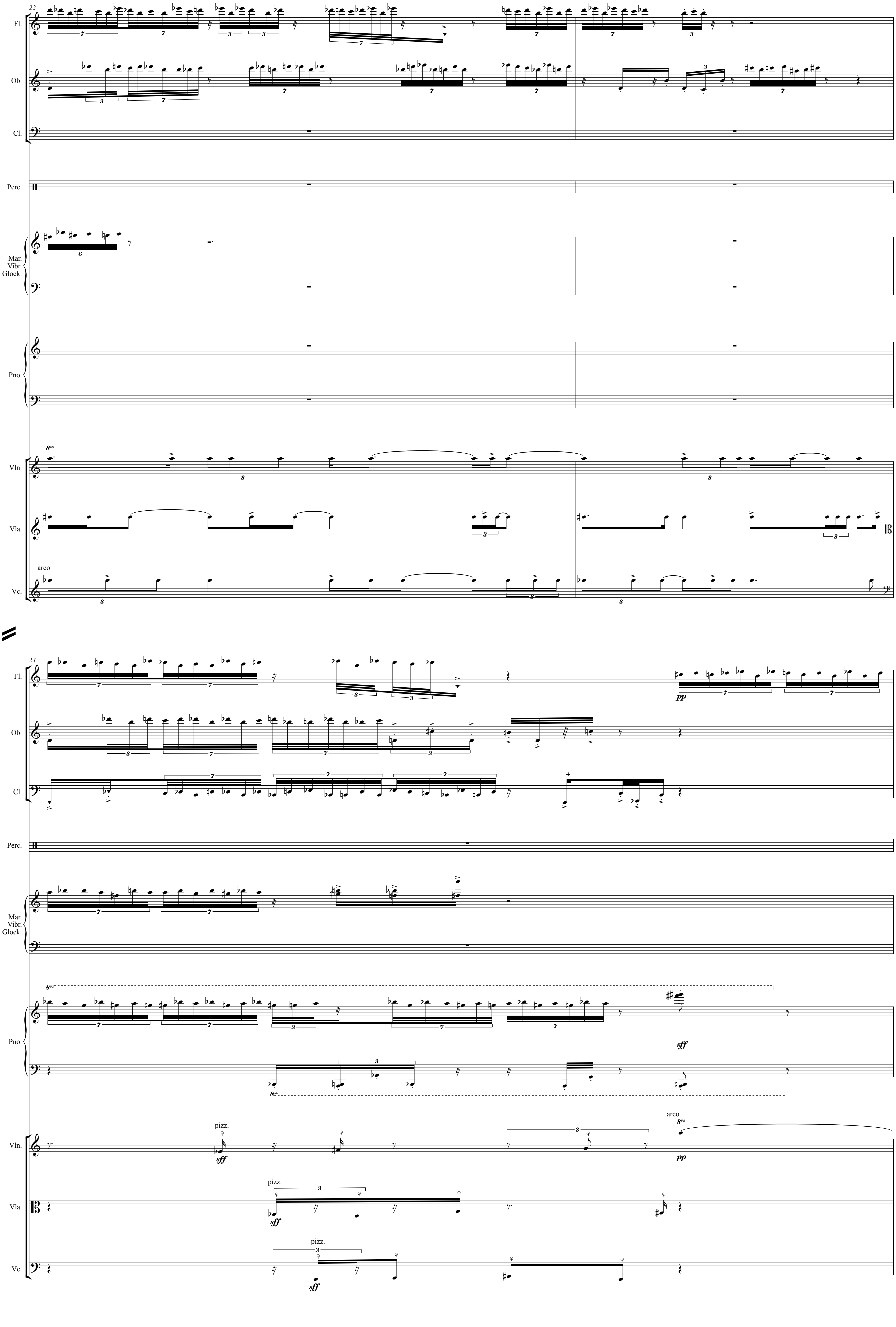
Petra Bachratá
2008

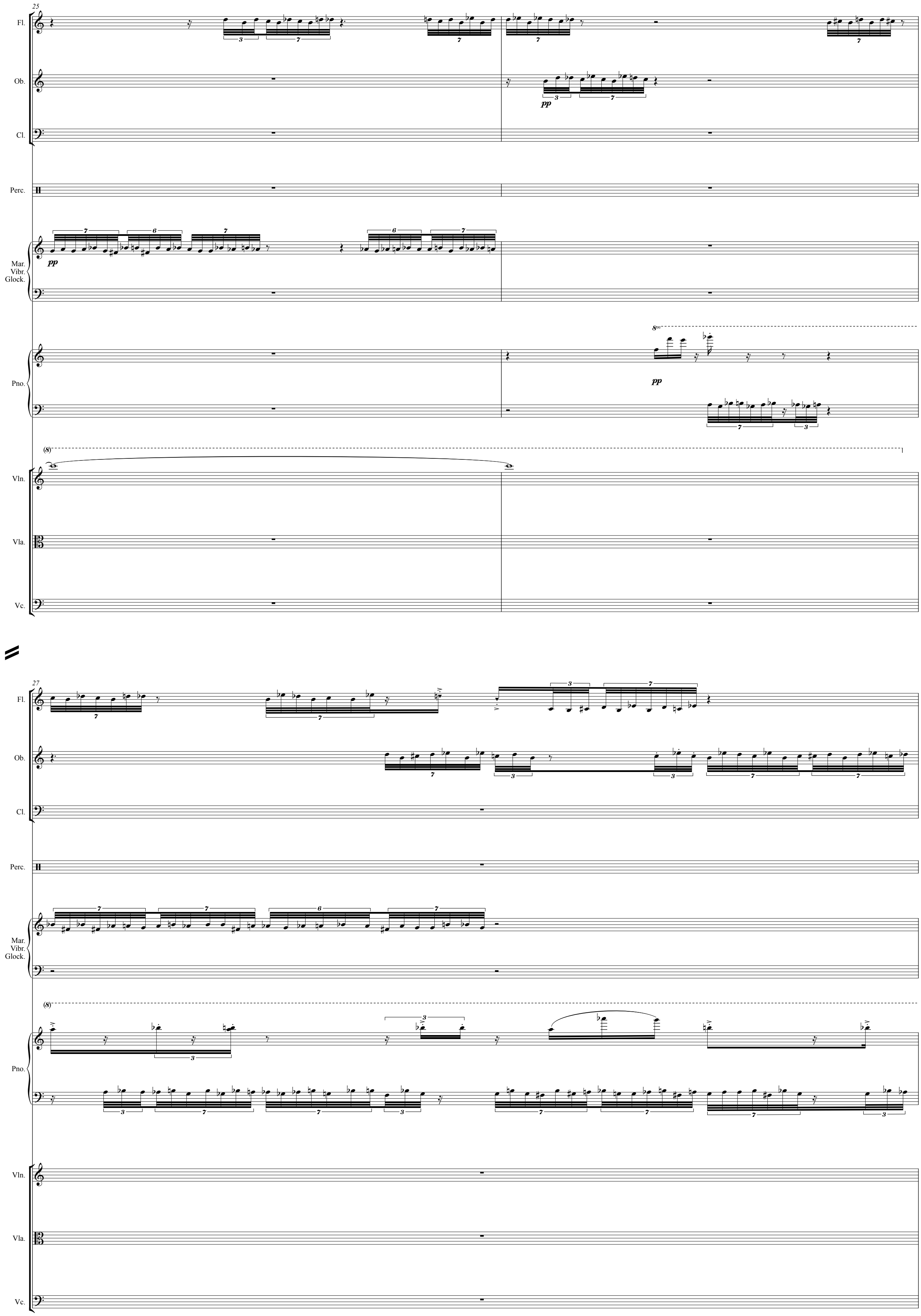

Fl.
Ob.
Cl.
Perc.
Mar.
Vibr.
Glock.
Pno.
Vln.
Vla.
Vc.
arco
gliss.
legato
Clarinet in B


10
Fl.
Ob.
Cl.
Bass clarinet
legato
Perc.
Mar.
Vibr.
Glock.
Pno.
Vln.
Vla.
Vc.
gliss.
12
breath sound
slap tongue
gliss.
pizz.
arco


14
Fl.
Ob.
legato
Cl.
Tom-toms, Bongos
Perc.
Mar.
Vibr.
Glock.
Pno.
Vln.
Vla.
Vc.
16
breath sound
arco
arco
arco


18
Fl.
Ob.
Cl.
Perc.
Vibraphone
Mar.
Vibr.
Glock.
Pno.
Vln.
Vla.
Vc.
legato
simile
pizz.
sfp
ff
sff
f
21
Marimba
arco
gliss.


22
Fl.
Ob.
Cl.
Perc.
Mar.
Vibr.
Glock.
Pno.
Vln.
Vla.
Vc.
arco
24
pp
sff
pizz.
arco
pp


25
Fl.
Ob.
Cl.
Perc.
Mar.
Vibr.
Glock.
Pno.
Vln.
Vla.
Vc.
pp
pp
pp
27
Fl.
Ob.
Cl.
Perc.
Mar.
Vibr.
Glock.
Pno.
Vln.
Vla.
Vc.

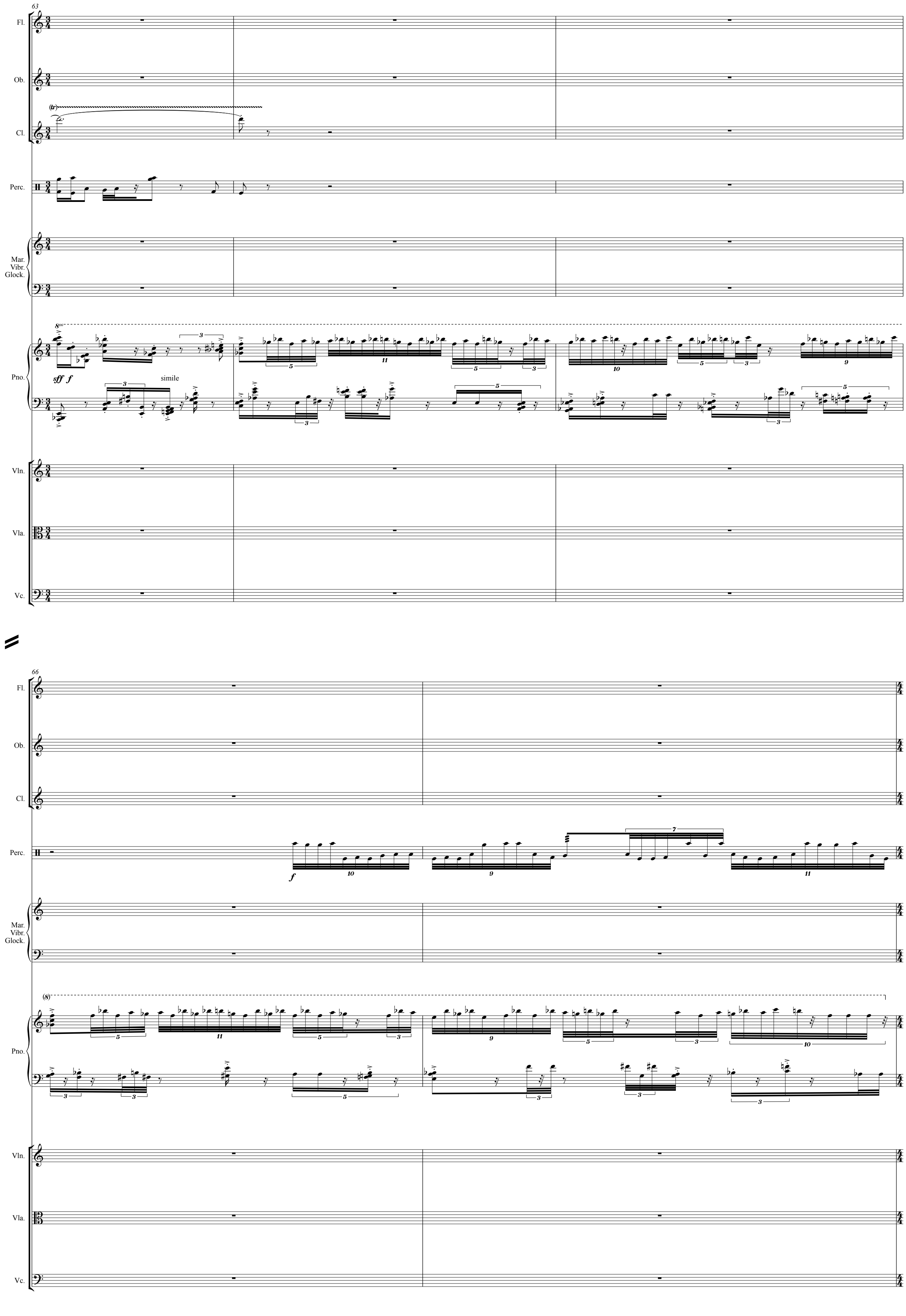

28
Fl.
Ob.
Cl.
Perc.
Mar.
Vibr.
Glock.
Pno.
Vln.
Vla.
Vc.
arco
gliss.
31
pizz.


34
Fl.
Ob.
Cl.
Perc.
Mar.
Vibr.
Glock.
Pno.
Vln.
Vla.
Vc.
cresc.
arco
pizz.
wrist cluster
cresc.
36
gliss.
(g a ♭a h ♭)
wrist cluster
play on the tailpiece

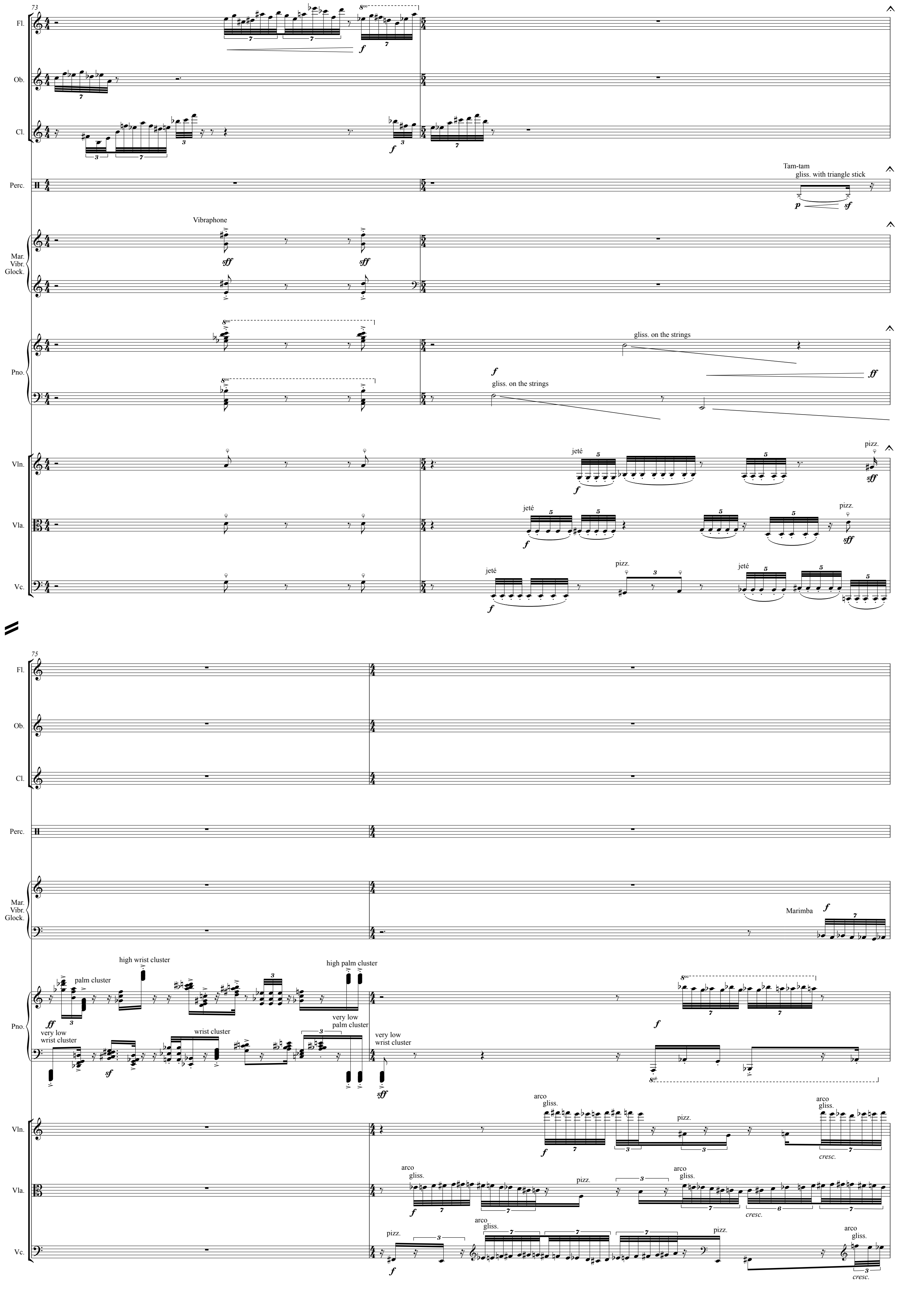

39
Fl.
Ob.
Cl.
Perc.
Mar.
Vibr.
Glock.
Pno.
Vln.
Vla.
Vc.
Piccolo
Clarinet in B
Glockenspiel (soft mallets)
pizz.
arco
gliss.
43


Flute in C
breath sound
aeolian sound
Bass clarinet
breath sound
aeolian sound
Marimba
bowed
very high cluster
very low cluster
pizz.
simile
arco
play on the tailpiece
Fl.
Ob.
Cl.
Perc.
Mar.
Vibr.
Glock.
Pno.
Vln.
Vla.
Vc.
lip pizz.
bowed
pizz. on strings
pizz.
on string
gliss.
sul pont.
tremolando


56
Fl.
Ob.
Cl.
Clarinet in B
Perc.
Glockenspiel (soft mallets)
Mar.
Vibr.
Glock.
Pno.
very high gliss.
on strings
Vln.
arco
gliss.
Vla.
Vc.
60
Piccolo
Tom-toms, Bongos


63
Fl.
Ob.
Cl.
Perc.
Mar.
Vibr.
Glock.
Pno.
sff f
simile
Vln.
Vla.
Vc.
66
Fl.
Ob.
Cl.
Perc.
f
Mar.
Vibr.
Glock.
Pno.
Vln.
Vla.
Vc.


68
Fl.
Ob.
Cl.
Perc.
Mar.
Vibr.
Glock.
Pno.
Vln.
Vla.
Vc.
Bass Drum
pizz.
simile
wrist cluster
71
Flute in C


73
Fl.
Ob.
Cl.
Perc.
Mar.
Vibr.
Glock.
Pno.
Vln.
Vla.
Vc.
Vibraphone
Tam-tam
gliss. with triangle stick
gliss. on the strings
gliss. on the strings
jeté
jeté
jeté
pizz.
pizz.
pizz.
75
Marimba
palm cluster
high wrist cluster
high palm cluster
very low
wrist cluster
wrist cluster
very low
palm cluster
very low
wrist cluster
arco
gliss.
pizz.
arco
gliss.
cresc.
arco
gliss.
pizz.
arco
gliss.
cresc.
pizz.
arco
gliss.
pizz.
arco
gliss.
cresc.


77
Fl.
Ob.
Cl.
Perc.
Mar.
Vibr.
Glock.
Pno.
Vln.
Vla.
Vc.
cresc.
cresc.
cresc.
(a a♯h c)
pizz
arco
gliss.
pizz.
arco
gliss.
gliss.
gliss.
pizz.
arco
gliss.
pizz.
79
Alt flute
aeolian sound
breath sound
aeolian sound
simile
lip pizz
tongue ram
whistling inside the flute
from distance of 5 cm
Bass clarinet
multiphonic
Tam-tam
gliss. with triangle stick
pizz.on strings
gliss.on the strings
pizz.
jeté
pizz.
arco
sul pont.
gliss.
arco
play on the tailpiece
tremolando

84
Fl.
Ob.
Cl.
Perc.
Mar.
Vibr.
Glock.
Pno.
Vln.
Vla.
Vc.
gliss. with triangle stick
pizz on the string
arco
sul pont.
pizz.
jeté
gliss.
87
multiphonic
make a slight glissando
down and up while whistling
Bass Drum
Tam-tam
(h c c ♯ d♯e)
gliss. on the strings


91
Fl.
Ob.
Cl.
Perc.
Marimba
bowed
Mar.
Vibr.
Glock.
bowed
Pno.
Vln.
Vla.
Vc.
pizz.
simile
94
Whistle-tone (W.T.)
Vibraphone
bowed
arco
wide vibrato
arco
tremolando


97
Fl.
Ob.
Cl.
Perc.
Mar.
Vibr.
Glock.
Pno.
Vln.
Vla.
Vc.
key sound
lip pizz.
wrist cluster
(h♭c d♭d e♭)
jeté
tremolando
pizz.
100
very high cluster
very low cluster
simile
arco


102
Fl.
Ob.
Cl.
Perc.
Mar.
Vibr.
Glock.
Pno.
palm cluster
very low
palm cluster
Vln.
pizz.
Vla.
pizz.
Vc.
pizz.
104
Fl.
Ob.
Cl.
Perc.
Tam-tam
Mar.
Vibr.
Glock.
Pno.
very high palm cluster
very low
palm cluster
Vln.
arco
gliss.
pizz.
arco
gliss.
cresc.
Vla.
arco
pizz.
arco
gliss.
pizz.
arco
gliss.
Vc.
arco
pizz.
arco
gliss.
pizz.
arco
gliss.


106
Fl.
Ob.
Clarinet in B
Cl.
cresc.
Perc.
let the tam-tam resonate
Mar. Vibr. Glock.
Pno.
Vln.
pizz
arco
gliss.
Vla.
pizz.
Vc.
108
strings start only when the resonance of tam-tam is very soft
pp
ppp

Somewhere... where the rainbow ends...

flute/bass flute, clarinet/bass clarinet, piano and percussion

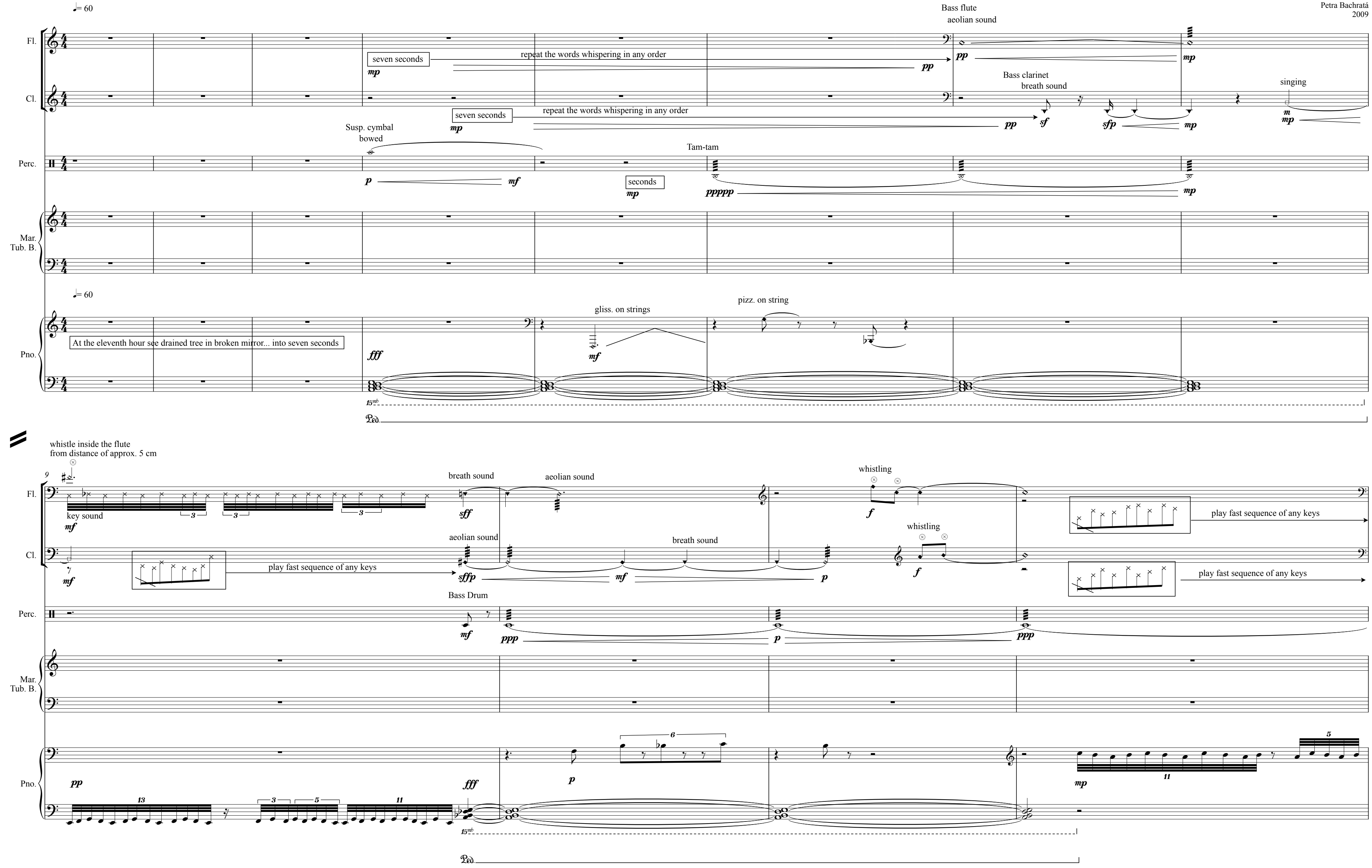
Petra Bachratá

2009

Somewhere... where the rainbow ends...

dedicated to Performa ensemble

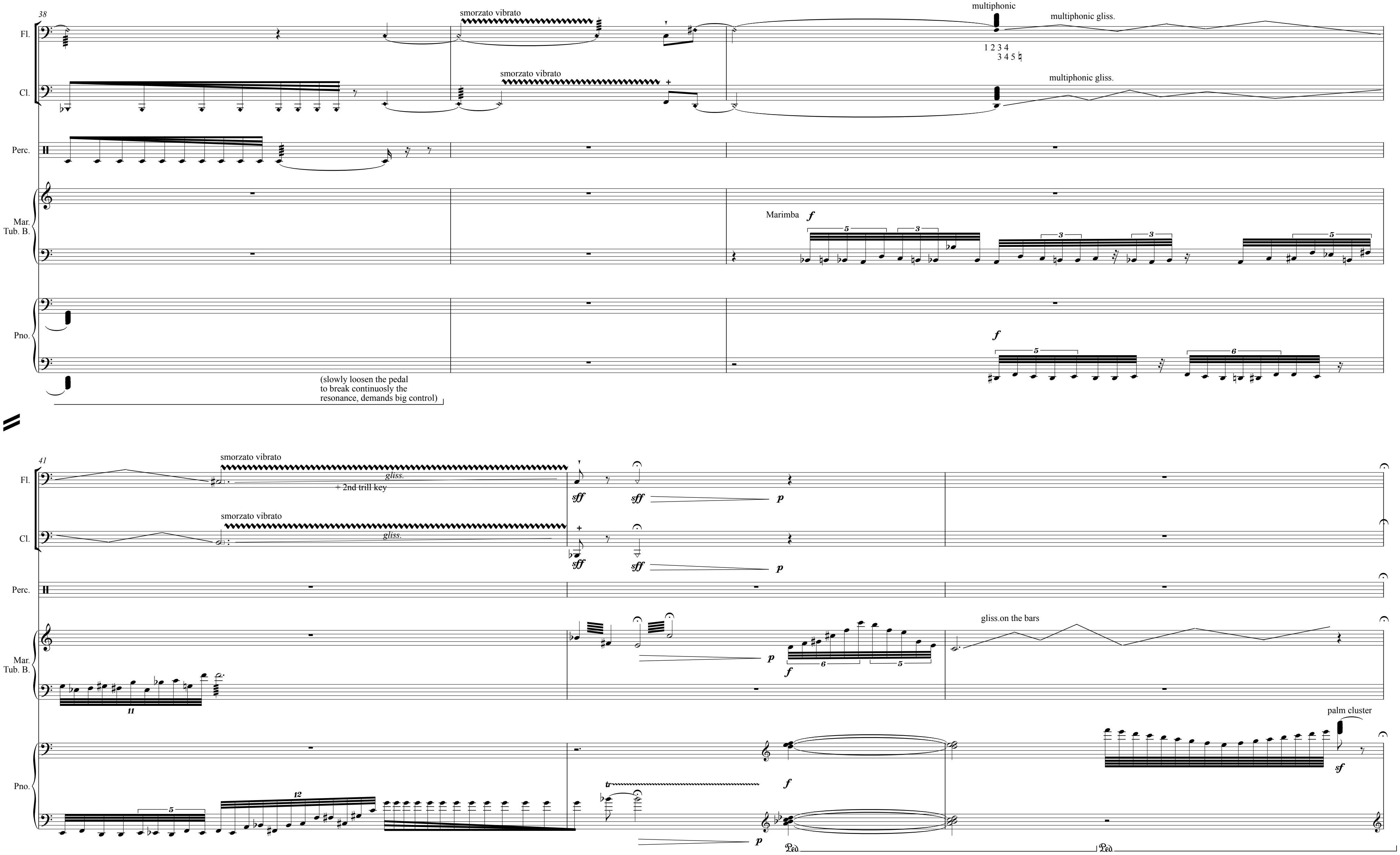
Petra Bachratá
2009




13
breath sound
play fast sequence of any keys
play fast sequence of any keys
Fl.
Cl.
Perc.
Mar.
Tub. B.
Pno.
sff
mf
7
5
tr
Tam-tam
ppp
p
sffp
f
mfp
mf
very low cluster
very low cluster
string gliss.
slap tongue
sf
scraping with triangle stick
18
gliss.
gliss.
playing and singing
tongue ram
slap tongue
playing and singing
sff
3
6
Tam-tam
Bass Drum
Tam-tam
undefinable danger
hit the strings with palm
8vb

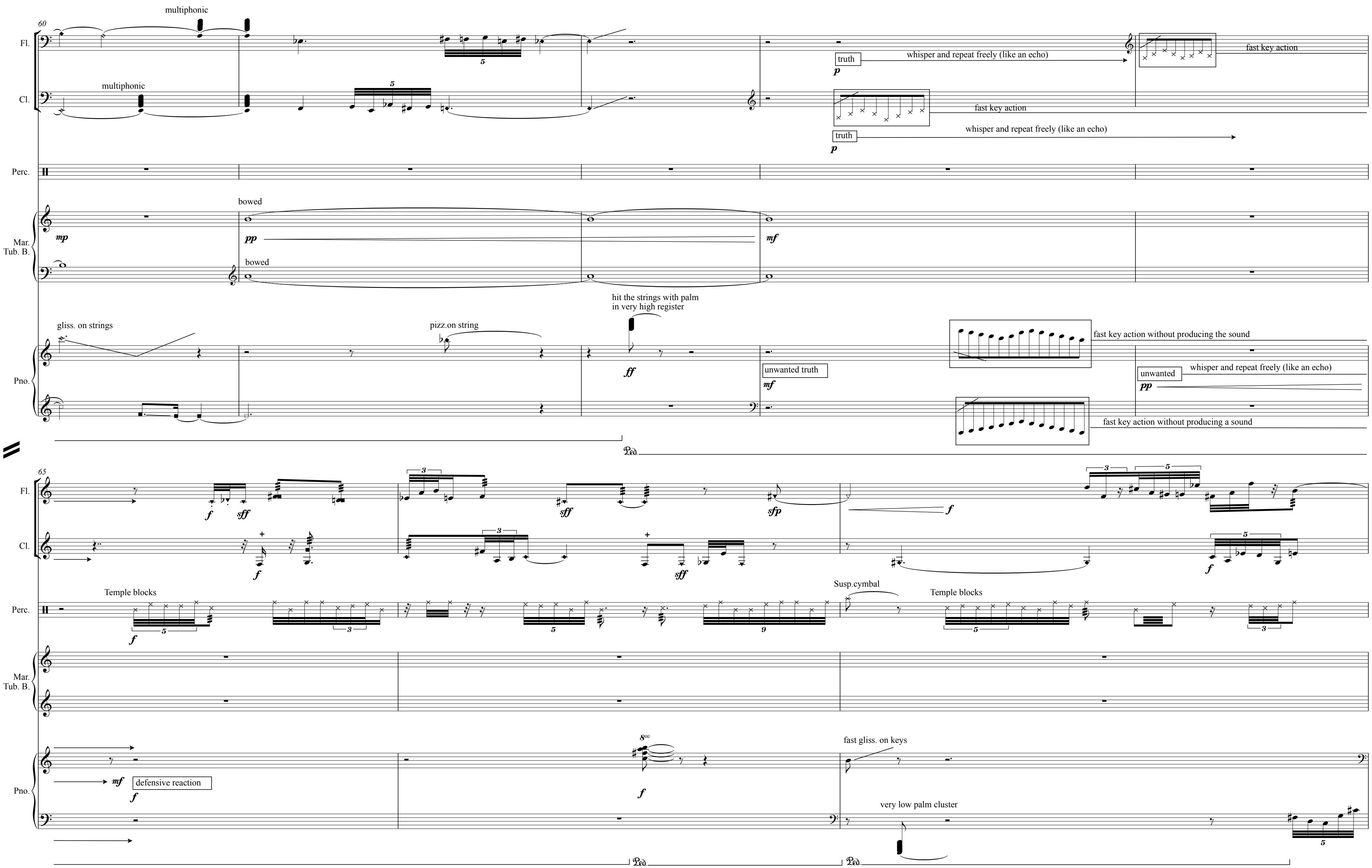

Fl.
Cl.
Perc.
Mar.
Tub. B.
Pno.
cresc.
tongue ram
improvizando
tk tk tk tk tk
soul on sale
repeat the words whispering
visions on sale
repeat the words whispering
Susp. cymbal
bowed
illusory visions in the deepness of soul on sale
palm cluster
Flute in C
gliss.on strings


sizzling sound
Fl.
Cl.
Perc.
Mar.
Tub. B.
Pno.
Clarinet in B
Marimba
gliss. on the bars
almost schizophrenic rainbow
use Ped freely
cresc.
subjective risk!
Bass flute
Bass clarinet
tortmenting hesitation
Bass Drum
low palm cluster
low palm cluster


38
Fl.
Cl.
Perc.
Mar.
Tub. B.
Pno.
smorzato vibrato
smorzato vibrato
multiphonic
multiphonic gliss.
1 2 3 4
3 4 5 ♮
multiphonic gliss.
Marimba
(slowly loosen the pedal
to break continuosly the
resonance, demands big control)
41
smorzato vibrato
gliss.
+ 2nd trill key
smorzato vibrato
gliss.
gliss.on the bars
palm cluster

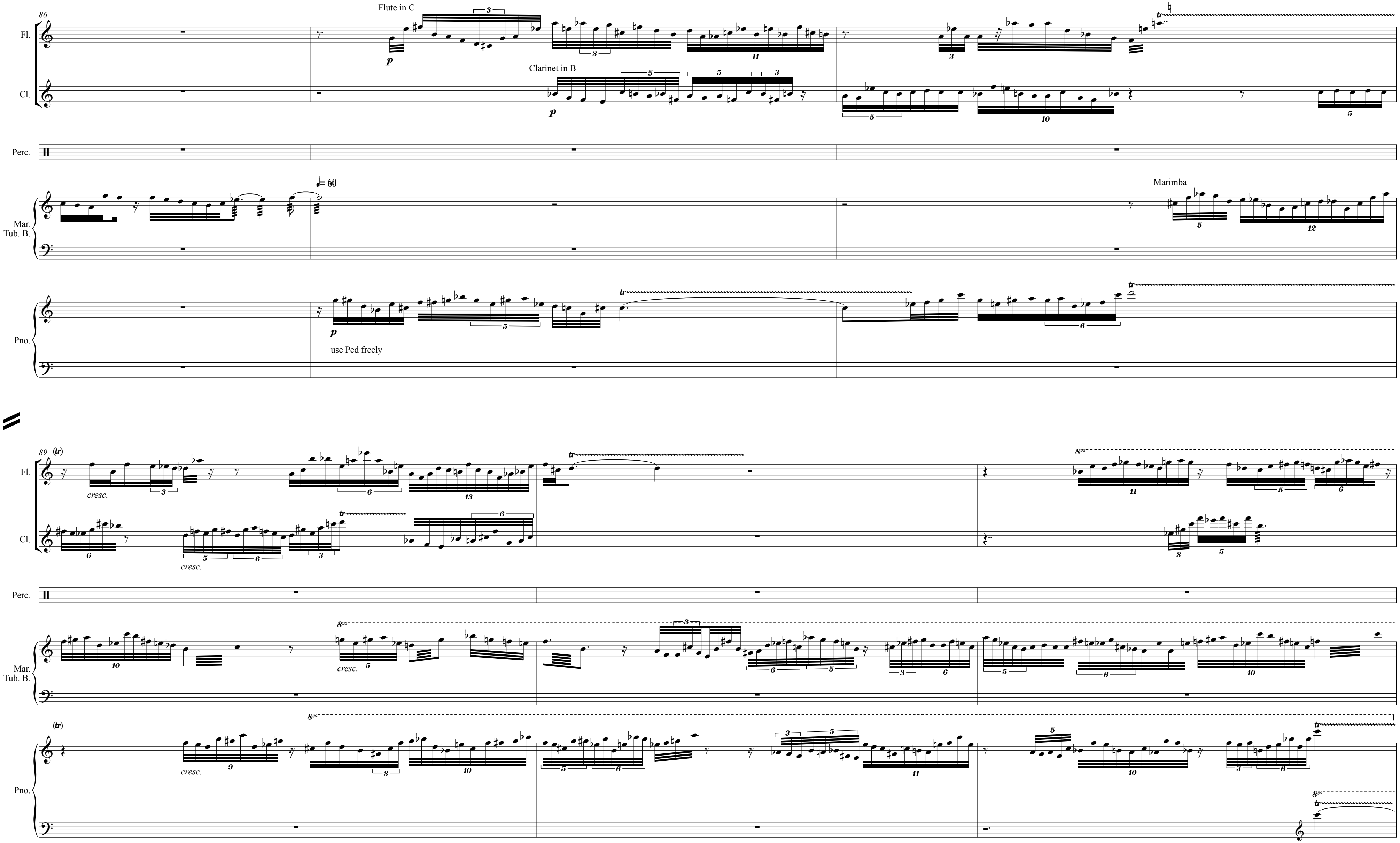

44
Fl.
Cl.
Perc.
Mar.
Tub. B.
Pno.
gliss on the bars
f
wrist cluster
high palm cluster
hit the strings
with palm
f
6
3
5
sf
palm cluster
palm cluster
Ped.
47
Fl.
Cl.
Perc.
Mar.
Tub. B.
Pno.
Flute in C
f
sparkling fire spasm !
f
fast multiple pipe gliss.
f
7
gliss. on strings
f
mp
palm cluster
f
8vb
Ped.


51
Fl.
Cl.
Perc.
Mar.
Tub. B.
Pno.
tongue ram
Clarinet in B
slap tongue
palm cluster
very low palm cluster
54
Bass flute
Bass clarinet
Tam-tam
Marimba
bowed
bowed
palm cluster
pull out some pages wet of tears dried out
hit the strings with palm
in very low register
pizz. on strings
gliss on strings
singing


60
Fl.
Cl.
Perc.
Mar.
Tub. B.
Pno.
multiphonic
multiphonic
truth
whisper and repeat freely (like an echo)
fast key action
fast key action
truth
whisper and repeat freely (like an echo)
bowed
bowed
gliss. on strings
pizz.on string
hit the strings with palm
in very high register
unwanted truth
fast key action without producing the sound
unwanted
whisper and repeat freely (like an echo)
fast key action without producing a sound
65
Temple blocks
Susp.cymbal
Temple blocks
defensive reaction
fast gliss. on keys
very low palm cluster

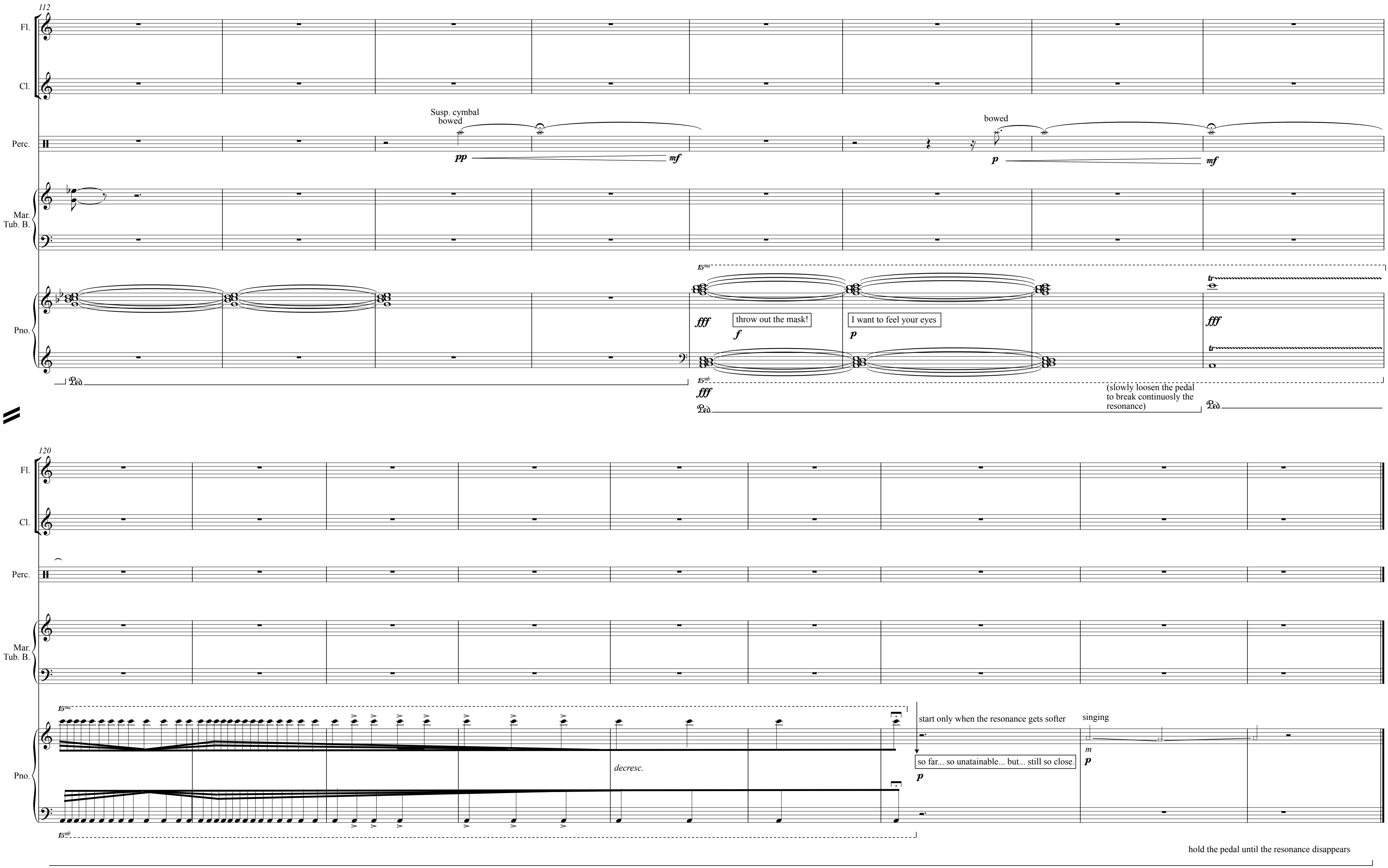

68
Fl.
Cl.
Perc.
Mar.
Tub. B.
Pno.
gliss.
gliss.
sff
sffp
f
sff
p
mf
f
Susp. cymbal
f
tr
71
Fl.
Cl.
Perc.
Mar.
Tub. B.
Pno.
tongue ram
lip pizz.
slap tongue
whistling
sff
p
f
ff
mf
f
ff
p
Tam-tam
bowed
Susp. cymbal
bowed
pp
mf
f
gliss. on lowest strings
f
gliss. on lowest strings


75
Fl.
Cl.
whistling
mf
Perc.
Mar.
Tub. B.
Tubular bells
(use medium beater)
mf
gliss.
f
returning preliminary past...or
mf
Pno.
very high palm cluster
wrist cluster
very high palm cluster
f
ff
wrist cluster
very low palm cluster
very low palm cluster
Ped.
Ped.
Ped.
81
is that past future?
mf
future
whispering freely
mp
pp
future
whispering freely
mp
pp
future
mp
Tubular bells (maximum possible tempo)
use vibraphone mallets
mf
singing
gliss.
m
gliss.
prepare indicated strings with gum or paper material for obtaining the percussive effect while playing on keys
for meassures 100-104


86
Fl.
Cl.
Perc.
Mar.
Tub. B.
Pno.
Flute in C
Clarinet in B
Marimba
♩= 60
p
use Ped freely
tr
89
cresc.
8va


92
Fl.
Cl.
Perc.
Mar.
Tub. B.
Pno.
fast chromatic sequences
fast chromatic sequences
decresc.
decresc.
mp
mf
ff
ff
gliss. on bars
decresc.
mp
gliss. on strings
decresc.
mp
ff
96
Tam-tam
bowed
p
p
p
p
walking through dream seeing that double image in mirror
mf
percussive effect
(play on keys coresponding to the prepared strings)


102
Fl.
Cl.
Perc.
Mar.
Tub. B.
Pno.
6
tr
gliss.
mf
Tubular bells
(use soft felt or leather covered beaters)
107
whistling
whistling
f
mp
p
5
7
gliss. on the strings


112
Fl.
Cl.
Susp. cymbal
bowed
Perc.
pp
mf
bowed
p
mf
Mar.
Tub. B.
Pno.
fff
throw out the mask!
f
I want to feel your eyes
p
fff
(slowly loosen the pedal
to break continuosly the
resonance)
fff
120
Fl.
Cl.
Perc.
Mar.
Tub. B.
Pno.
decresc.
start only when the resonance gets softer
so far... so unatainable... but... still so close.
p
singing
p
hold the pedal until the resonance disappears