The dramaturgy of music : its impact on my composition

Javier Alejandro Garavaglia

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INDEX

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Declaration

I hereby declare that the group of works which constitute this PhD by prior output as a whole is not substantially the same as any previously submitted or currently being submitted whether in published or unpublished form, for a degree, diploma, or similar qualification at any university or similar institution. The music composed for the six works is solely my own and nobody else's: these works are registered solely under my name and authorship for the purpose of collection of authorship royalties by the GEMA (*Gesellschaft für musikalische Aufführungs- und mechanische Vervielfältigungsrechte*) in Germany, under the following registration numbers:

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L.S. (waiting for changes): 6.013.675

Color Code is a collaborative work; the nature and extent of the collaboration is explained in more detail in Section II.ii.e and Appendix V. Consent for this submission of the video part for non-commercial purposes has been sought.

London Metropolitan University

PhD by Prior Output

Javier Alejandro Garavaglia

The Dramaturgy of Music: its Impact on my Composition

Abstract

This submission for PhD by Prior Output (comprising of six compositions and this dissertation) defines my personal approach to musical composition using music dramaturgy as its main source of inspiration and expression, contextualising the compositions within other pieces in the field and also within my own production. The pieces were selected following recommendations and regulations from the Graduate School at London Metropolitan University, which are fully explained in section II.i. A further criterion for the selection of precisely these six pieces was, that in spite of their apparent diversity (showing a vast range of compositional techniques, including acousmatic music, ensemble and solo pieces with live-electronics) they nevertheless form a 'coherent whole', as it is explained in section II.i and II.ii.

A detailed analysis of the compositional techniques for each of the six works, a list of all works and publications of my authorship in the public domain, reviews about some of the works and diverse publications related to the compositions or main subjects are presented in the Appendices, as required. Papers which are relevant either to the pieces or to some of the concepts explained in this dissertation are presented in the appendices XV to XIX.

List of the works included in the prior output:

Gegensätze (gegenseitig): alto flute, quadrophonic tape and live-electronics (ca. 33')
Arte Poética (I): quadrophonic tape (ca. 8')
Overture (in memoriam T.A.T.): quadrophonic tape (ca. 11')
Spectral colours: ensemble and tape (ca. 11')
Color Code: quadrophonic tape and live-electronics, live viola, video (ca. 30')
L.S. (waiting for changes): small orchestra (ca.12')

Keywords

Music dramaturgy, intrinsic and extrinsic music dramaturgy, communication process, musical discourse, musical semiotics, sound imprint, intention/reception, something-to-hold-on-to-factors.

Section I
Introduction

I.i Description of the Prior Output

The discipline of this PhD by prior output is music composition. Through the selection of six pieces of my own authorship, which were composed between 1994 and 2001, this dissertation examines my aesthetical, artistic and philosophical position regarding how I approach the act of composing music. The six compositions are presented below, in chronological order of composition:

(1) *Gegensätze (gegenseitig)* for alto flute, quadrophonic tape and live-electronics, composed in 1994. Research project: implementation of the *AUDIACSystem*[1] a system for the creation of Audio real-time processing at *ICEM* (*Institut für Computermusik und Elektronische Medien - Folkwang Hochschule Essen*, Germany). Duration: 33:00.

(2) *Arte Poética (I)* for quadrophonic tape, composed 1995, based on the first stanza of the poem 'Arte poética' by Jorge Luis Borges. Produced at *ICEM* (*Folkwang Hochschule Essen*, Germany). Duration: 8:16

(3) *Spectral colours* for Ensemble and tape, composed in 1996/7. Tape produced at ICEM (*Folkwang Hochschule Essen*, Germany). Duration: ca. 11 minutes.

(4) *Overture (in memoriam T. A. T.)* for quadrophonic tape, composed in 1997 and dedicated to the memory of Tomás Alejandro Tichauer. Produced at *ICEM* (*Folkwang Hochschule Essen*, Germany). Duration: 10:40

(5) *Color Code* a concert/installation for video projection on two screens, quadrophonic tape, viola and live-electronics (MAX/MSP) by the *Gruppe Animato,* based on the text 'Postmoderne Farben' (1988) by Vilém Flusser. This multimedia project, composed in 1998, was commissioned by the *Ministerium für Wissenschaft und Forschung des Landes Nordrhein-Westfallen* in cooperation with the *Universität Bielefeld*, the *Fachhochshule Bielefeld*, the *Folkwang-Hochschule Essen (ICEM)* and the group *Multimedia und Kunst* (all in Germany). Members of the *Gruppe Animato*: graphic design: Gottfried Jäger and Karl Martin Holzhäuser; image computer generation and programming: Peter Serocka; music composition, sound design and programming: Javier Alejandro Garavaglia. Duration: 30:09

(6) *L.S. (waiting for changes)* for small orchestra, composed in 2001 and commissioned by the *Luxembourg Sinfonietta* and the *Luxemburger Gesellschaft für Neue Musik*. Duration: ca. 11 minutes.

[1] Full details about this system can be found in section II.ii.a

I.ii Compositional Goals - Contributions to the Field.

The selection of these six pieces has a double purpose: on the one hand, to provide a wide spectrum of possibilities to demonstrate a 'coherent whole', in which the dramaturgy of music plays an essential role; on the other hand, to comply with requirements by the Graduate School at London Metropolitan University, by presenting works already in the public domain, which were also produced or/and premiered within an academic environment.

Although these six compositions (and the rest of my composition) differ in their genres and sources of inspiration, the main (and common) point of departure, the dramatic intention, unifies them. Composition techniques follow the need dictated by the dramatic intention in each case.

My striving for new means of expression -technical and aesthetical- in these particular six works shows a comprehensive view of my own development as a composer in the last two decades. My original contributions to the field, however, do not only include music composition (and, up to an extent, music performance) but equally the publication of several articles on the topic of music composition and music dramaturgy, some of which are closely related to the six compositions herewith presented. Apart from that, it is worth mentioning that particularly two of the compositions -*Gegensätze (gegenseitig)* and *Color Code*- have profoundly influenced my following contributions to the field of composition with live-electronics[2] as much as publications about those topics.[3]

My principal goal as a composer is *expression*. The word *expression* can be defined as 'something that manifests, embodies, or symbolises something else'.[4] In the particular case of my composition, the object of expression manifests itself by musical means. Although the object (source) of expression can vary, the results shall always emerge as a certain dramaturgy arousing[5] in the listener's mind. After a thorough analysis of the compositional techniques of each of the pieces (presented in the appendices I to VI), it is shown that the compositional challenge lies in adjusting or even creating the adequate compositional techniques for each

[2] For example, in works such as *NINTH (music for Viola and Computer)* from 2002, *Ableitungen des Konzepts der Wiederholung (for Ala)* from 2003 and *Intersections (memories)* from 2007 (see Appendix VII, XV, XVII, XVIII and XIX for more details).

[3] Such as: Garavaglia, JMM article online, 2008 and Garavaglia, 2010, fully presented in Appendix XVIII and XIX respectively.

[4] Or also 'a mode, means, or use of significant representation or symbolism; especially felicitous or vivid indication or depiction of mood or sentiment.' Both quotes from: Merriam-Webster's Collegiate Dictionary-Encyclopaedia Britannica Deluxe Edition 2004.

[5] Arousal is meant herewith as defined in psychology: 'to rouse or stimulate to action or to psychological readiness for activity. Encyclopaedia Britannica Library - 2004: Arouse.

individual piece[6] in order to achieve the main goal: *to express musically its dramatic contents.* The techniques developed for *Gegensätze (gegenseitig)* (Appendix I) and for *Overture (in memoriam T.A.T.)* (Appendix IV) are typical cases.

Expression implies also *communication.* Thus, semiotics has a profound impact on how I organise the musical discourse in each of my pieces in order to communicate their specific dramaturgic intention. In particular, Eco's concept of general semiotics (Caesar, p.81 and ff) and Nattiez's musical semiotics regarding the music discourse (Nattiez, 1990) are my main sources. Furthermore, I attach the highest importance to the title of a composition as an element of 'communicating through music', as it sheds light on the narrative intended. An explanation of why the titles of some of the pieces herewith presented show a clear tendency toward having a main and a secondary title (the latter between parenthesis) is offered in section II.i.

My philosophical approach to music's dramaturgy was published in an online article in 2008, (Garavaglia, JMM article online, 2008)[7] in connection to music technology. In this article, I make a clear distinction between the type of dramaturgy implied in a piece of music and how it is perceived, which I call respectively intrinsic and extrinsic types of music dramaturgy. This approach, even though based on the same basic principles, differs from current empirical research in the area, such as the *Intention/Reception* project by Landy and Weale (Weale, p. 189), as it proposes an alternative typification for music dramaturgy and, mainly, because it does not concentrate exclusively on the goal of perceiving what is intended.

I.iii Contextualisation within the Field.

Each piece presented herewith belongs to the category of what is generally considered 'contemporary music'. Although this term is not always used to define the same type of music and sometimes includes rather opposed types of music, it refers here specifically to the type of music from roughly 1945 onwards, generally described as academic/serious/modern-classical music[8].

[6] Meaning the development of form, pitches, rhythms, programming of interactive algorithms/synthetic sounds, orchestration, etc.

[7] This article is reproduced in full length in Appendix XVIII.

[8] 'In the broadest and popular sense, Contemporary music is any music being written in the present day. This could include any kind of present music. However in the strict historical and musicological terminology, the term Contemporary music exclusively refers to the modern forms of art music, this includes: the post-1945 modern forms of post-tonal music after the death of Anton Webern (including serial music, electroacoustic music, Concrete music, experimental music, atonal music, minimalist music, etc.). In a more restricted sense it may only include the most recent forms of this music: Contemporary classical music (post-1975) (including post-modern music, Spectral music, post-minimalism, sound art, etc.).'
Quoted from http://en.wikipedia.org/wiki/Contemporary_music. Site accessed on 22.6.09

Having studied composition in two different countries (Argentina and Germany), my experiences have been informed by the cultural and aesthetic characteristics of both countries. Without entering into the matter in too much depth, the tendency in Argentina can arguably be seen as intuitive, whereas in Germany, there is a much more intellectual, analytical and mental attitude towards listening to music and composing. My composition techniques were profoundly influenced and developed during my postgraduate studies at the Folkwang Hochschule Essen, Germany under the supervision of Prof. Nicolaus A. Huber (1990-1992). In particular, his teaching of techniques by which compositional materials could be developed from basic cells had a great impact in how I approached composition since then. Apart from that, and due to the fact that Huber studied with Luigi Nono in Venice in the 1970s, works by Nono such as *Ricorda cosa ti hanno fatto in Auschwitz* (acousmatic work for tape alone), *La fabbrica illuminata* (tape and soprano) or *Il Canto Sospeso* (orchestra and soloists) informed my entire composition. The main reason for this lies in the fact that Nono was very precise about the dramatic intention of his works (in all of the previously mentioned cases, the intention was politically connected) and accommodated his compositional techniques to that goal.

Within the tradition of contemporary music, my pieces include instrumental and electroacoustic composition. The tradition of my acousmatic works can be contextualised in a direct line with the electroacoustic music composed from the 1950s by Karlheinz Stockhausen, Gottfried Michael König (algorithmic composition) and more recent composers such as Jonty Harrison, Simon Emmerson, Ludger Brümmer, Trevor Wishart, Barry Truax, Larry Austin and Dirk Reith. Concerning compositions including real-time interaction, my contribution to the field of interactive music has been modelled on works such as *Music for Hi-Hat and computer* and *Music for clarinet and ISPW* by Cort Lippe. Works by Nono, Berio and Ligeti, in particular their orchestral pieces, had a great influence on my instrumental pieces.

The next section contextualises my composition within my own production and within the field of contemporary music. It offers an explanation about the most remarkable characteristic of my music: the usage of dramaturgic intention as a compositional method to which all other characteristics, such as, for example, compositional techniques and 'sound imprint', are subordinate.

Section II
Contextualisation and Description

In this section, each of the six pieces which constitute the main body of work for this PhD by prior output is described and contextualised. For a deeper technical analysis, compositional techniques and miscellaneous information about each piece are presented in the appendices.

II.i General Characteristics of the Output

Before entering in more depth into the matter, it is necessary to clarify the reasons for choosing precisely these six works.

Firstly, at the time of registration of this PhD (2005), it was required by the Graduate School of London Metropolitan University that each work prior output had to be produced within an academic environment and had to be, at that time, already in the public domain. By 2005, each of the pieces from this body of work was already in the public domain with at least one public performance, with some of the pieces additionally having been published on a commercially available CD. In addition to that, some of the pieces were the product of research projects developed within an academic environment, in particular *Gegensäzte (gegenseitig)* and *Color Code.* Even though some other, perhaps more recent works could have been selected at the time of registration, the necessity to comply with the University's regulations, which also required to present a coherent body of work, left me with no choice other than the inclusion of precisely these six works.

Secondly, the six pieces form a solid body of work, which shows my composition as a unified and coherent whole, in spite of the different styles included. This 'diversity within unity' was consciously sought for the output of the PhD, in order to cover my composition from several angles with the inclusion of interactive, acousmatic, instrumental and multimedia pieces. The coherent whole among them is given by a group of factors, which are led by the dramaturgic intention imprinted in the musical discourse of each piece. All other factors, which are explained in detail later in this section, underlie the dramatic intention and reception in each piece; they can be considered as the chosen means to obtain the principal goal. Hence, my views on music dramaturgy and its communication chain, as introduced in Garavaglia, 2008, are presented herewith in practice, in the form of six musical pieces. This fundamental position reveals that my main interest in music composition is of semiotic nature, where semantic[9] and essentially,

[9] 'The word "semantics" itself denotes a range of ideas, from the popular to the highly technical. It is often used in ordinary language to denote a problem of understanding that comes down to word selection or connotation.' Quoted from: http://en.wikipedia.org/wiki/Semantics. Accessed: 24.09.09.
Semantics is basically the relationship between signs and what they refer to.

pragmatic[10] values have priority over syntactic values.[11] To consider the dramaturgy of music from the perspective of its reception, it is necessary to understand what happens in the mind or personal universe of *each* listener. Through the process of music communication, listeners take the information (intended dramaturgy) and translate, assimilate and understand it in their own personal manner according to their current moods, cultural background, personal experiences, sensibility, age, and may be even the prosodic cues of their own languages.[12] This is linked to the pragmatic value of semiotics, which establishes the relationship between signs and their impact on those using them.[13] In this respect, Charles Peirce's thinking has a great influence in my philosophical approach to composition, in particular, Peirce's concept of the 'phaneron', which is explained below: [14]

> This world of experience, the 'phenomenal world' of the philosophers, is an internal projection of a possible external reality. However, the fact it is processed by internally generated factors leads one to the unavoidable conclusion that these may not be presenting an accurate or true representation of that external world. ... For the philosopher Charles Peirce, this subjective world of the senses was a real psychological location, an inner world that he calls the phaneron. ... So we all exist in our own phanerons. (Peake, p. 57)

This said, there are six main factors, all of which characterise my composition: the dramaturgic intention (materialised through the musical discourse) including the innumerable possibilities of

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[10] 'Studies how the transmission of meaning depends not only on the linguistic knowledge (for example, grammar, lexicon etc.) of the speaker and listener, but also on the context of the utterance, knowledge about the status of those involved, the inferred intent of the speaker, and so on.' Quoted from: http://en.wikipedia.org/wiki/Pragmatics. Accessed: 24.09.09.

Pragmatics is the relationship between signs and their impact on those using them.

[11] 'The study of the principles and rules for constructing sentences in natural languages. In addition to referring to the discipline, the term syntax is also used to refer directly to the rules and principles that govern the sentence structure of any individual language... '. Quoted from: http://en.wikipedia.org/wiki/Syntax. Accessed: 24.09.09.

Syntactics refers to the relationship between signs in formal structures.

[12] The prosodic cue (what linguistics call to different intonations in different languages in the way of asking, making remarks, etc.), and its relationship with music and pitch is a field of research itself, and therefore is not pursued here further. It needs to be mentioned though, as it may be one vital issue regarding how different people react to different musical discourses, due to the expectation that it may arise.

[13] See footnote 9.

[14] 'Phaneroscopy is the description of the *phaneron*; and by the *phaneron* I mean the collective total of all that is in any way or in any sense present to the mind, quite regardless of whether it corresponds to any real thing or not. If you ask present *when*, and to *whose* mind, I reply that I leave these questions unanswered, never having entertained a doubt that those features of the *phaneron* that I have found in my mind are present at all times and to all minds. So far as I have developed this science of *phaneroscopy*, it is occupied with the formal elements of the *phaneron*. (The Commens Dictionary of Peirce's Terms – Peirce's Terminology in His Own Words: http://www.helsinki.fi/science/commens/terms/phaneron.html) (Accessed: 25.12.2006)

its reception by an audience, is the most predominant; the other five are subordinate to it. A full explanation follows.

1) The Dramaturgy of Music and the Musical Discourse.

My connection to the dramaturgy of music and its impact on my composition combines research in the area[15] with my own research and practice, as can be observed in some of my publications.[16]

Previously, I mentioned that the dramaturgy of music, or most precisely, the narrative intention of the musical discourse and its perception by an audience, is at the foreground of my compositional activity. Nattiez's writings are arguably one of the main sources on musical discourse and musical semiotics; in my case, the way in which I concentrate on the musical discourse of my pieces is partially based on Nattiez's views:

> In contradistinction to human language, musical discourse does not strive to convey clear, logically articulated messages. For this reason, we may well ask whether one can speak of such things as "musical narrativity". ..... Musical discourse inscribes itself in time. It is comprised of repetitions, recollections, preparations, expectations, and resolutions, and in the realm of melodic syntax. (Nattiez, p. 127)

Applied specifically to music, the discourse should therefore be *the means of carrying the musical expression.* However, the expression intended in my music may or may not be understood by the listener as conceived, depending on each particular case; the extrinsic dramaturgy (as explained in Garavaglia, 2008) that emerges in this case is tied to the cultural environment and personal background of each particular listener .

> If the listener, in hearing music, experiences the suasions of what I would like to call the narrative impulse, this is because he or she hears (on the level of strictly musical discourse) recollections, expectations, and resolutions, but does not know what is expected, what resolved. The listener will be seized by a desire to complete, in words, what music does not say, because music is incapable of saying it. Such things are not in music's semiological nature. (Nattiez, p. 128)

Yet, the clearer the musical discourse, the better the reception that may be obtained from the original intention assigned to the music. This is paramount in my composition. How this materialises in each concrete case, is explained later, piece-by-piece, in section II.ii.

As also previously mentioned in the Introduction, I was highly influenced in the first half of the 1990s by Nono's work. My view, that a composition must have a clear intention in its musical discourse as much as in its title has been modelled on some of Nono's compositions with a clear dramaturgic intention, such as, for example *Il canto sospeso.* The article *Boulez, Nono und die Idee der Perfektion*, by Clytus Gootwald (Gootwald, pp. 140-142) may shed some light about this influence. In this article, Gootwald describes a discussion between Stockhausen and Nono with regard precisely to Nono's *Il canto sospeso.* Apparently, Stockhausen did not understand Nono's usage of text in this piece

[15] Such as the *Intention/Reception project* by Weale and Landy (Weale, 2006)

[16] See appendices VII, VIII, XVII and XVIII.

(the text, taken from letters of Italian prisoners condemned to death by the Nazi regime, is completely disintegrated by Nono in small particles -generally syllables or simple vocals- among the choir's several parts, making it very difficult to be understood).[17] Stockhausen justified Nono by interpreting this usage as a consequence (and an extension) of the serial treatment of the musical structures. Without entering into the matter of discussing Nono's answer to Stockhausen's views,[18] my interpretation is that, Nono's dramatic intention to convey the idea of destruction (which dominates the entire work) was achieved by manipulating the selected texts in that particular way, while the serial treatment was simply the means to materialise that purpose with music. In my composition, this closely resembles the usage of words in *Arte Poética (I)* and in works outside those presented herewith, such as, for example, *Laberinto [...palabras, poemas...]* from 1990/1). A more personal work by Nono, *A Carlo Scarpa, architetto, ai suoi infiniti possibili* for orchestra using microtonality (quarter, eight and sixteen subdivisions of a tone), has a considerable resemblance in its dramatic intention to my *Overture (in memoriam T.A.T.)*, even though the medium used is very different in each case (orchestral by Nono, acousmatic in my case). The dramaturgical factor is therefore always at the foreground of my compositional activity, conditioning all other factors.

2) Basic elements as point of departure for developing ideas and materials.

All of the pieces presented herewith originate from basic elements, a technique that I developed in full after my studies with Nicolaus A. Huber in the early 1990s. These basic elements can be, for example, a concept,[19] a sonic cell, a mathematical row, and so on. The rest of the compositional materials derive from these basic elements. This brings coherence to the entire structure of the work, and helps in my case to expose the specific dramatic intention of each piece.

Boulez's frequent technique of developing materials which, starting from a basic cell, chord or series of notes, are derived and transformed during the entire piece was of great influence in my composition. A good and complex example of this technique is his piece *...explosante, fixe...*, [20] which has seen since its conception in 1971 so far six different versions. Originally, the work began with the note E flat, which in German is the note 'S',

[17] 'Wozu dann überhaupt Text, und gerade diesen?, nur um ihn zu zerstören?' ['why then text, and specially this one, for it only to be destroyed'], taken by Gootwald from *Karheinz Stockhausen: Texte zu eigenen Werken und zur Kunst Anderen. Aktuelles Bd. 2, edited by Dieter Schnebel, Köln 1964, pages 157-166.*

[18] Nono's response was quite strange indeed, as he replied to Stockhausen by pointing both Nazism as a monster of irrationalism as much as the 'necessity of Christ's passion' as a motive, something that must have left Stockhausen speechless.

[19] In *Gegensätze (gegenseitig)*, the concepts of Thesis and Anthithesis -explained Appendix I and XV- govern the entire compositional process of the piece.

[20] The final version so far (1991-93) presents the following instrumentation: MIDI flute, two flutes, ensemble and live-electronics.

the first letter in the surname of Igor Stravinsky. Stravinsky had died shortly before Boulez began this piece, something that may have had a determining effect on the dramatic effect of the piece.[21] A cell of seven notes was the main and only material that Boulez used for the entire composition, attaching a prominent note to each section, starting with the E flat. The latest version (1991-93) inverted this, with the note E flat as the consequence of the formal-dramatic journey. *L.S. (waiting for changes)* was composed following a similar schema.

Nono's *A Carlo Scarpa, architetto, ai suoi infiniti possibili* for orchestra using microtonality is another work, which had a decisive impact on this aspect of my composition. The work is based solely on two notes (C and 'S', which is B flat in German, which are the initials of Carlo Scarpa) and the microtonal gradations of quarter, eight and sixteen subdivisions of a tone, forming clusters of microtones, had technically a substantial influence on the conception of *Spectral colours*, albeit with different means and intention. The approach of deriving the main material from a primordial cell or idea is perhaps more evident in *Gegensätze (gegenseitig)*, in which all micro-and-macro structures are derived from the concept of opposition while the pitches derive from an original chromatic scale beginning in the note G. The way of transferring the main structural parameters from primordial cells is also profusely used (albeit in different and varied ways) in *Arte Poética (I)* and in *Overture (in memoriam T.A.T.)*.

3) Sound imprint

The usage of complex timbral combinations through the juxtaposition of rather long layers of sound, which do not possess a clear or apparent rhythmic structure, is a rather constant sonic characteristic in my pieces. The layers normally result in rather complex harmonic textures. External influences for this characteristic in my composition are rather varied and include works by Ligeti (mostly his concept of micropolyphony in works such as *Atmospheres* [1961] and *Lontano* [1967]), Berio (for example, his *Sinfonia* [1968]) and Ludger Brümmer (in acousmatic pieces such as *The gates of H.* [1994], *la cloche sans vallées* [1996] and *Phrenos* [1998]).

In my electroacoustic music, sound-layers are produced using Digital Signal Processes (DSP). Some of the most common DSPs to be found in my composition are: time stretching, pitch-shifting, granular synthesis, AM and Chowning FM.

In my instrumental pieces, complex layers of sounds are mainly achieved by the usage of clusters or complex chords. This distinguishing mark is far more prominent than the usage of either melody or easily recognisable rhythms, which are definitely the less dominant attributes of my composition. The search for timbre (or 'colour') as a desired sonic result is more evident in my acousmatic works (or those which include a tape part in them), although the instrumental pieces rigorously undergo a similar treatment. Rhythm is used in many cases merely to accentuate the colouristic effect of the sound layers but seldom to

[21] One of its several versions, from 1985, was called *Mémoriale (...explosante-fixe....Originel)*).

give a rhythmical character (something evident in *Spectral colours*). This characteristic is directly linked to the intention of each piece, as the textures from which the musical discourse is made of are modelled on rhythmic structures, which contribute to create the intended mood. It is my view, that a great portion of the dramatic intention in my work relies on the type of sound imprint given to each piece, and the most frequent technique to achieve this is the usage of long, evolving sound layers, which result in complex harmonic textures.

In my composition, the usage of timbre can be associated with the concept of colour, which is suggested in *Spectral colours* and included in its visual dimension in *Color Code*. These two works combine electroacoustic elements with traditional instruments, where the colouristic domain flows freely between the particular instrumental combinations and the sound from the electronics. In the case of *Spectral colours*, the parameter *rhythm* is quasi dissolved into colour, as the rhythmical patterns and formal sections are repeated, changing their instrumentation, with an impact on both macro- and micro- structures. The tape part of *Spectral colours*, which is a strong transformation of the recording of original viola sounds played *sul ponticello*, presents different textures, which add colour and sustain the harmonic structure of the piece, which is entirely based on clusters. The tape part here is an extension of the realms of the harmonic clusters coming from the ensemble.

The remaining pieces are not dissimilar with regard to the usage of timbre as a predominant element, even though they differ quite considerably in how the timbrical attribute has been achieved: two of these pieces are acousmatic (*Arte Poética (I)* and *Overture [in memoriam T.A.T.]*), and the third is purely instrumental (*L.S. [waiting for changes]*). In *Arte Poética (I)*, timbre is used to suggest to the audience the ideas of 'water' or 'time', the main topics of the stanza of the homonymous poem. The sonic material is mainly the human voice (actually, *my* voice), but the different sonic transformations through different sound-synthesis procedures make the illusion of water sounds. Several layers of Chowning FM-based sounds were used in the last four minutes of the piece to describe musically the concept of time.

Overture (in memoriam T.A.T.) works with multiple transformations of previously recorded instrumental sounds (an orchestral chord, plus viola and clarinet sounds). The sample with the orchestral chord was transposed several times upwards and downwards using pitch shifting on a phase vocoder. Afterwards, the usage of those transpositions created new chords with new timbres, which are the main element used to set the intrinsic dramaturgy of the work. These different, juxtaposed layers of sounds were also treated with time stretching, which should suggest the idea of eternity intended.

L.S. (waiting for changes), the only purely instrumental work of this selection, is not different in its compositional approach to the others. The techniques utilised in the composition of the different structures are very similar to those utilised in the other pieces: rhythms serve the instrumentation and both -together with the usage of different registers

and tempi-, materialise themselves as different colours or timbres, signalising some of the changes outlined in the title. The general intention sonically is to obtain a quasi-electronic sound from the small orchestra.

4) Continuity of the musical discourse against separation; its impact on the form

As musical pieces are events (Garavaglia, 2008), which happen during the passing of time, their structure is of vital importance with regard to the relationship between their intention and how they are perceived. Following Delalande's concepts of taxonomic listening and further figurativization (Landy, 2007 p. 94), the form of each work must be conceived in such a way that it is able to transmit the intended dramatic contents during the passing of time. It is my conviction, that without a clear structure in the musical form, it is impossible to convey concordant results in the relationship intention/perception. Hence, none of the pieces herewith presented was composed as separated movements or sections; invariably, there is always a transition from one section to the other, which avoids breaks or pauses between them. The subject of continuity is directly linked to my main purpose in composition, which is to express a dramatic intention with music. Hence, continuity in the musical discourse is characteristic of not only these six pieces, but of most of my compositional production. The concept of interruption is contrary to my aesthetical aims to obtain a successful and satisfactory result in the musical narrative of my compositions. Without continuity in the musical discourse, it is not possible for me to exactly express my narrative intentions in music in the way I consider them to be more effective. Silence or breaks in my music must always have an expressive and dramatic meaning or implication, which, far from separating sections, unify them dramatically. This implies a particular conception of how to deal with the perception of time during the performance of the pieces. Consequently, the form of each piece, which is determined by the dramaturgic intentions in each case, is modelled likewise on the characteristic of continuity. However, none of the six works are based on predetermined forms: their forms emerge and evolve from the dramaturgic necessities and intentions particular to each of them, and are dictated strictly by the intrinsic dramaturgic purposes and not by external factors. Herewith, my approach is very close to the concept of form introduced by Debussy in *Jeux* (1913), which influenced many composers in the 1950s, such as Boulez, Eimert, Ligeti and Stockhausen. The formal structure in *Jeux* is described by Pasler (Pasler, p. 74) as a 'process form' because Debussy considered time and form as a 'constant metamorphosis'. Pasler also highlights the fact that this concept is close to the philosophy of Bergson, who was contemporary to Debussy, therefore suggesting that such a formal conception might not have been possible without Bergson's thought (and vice-versa):

> The idea of time as a function of invention rather than as quantitative length led both Debussy and Bergson to focus on qualitative in- stead of quantitative change. In the same year (1907) that Debussy wrote to Durand defining musical form in terms of two qualities,

timbre and rhythm, Bergson published Creative Evolution, exploring the nature of qualitative change. (Pasler, p. 74)

In 1907, Debussy wrote the following observation to his publisher Durand: 'Music is not, in its essence, a thing which can flow within a rigorous and traditional form. It is *de couleurs et de temps rythmé*' (Pasler, p. 72).[22] Stockhausen called this type of structure 'moment form'.[23] The concept of 'moment-form' is, to mention just one example, extremely close to the form of *L.S. (waiting for changes)*. Similarly to *Jeux,* it has several sections with different metric changes and very frequent changes of metronome indications. However, as in my other pieces, the sections are not presented in separated movements, but rather in a single, continuous structure.

Apart from Bergson, the philosophy by Heracleitus is paramount to my formal conception of musical structures, in particular, his view about the *persistence of unity,*[24] which can be associated to the 'continuity aspect' attributed to my composition. In a more particular way, it also exerts its influence on the entire conception of two pieces presented with this PhD, *Gegensätze (gegenseitig)* and *Arte Poética (I)*, what is explained in sections II.ii.a and II.ii.b respectively.

5) Usage of words for compositional purposes:

The recurrent usage of words for compositional purposes is present in my composition, and in particular, in some (but not all) of the works herewith presented. In very different ways, words serve to develop the main materials for three of the compositions: *Arte Poética (I)*, *L.S. (waiting for changes)* and *Overture (in memoriam T.A.T.)*. The acousmatic piece *Arte Poética (I)* works directly with the recorded sound of the words included in the stanza. The structure of the composition is based on relationships extracted from the inner structure of the stanza and from the words contain in it: for example, the syllable components of the words serve to derive further structural parameters for the entire piece (this process is explained in Appendix I in full detail). The understanding of the dramatic plot here depends mainly on the explicit usage of words and the direct imitation in sound of the content of the four verses of the first stanza of the poem. Therefore, words are the

[22] 'La musique n'est pas par son essence une chose qui puisse se couler dans une forme rigoureuse et traditionelle. Elle est de coulerus et de temps rythmés.' (Pasler, p. 72, footnote 28)

[23] 'Moment forms, as Stockhausen defines them in "Momentform" *Texte zur elektronischen und instrumentalen Musik* (Cologne, 1963), render every moment, "something individual, independent, and centered in itself, capable of existing on its own," rather than the consequence or cause of any surrounding moments.' (Pasler, p. 68, footnote 18)

[24] 'The resulting dynamic equilibrium maintains an orderly balance in the world. This persistence of unity despite change is illustrated by Heracleitus' famous analogy of life to a river: "Upon those who step into the same rivers different and ever different waters flow down." Plato later took this doctrine to mean that all things are in constant flux, regardless of how they appear to the senses.' Encyclopaedia Britannica Library - 2004: 'Heracleitus'.

main factor to hold on to in *Arte Poética (I)* as they condition the emergent results of the work's intrinsic dramaturgy. Even if the listener was to ignore the poetic connotation, the intention to imitate sonically the main elements referred to in the text, such as 'water' and 'river', would still be evident and crucial to the piece's understanding. These elements should give listeners a clear idea of the dramatic contents of the piece.

Words are differently used for compositional and dramaturgical means in *L.S. (waiting for changes)*: rhythms and pitches are derived from the inner structure of some words (explained in full in Appendix VI), although the words themselves and their meaning are not present as such in the work. A similar case occurs in *Overture (in memoriam T.A.T.)*, in which the letters and syllables derived from the full name of the person alluded in the title, along with numeric relationships derived from his birthday, serve to organise the compositional parameters in this and its sister piece, *T.A.T. (a man's life)* (see Appendix IV).

6) Title of the compositions

I attach the highest importance to the title of a composition. The title of a musical composition can be generally considered as one of the main *Something to Hold on to Factors,* as referred to by Landy (Weale, p.189 and p. 192 and Landy, p.ix, 3, 26-35). However, depending on how the title of a piece is formulated, it can guide, but also mislead listeners (deliberately or otherwise), in regard to the type of understanding (that is, the type of dramaturgy) that is expected from the dramaturgic intention of a piece. The titles of the six pieces herewith presented have the clear intention of clarifying the narrative of the musical discourse in each case. Besides, there is a clear tendency towards having a main and a secondary title (the latter between parenthesis). In some cases, the second part can be explicatory (clarifying for example a predefined dramaturgy as in the case of *Overture [in memoriam T.A.T.]*); in other cases, it is used as a complement, as in *Gegensätze (gegenseitig)*.[25] The only two exceptions are the pieces *Color Code* and *Spectral colours*: the first is the given title for a commissioned research project; the second is derived (an exception amongst my works) from the compositional techniques used in it. However, and observing my entire production, titles in two parts clearly outbalance single ones. This is a particularity to be found in my composition, which is quite original in the field due to its almost constant usage. In all titles, the goal is to shed light on the dramatic contents intended in the pieces.

From all the above, it can be gathered, that what must be considered my main source of inspiration and my starting point to any compositional work is its dramaturgic intention and that all other characteristics serve to that purpose. The next section gives a description of each work.

[25] Which means in English *Opposites (reciprocally)*

II.ii General Description of Each Work

The rest of this section considers, in chronological order, all six compositions in particular, presenting a short description without further technical aspects. This division acknowledges the premise that this dissertation is not chiefly about the compositional techniques of the pieces, but about the common ground among them; primarily, music dramaturgy. However, the compositional techniques are fully explained in Appendices I to VI, as they may further clarify certain aspects of the pieces, their contextualisation as a 'coherent whole' and their relationship with the dramaturgy intended.

The following subsections present a description of each work. The intended dramaturgy is classified for each piece according to the typification given in Garavaglia, 2008.

II.ii.a *Gegensätze (gegenseitig)* - 1994

Instrumentation: alto flute, quadrophonic tape and quadrophonic live-electronics
Genre: electroacoustic (instrumental / tape / real-time DSP interaction)
Duration: ca. 33 Minutes

Gegensätze (gegenseitig) was the first interactive composition using the *AUDIACSystem*, a system developed at *ICEM* (*Institut für Computermusik und Elektronische Medien*), *Folkwang Hochschule Essen* (Germany). The *AUDIACSystem* was a long-term, collaborative research project, which took place from 1988 to ca. 1995 between *ICEM* and the company *Micro-control*. Lecturers Markus Lepper and Thomas Neuhaus (both from *ICEM*) were the main responsible for the software development -the programming language *APOS*- especially written for this system. The *AUDIACSystem*, was financed by the *Ministerium für Wissenschaft und Forschung des Landes Nordrhein-Westfalen* and the *Bundesministerium für Forschung und Technologie* in Germany. The aim of the project was to build specific hardware and to program suitable software for the purpose of composing and performing interactive music in real-time. Full details about the *AUDIACSystem* can be found in a paper I wrote in 1995.[26]

In 1994, when the system's development was fully advanced and running in a rather stable manner, I was invited to compose what became the first purely interactive musical composition using the system. Even though the idea, development and composition of all

[26] 'The necessity of composing with live-electronics. A short account of the piece '*Gegensaetze (gegenseitig)*' and of the hardware (*AUDIACSystem*) used to produce real-time processes on it'. Proceedings Book: 2nd Brazilian Symposium on Computer Music (SCBII). Canela - August 1995. The paper is presented in Appendix XV in an altered and improved form, which was read at the 5th Annual Florida Electroacoustic Music Festival (University of Florida, USA) in March 1996 (unpublished).

of the DSP functions were my own, they were programmed in APOS (the programming language specially designed for the *AUDIACSystem*) by Markus Lepper.[27]

Gegensätze (gegenseitig) is based on the concept of opposites, intending to musically describe, from micro- to macro- structural levels, a wider conception of the main idea, in which elements do not only stand opposed to each other (as contraries), but also reciprocally interact, producing new musical elements from this interaction. This idea is very close to the Chinese concept of Yin and Yang,[28] as, in both cases, a new 'totality' can only be achieved by the reciprocal interaction of two elements. Thus, the intention is that the concept of 'opposites' should not merely stand for opposition (negatively), but also imply, in a positive sense, that opposite elements can complement each other, and, that as a result, something positively new can emerge.

The place of this piece in my composition is vital, as this was the first time I worked on an interactive piece using DSP functions in real-time. It can be clearly seen that the path initiated in this piece (which was rather free from external influences, as in 1994 I had not yet been introduced to major works in the field), was the one I was to follow in most of my interactive pieces since then. Pieces following the mentioned path are, for example: *NINTH (music for Viola and Computer), Ableitungen des Konzepts der Wiederholung (for Ala), Hoquetus, Intersections (memories)* and *farb-laut E – VIOLET* (see appendices XVII and XIX for further details).

The inner dramaturgy implied in the piece is open to be interpreted from several points of view and, therefore, needs to be classified under the *a posteriori* subtype, as explained in Garavaglia, 2008. The main intention is to make apparent the concept of *Thesis-Antithesis* (similar to the concept by Heracleitus, in which opposite elements

[27] By 1997, due to the development of computing techniques in the market (such as the first Apple G3 computers equipped with MAX/MSP), the project had to be abandoned. Already in 1996 I decided to record all of the DSP functions of the piece and include them in the tape part, and at the same time, I composed more music for the flute part and programmed different live-electronics, all of which resulted in a rather different piece, which however respected the same basic conception and intention. This composition is called *Contraries (resonances)*.

[28] Pinyin Yinyang, Japanese *In-yō*, in Eastern thought, the two complementary forces, or principles, that make up all aspects and phenomena of life. Yin is conceived of as earth, female, dark, passive, and absorbing; it is present in even numbers, in valleys and streams, and is represented by the tiger, the colour orange, and a broken line. Yang is conceived of as heaven, male, light, active, and penetrating; it is present in odd numbers, in mountains, and is represented by the dragon, the colour azure, and an unbroken line. The two are both said to proceed from the Supreme Ultimate (T'ai Chi), their interplay on one another (as one increases the other decreases) being a description of the actual process of the universe and all that is in it. In harmony, the two are depicted as the light and dark halves of a circle. (Encyclopaedia Britannica Library 2004: Yin-Yang).

define each other, as part of the logos)[29] and to transfer this idea to a human, social and political context. Even though the basic principle of opposites may become apparent -by listening to the piece- at many levels, there is no preconception about what the piece's dramatic intention should be, as there are no programmatic elements involved in this composition. The title of the piece does not suggest any either. However, at the time the piece was composed, neo-Nazi ideas were spreading out -in Germany and elsewhere-, and violent intolerance was unfortunately the most common outcome. Hence, the concept of reciprocal action of opposite elements producing a new, positive result can be considered (and hopefully, also perceived) as standing against intolerance, racism and discrimination. However, neither has my piece a secret programme nor is it a political work (in the sense several pieces by Nono indeed are). In spite of this fact, the work may be related to the subjects previously mentioned by understanding its main intention (for which the title should be an important factor to hold on to).

The continuous form of the piece is not preconceived: it derives from the compositional methods. Thus, given the open nature of the proposed intention, the story emerging in each listener's mind (the extrinsic dramaturgy) shall be that of variable and multiple interpretations, all related in some way to the concepts of *Thesis* and *Antithesis,* to their synergy and to their interaction.

II.ii.b *Arte Poética (I)* - 1995

Instrumentation: quadrophonic tape.
Genre: electroacoustic: acousmatic
Duration: 8:09

At the beginning of the 1990s, I became increasingly interested in the writings by the Argentinean writer Jorge Luis Borges, in particular, in his poetry. During this time, I composed the instrumental pieces *Laberinto (..'palabras, poemas'..)* (1990/1)[30] and *Poème du temps qui ne passe pas (..'del otro lado del muro'..)*, a chamber opera

[29] 'A significant manifestation of the logos, Heracleitus claimed, is the underlying connection between opposites. For example, health and disease define each other. Good and evil, hot and cold, and other opposites are similarly related. In addition, he noted that a single substance may be perceived in varied ways—seawater is both harmful (for men) and beneficial (for fishes). His understanding of the relation of opposites to each other enabled him to overcome the chaotic and divergent natureof the world, and he asserted that the world exists as a coherent system in which a change in one direction is ultimately balanced by a corresponding change in another. Between all things there is a hidden connection, so that those that are apparently "tending apart" are actually "being brought together." '. Encyclopaedia Britannica Library - 2004: 'Heracleitus'.

[30] The instrumentation is as follows: four singers and chamber ensemble, based on poems by Jorge Luis Borges, Marcelo Gasparini and Alejandra Pizarnik (all born in Argentina).

(1993/4),[31] which were based on some of his poems. What fascinated me the most about his work was his non-Christian philosophical approach to the subject 'life and beyond', where (whether in his poems or short stories) the recurrent theme is the fine line between dream, death and life: sometimes life seems to be dreamed and dreams seem to be lived. To clarify this concept, it is worth quoting the following passage:

> In 1938, the year his father died, Borges suffered a severe head wound and subsequent blood poisoning, which left him near death, bereft of speech, and fearing for his sanity. This experience appears to have freed in him the deepest forces of creation. In the next eight years he produced his best fantastic stories, those later collected in the series of *Ficciones* ('Fictions') and the volume of English translations entitled The Aleph and Other Stories, 1933–69. During this time, he and another writer, Adolfo Bioy Casares, jointly wrote detective stories under the pseudonym H. Bustos Domecq (combining ancestral names of the two writers' families), which were published in 1942 as *Seis problemas para Don Isidro Parodi* (Six Problems for Don Isidro Parodi). The works of this period revealed for the first time Borges's entire dreamworld, an ironical or paradoxical version of the real one, with its own language and systems of symbols.[32]

These 'systems of symbols' is what attracted me the most. They describe in general an a-temporal or timeless dimension, which in many cases is represented by images such as the moon, mirrors or antique Greek philosophers and myths, just to mention the most common.

During the fall of 1994, I dedicated my full attention to his poem '*Arte Poética*'. This poem is written in seven stanzas of four verses, each containing eleven syllables. The main factor, which triggered my interest to compose one piece (or several) based on the poem[33] was the way Borges combines here most of his aesthetical and philosophical ideas in such a concise and clear manner.[34] The following passage by Donna Seaman refers explicitly to this poem, including a translation of the third stanza:

> Poetry is the heart of Borges' metaphysical, mythical, and cosmopolitan oeuvre, and this bilingual collection of nearly 200 poems aptly forms the centerpiece of a triptych of new volumes that began with Borges' fiction and will conclude with nonfiction. Borges' first published works were poems, and it was poetry he returned to in his later years once his eyesight began to fail.

[31] Chamber opera for soprano, bass-baritone, piano, flute, cello and percussion, based on poems by Jorge Luis Borges, Alejandra Pizarnik and Louis Aragón.

[32] Encyclopaedia Britannica Library - 2004: Borges, Jorge Luis

[33] Actually, the original plan was to compose a cycle of pieces for acousmatic music, each piece for each of the 7 stanzas, with instrumental intermezzi between each of them. Even though all seven acousmatic pieces were composed within 1994-1996, the instrumental part was never incorporated. However, two further electroacoustic pieces (quadrophonic) were composed and produced to complete the cycle: *Arte Poética (II Stanza)* (1995) sonifying only the second stanza, and *Arte Poética (Stanzas III to VII)* (1996), including the remaining four stanzas of the poem. Both used the pieces formerly composed for each stanza, as previously stated.

[34] A free translation of the entire poem can be found in Appendix II, together with the original in Spanish.

> Borges acknowledged the persistence and significance of poetry in his 1960 poem 'Ars Poetica': 'To see in death sleep, and in the sunset/a sad gold--such is poetry, / Which is immortal and poor. Poetry / Returns like the dawn and the sunset.' Over the decades, Borges pondered time, conjured the many moods of his beloved Buenos Aires, and wrote of tigers, rivers, mirrors, and the moon, often in response to the musings of great poets and novelists of the past. (Donna Seaman, 1999)[35]

It must be observed, that the original title of the poem in Spanish is 'Arte Poética' and not 'Ars Poetica', as Seaman quotes in her article, which would be its translation into Latin. As Spanish is my native language, my natural choice of words differs from Seaman's in my free translation of the entire poem into English in Appendix II: for example, the most significant case would be 'dream' instead of 'sleep', as it reflects better not only the meaning of the word but also the original intention[36].

Arte poética (I) is an acousmatic, quadrophonic piece based on the first stanza of the poem. In this stanza, Borges works with the following idea by Heracleitus: '*Upon those who step into the same rivers different and ever different waters flow down.*'[37] This becomes apparent by the usage of the words *agua* (water) and *río* (river) combined with *tiempo* (time) in the stanza. After the stanza was recorded using my voice, those words were extracted from the recording and set to be repeated in different channels (speakers) throughout the entire duration of the work. By further treating the complete recording of the stanza with different types of sound synthesis, the main intention was to create the sensation of water flowing like a river in different directions in the concert space (hence, further exploiting the possibilities of the quadrophonic setting). Other sound synthesis procedures (mainly complex Chowning FM) allowed for the creation of sounds representing the idea of time in the second half of the work. In order to sonically and spatially portrait the types of timbres and sounds that the poem suggests (those, for example, representing rivers, water or time), the usage of electroacoustic media was paramount.

In the next few years after completing *Arte poética (I)*, I composed two more pieces, which included the rest of the poem. In 1995 the piece *Arte Poética (II. Stanza)* included the second stanza; the last piece *Arte Poética (Stanzas III to VII)*, was composed in 1996 and included the rest of the poem. The dramaturgic intention in both remains the same

[35] http://www.themodernword.com/Borges/borges_works3.html

[36] It is clear, that 'to sleep' means an action, which may or may not imply the action of dreaming. Borges uses the Spanish words 'soñar' and 'sueño', which are clearly the equivalents to 'to dream' and 'dream' respectively. There is a double purpose in this: on the one hand, he constantly uses an alliteration with the letter and sound 's'; on the other hand, and comparing his position to other of his poems, the entire conception is oneiric, which is connected to the action of dreaming and not to mere sleeping.

[37] Encyclopaedia Britannica Library - 2004: Heracleitus

as previously explained. Therefore, these three acousmatic pieces can be performed independently -each of them has its own particular dramaturgic content- or as a cycle, with the dramatic intention of the entire poem. The piece clearly has a given subject in the poem itself and therefore its main dramatic line has been already established before any performance. Hence, the listener is faced with an *a priori* type of intrinsic dramaturgy. The piece is mainly programmatic, following closely the verses and words of the stanza.

With regard to the usage of words as a general characteristic of my composition, in this piece the explicit usage of words in Spanish are the factors to hold on to the main themes of this stanza. The composition imitates sonically -using diverse DSP techniques- the elements presented in the poem. On the one hand, water is imitated by the usage of sounds derived from the human voice; by using a quadrophonic spatialisation of those sounds, 'rivers of sound' are virtually created, crossing the concert hall through all loudspeakers. On the other hand, the concept of *time* is represented mainly by synthetic sounds obtained by several mixed combinations of Chowning FM.[38] During the entire piece, the main words *mirar, tiempo, río* and *agua* (look, time, river and water) are spatially localised in a particular loudspeaker and are repeated throughout the piece with a dynamically programmed reverb-time increase (which supports the dramatic image of submersion in water).

Even though listeners still have enough room for their own interpretation, the basic dramatic narrative set by the poem and followed by the music does not leave them many ways of understanding the dramatic core of this music other than in the manner intended. For most performances (or recordings on commercial CD) programme notes with at least the stanza printed (and eventually, a translation) can be supplied, where the meaning of this music can be mostly followed, instead of being merely interpreted. However, as the entire text of the stanza is not sonically present in the piece (only the words mentioned above), there is still a rather significant space for free interpretation and hence, the emergent dramaturgy may differ from the intended *a priori* subtype of intrinsic dramaturgy.

[38] The main idea behind using Chowning FM here is that the resulting sounds do not directly relate sonically to anything obviously material in nature.

II.ii.c *Spectral colours* – 1996/97

Instrumentation: Ensemble and tape

Genre: Instrumental with electroacoustic elements

Duration: ca. 12 Minutes

The conception and origin of *Spectral colours* can be traced in my very first electroacoustic music project (*Räume* for stereo tape, 1992), where the recording of three notes played *sul ponticello* on a viola were transposed downwards and subsequently time-stretched utilising analogue techniques. Because these sounds were recorded very close to the bridge, their timbre was rather complex and rich in harmonics, something particularly perceptible in the lower transpositions. In 1996, I revised and digitised this piece, enhancing it from the technical point of view and planned to add instruments to it. This idea eventually became *Spectral colours*, which can be described as a spectral-cluster piece, in which clusters are built from an additive system, with the colour of the individual notes changing permanently, within a symmetrical structure. The clusters build up from a single note, upwards and downwards, where each note changes its instrumentation (its colour or timbre) every time a new note is added to the field. As the piece was finished, in early 1997, it was my first piece for ensemble since my chamber opera *Poème du temps qui ne passe pas (..'del otro lado del muro'..)*. The main reason for that was that between 1994 and 1997, I was fully committed to composing whether acousmatic pieces (such as the cycle *Arte Poética*), or interactive pieces, such as *Gegensätze (gegenseitig)* and its second version, *Contraries (resonances)*, apart from the two pieces dedicated to Tomás Tichauer, one of which, *Overture (in memoriam T.A.T.)* is presented with this PhD.

Spectral colours is one of the two pieces herewith, which has no second part in its title. The title is quite self-explanatory, but only with regard to the kind of sonic result the listener can expect to hear. There is a concealed preconceived programme displayed in the formal structure of the work, which is the result of mathematical derivations of the harmonic relationships taken from the three main pitches selected for the composition (see Appendix III for full technical details). The hidden intention of this palindromic structure, however, is based on rather autobiographic motives, which relate to a long period of serious illness that put my life at risk. The trajectory of the form, which, initiated from a single point (the note D) develops to a climax towards the middle of the piece, is a musical analogy, representing the point of being healthy, to a climax (being seriously sick), and a return to a healthy life. The coda, explained below in more detail, serves as an anticlimax and partially destroys the symmetrical arch form, taking it to another level of perception. The piece was composed immediately after the period of sickness previously mentioned. This story, however, which I do not reveal in any programme note, is meant to remain concealed. The intention of the piece is to describe a journey, which

grows from a point of unity (unity in the note D) to a point of maximum tension and back to the original unity. The story is only a source of inspiration. The ensemble part and the tape mirror each other in the manner they develop, even though they start from different registers (the tape part begins with low frequencies while the ensemble starts in the middle register). The dramatic journey intended is realised by the usage of complex music layers, which create a constant change of timbre for the entire duration of the piece. The main two layers are the ensemble and the tape. However, each of them is made of fine layers of sound, which in both cases consist of clusters derived from the basic three notes (see Appendix III for full details). Further, the two main layers share the same dramatic effect of returning to the point where they started. Hence, the entire piece is composed as a palindrome in two main parallel layers: the ensemble on one hand, and the tape on the other. For the ensemble part, the first note is also the last note, before the *coda* begins. This palindrome form (similar to the third movement of Berg's *Lyrische Suite,* which is an exact mirror of itself from its half), is quite effective in the evocation of images or situations that repeat themselves, such as cycles, mirrors, and so on. Recursiveness is at the core of the formal aspect of the piece, as much as it is in the repetition of other compositional parameters such as, for example, fixed patterns in pitch and rhythm, which change their timbre through varied instrumentation (the *colours* meant in the title).

Dramaturgically, the coda requires special attention, as, due to the contrasting sonic elements involved (compared to the rest of the piece), it takes perception to a different direction. Even though composed with different layers of sounds derived from the basic cells, the sound imprint of the coda is in a noticeable contrast with the rest of the piece. It makes abundant usage of sounds either of high pitch or indeterminate pitch, such as noisy effects in the strings; added to that is the absence of both tape and instrumental clusters listened to up to that point. The listener is guided in the coda by the idea of ascension (mostly given by the plucked strings on the piano), which is kept until the end of the piece. Even though the intention of ascension is here rather clear, how it may be finally understood is dependent on the personal universe of each listener. The function of a contrasting coda in this work is mainly to supply an element of surprise. The structure of the piece is quite rigid, following a system of numeric derivations (Appendix III) for most musical parameters. Therefore, my intention was to break that rigidity (which can turn at some point rather predictable) towards the end of the composition. In a closer view, the musical elements included in it are still strongly related to those previously heard. However, in the manner they were composed, they may appear as new and rather foreign to the listener. Even if the idea of recursiveness and related reactions to it can be considered as the main ingredients of the dramaturgic intention, such an intention will be perceived inevitably in several, different ways. Hence, the intrinsic dramaturgy of this composition corresponds to the *a posteriori* type, as I propose in Garavaglia, 2008,

because clues to the original intention can only be found in the music parameters (form, rhythm, pitch) and/or in the title of the work.

II.ii.d *Overture (in memoriam T.A.T.)* - 1997

Instrumentation: Quadrophonic tape
Genre: electroacoustic: acousmatic
Duration: 10:39

This work is closely related to its twenty-five minutes-long sister piece: *T.A.T. (a man's life)*, for viola, bass clarinet, quadrophonic tape and live-electronics. *Overture* is the second of the two pieces. Despite their difference in length and instrumentation, both works share most of the compositional techniques and many of the sounds in their tape parts. They also share the common (albeit not identical) dramatic intention, which pays homage to the memory of my viola professor Tomás Alejandro Tichauer, who died in December 1994 of a heart attack. I studied with Tichauer in Buenos Aires for a period of almost ten years and, along those years, he became a very fond friend of mine. This said, it is almost unnecessary to remark on the utmost personal circumstances in which both works were conceived.

Even though there is no storyboard, text or poem as source of inspiration, the title of the *Overture* is clear enough to show that the work pays tribute to somebody who has died and thus, predisposes the audience for that particular understanding. On the one hand, *T.A.T. (a man's life)*, recreates sonically -with the aid of two instruments and electronics- the different periods of his life.[39]On the other hand, *Overture (in memoriam T.A.T.)*, which is acousmatic and shorter in length, renders a tribute to him and his life from the perspective of my own emotions, with a similar formal structure. Nevertheless, both compositions stand as separate entities on their own right and are not required to be played together.

The main dramatic intention of the piece is achieved by the usage of basic materials, mainly, a sample of an orchestral chord in C major,[41] digitally treated in a variety of ways (time-stretching and pitch-shifting), which dominates most of the work. Timbrically, the chord is presented in several layers, which form rather complex harmonic results. The

[39] *T.A.T. (a man's life)* is divided in six, continuous parts:

1- 'From nothing to life', that is, the conception of a life (both instruments and tape).
2- 'Birth' takes place at minute 5:00:000 (solo tape).
3- 'Begin of a life', which runs from minute 5:42:000 up to minute 9:00:000. (solo tape).
4- 'Maturity' up to minute 14:00:000 (both instruments and tape)
5- 'Age of loss ' (solo tape)
6- 'Death and beyond' from minute 17:40:000 up to the end. (both instruments and tape, later solo tape)

[41] The chord was taken from the beginning of the overture of the opera *Die Meistersinger von Nürnberg* by Wagner.

latter are produced by pitch-shifting the chord up-and-downwards, following algorithms based on numeric rows, which derive from Tichauer's date of birth and from his complete name. Therefore, the usage of words is an essential component of the basic elements, from which the piece is composed. The rest of the electroacoustic materials (viola and clarinet samples) were also organised in layers and according to algorithms based on those numeric rows. Despite the fact, that it is very unlikely that the audience may be fully aware of the hidden mathematical and personal connotations previously mentioned, the music is rather clear in its development, with a dark beginning (given by low transpositions of the main sample), followed by several sections of high harmonic density, leading to a finale of exaltation. This finale is basically another transformation of the main orchestral sample, which, stretched in time, dissolves gradually into nothing via a fade-out in the last forty seconds of the piece, a dramaturgic symbol that represents the idea of death and nothingness.

With regard to the general dramaturgical aspect of this piece, and in spite of the different instrumentation and of the narrative intention, it is nonetheless very similar to the facts described for *Spectral colours*, as the basic dramatic line set by the music and mainly, by the title, should not allow for a radical change in the interpretation of the dramatic intentions (in this case, tribute and mourning).

II.ii.e *Color Code* - 1998

Instrumentation: quadrophonic tape, viola, live-electronics, video
Genre: multimedia / interactive / interdisciplinary
Duration: ca. 30 Minutes

Of all of the works presented herewith, this is the only piece in which I was not totally in charge of the entire project. The nature of the piece was rather complex and originated mainly in an initiative by the leaders of 'Gruppe Animato', Professor Gottfried Jäger and Prof. Karl Martin Holzhäuser (*Fachhochschule Bielefeld, Fachbereich Design*[42]) along with some members at the *Universität Bielefeld*, in Germany. The group was a member of a bigger society, *Multimedia und Kunst* -founded in 1997 under the direction of Prof. Dirk Reith, at the Folkwang Hochschule Essen- as part of an innovation programme for the development of digital art in the German state of Nordrhein-Westfalen. The project *Color Code* was approved with a total amount of 120,000 German marks (equivalent to approx. 60,000 Euros) in early 1998. The main idea was to create an interdisciplinary project based on the text *Postmoderne Farben*[43] written in 1988 by the media philosopher Vilém Flusser (1920-1991) using sound and image in digital form. Flusser's vision was rather modern in its own time, and the advance of technologies by 1998 made

[42] University of Applied Sciences – Center for Advanced Photography and Media Studies.

[43] German for 'Postmodern colours'.

possible the attempt to materialise this thought in a multimedia event. I joined the *'Gruppe Animato'* in the spring of 1998 to provide for the entire sound production of the project.

The core of the project relies on Flusser's concept of confrontation of 'codes'. He explained that mathematical codes are made of symbols, which mean 'quantities'. In his view, there are other codes however, and their symbols could mean 'qualities'. Below, a defining quote from his article *Postmoderne Farben,* dedicated to Prof. Jäger:

> 'The task is to create codes, which are clear and precise as the ones used by mathematics, but which can not only quantify but also qualify. With this purpose, colours can be used: applied as symbols, they mean qualities, but they are quantifiable. This has already begun: see as an example the colours in the traffic-code, or the etiquettes of specific products. But the issue goes further.' (Flusser, 1988).[44]

A relevant aspect of the project is that, in spite of the traditional working mode of firstly creating the image and afterwards developing the sound (in order to underline the moving image), in this case, the music composition (in particular the tape part, with its three sections) was composed before any animation or image was planned. Consequently, the resulting dramaturgy was set by the music, with the moving image (in this case, pure colour) following it frame by frame. This has a big impact in how the work can be received by the audience. In spite of this, as *Color Code* is an interdisciplinary project, the way of interpreting its dramaturgy cannot involve only listening to the music, but it requires to be appraised as a whole. In the form of an audiovisual concert-installation, *Color Code* presents the idea of colour visually and sonically, by the usage of electroacoustic music (tape and viola with real-time, computer generated live-electronics). By bringing together decisions originated in 'pure' rational thought and combining them with free artistic imagination, the result is a mixture of graphic art, music, space and geometry, open to several interpretations.

Color Code exists in several versions:

(a) **Concert-Installation**: (Duration: 30 Minutes). This version is for three tape sections with moving image (which are called *Akt I, II* and *III*) and two *intermezzi* between each *Akt*, which are played by the viola with live-electronics (MAX/MSP),

[44] Free translation from the original German: 'Also lautet die Aufgabe, Codes herzustellen, welche ebenso klar und deutlich sind wie die mathematischen, aber welche nicht nur quantifizieren, sondern auch qualifizieren. Mit dieser Absicht kann man Farben verwenden: als Symbole angewandt, bedeuten sie Qualitäten, sind aber quantifizierbar. Damit hat man auch bereits begonnen: siehe zum Beispiel die Farben im Verkehrscode oder auf Etiketten spezifischer Waren. Aber die Sache geht weiter.'

with almost no image included[45]. In this version, the image is sent to two big screens, one opposed to the other, in a big hall, with the audience allowed to walk around and between the screens, or even to sit between them on big cushions. The viola player is set aside of the scene, in order to avoid any interference with the images. This was the version of the world premiere, and the one presented for this PhD on the attached DVD.

(b) **Concert Version A:** similar to the former one. The only difference relies on both projections sent to one single screen, with the live performer also on the stage.

(c) **Concert Version B:** similar to the former one. After *Akt III*, there is a *coda*, similar in nature to the *intermezzi*, for viola and live-electronics. This is the longest version of the piece, exceeding the former ones by circa two minutes.

(d) **Concert Version C:** the shortest of all, it eliminates both *intermezzi* and leaves only the three quadrophonic tape parts (*Akt I, II & III*) and the images on one screen (duration ca. 20 Minutes).

(e) **Installation Version:** identical as the former one, but can be adapted to any room situation with multiple screens, if possible.

These versions share the three 'acts', which integrate quadrophonic tape and moving image. In them, the 'codification' of colour is achieved by exclusively using synthetic sound on the tape part, which matches the slow introduction of different colours throughout the entire length of the project. For example: the feeling of coldness implied by the colour 'blue' in the introduction of *Akt I* is matched (or coded, as is the intention of the piece) with simple additive sound synthesis procedures and filters. Similarly, in *Akt II*, when the colour green is introduced, sounds get analogously richer in their spectral components, something that evolves fully in *Akt III,* in which all colours in many gradations appear, and at the same time, the richness in spectral content of the sounds involved reaches its peak. Colour is treated as an entity, and therefore appears throughout without any determined form, to stress its ontological attributes of being colour and nothing else. Thus, timbre is sonically the most important characteristic of this piece: sounds are gradually organised in layers of diverse harmonic complexity, with the intention of matching the visual part, for example, as was previously explained with the colour 'blue'. In spite of the piece's collaborative nature, its form is continuous -as most of my composition- with parts overlapping without breaks. There is a clear, continuous evolution in harmonic complexity throughout its structure, which follows closely the incorporation of richer and more complex visual textures.

[45] The generation of image is reduced to a slow process of ca. five minutes from white to black in *Intermezzo I* and from black to white in *Intermezzo II*. This was a decision taken by the group, so that full attention could be paid to the viola parts, without the need of stopping the generation of image completely.

Because there is no preconceived programme -only the abstract idea of codifying colours by means of new technologies- the dramaturgical interpretation can vary significantly from listener to listener. Even though most of the music composed preceded the production of the graphics -which were afterwards adapted to the music- listeners will not be normally aware of this fact, so that results emerging from the audition will be more likely a simultaneous interaction of visual and sound contents rather than focusing on one of those aspects only. These results may be rather diverse in nature, and different listeners may interpret, identify and understand different dramatic paths. Moreover, due to the several and different versions, the position of the listener can substantially vary, either by being 'inside' (and almost participating in the event, as in the concert-installation version) or by being 'outside', in a passive position, in any of the concert versions.

With regard to the live-electronics, this piece -together with *Gegensätze (gegenseitig)*- highly influenced my approach to interactivity in my next pieces. *Color Code* marked also the first time I used MAX/MSP in an interactive composition. All of these influences had a big impact on great part of my production since 1998, a period during which my composition counts several interactive works. Hence, the importance of incorporating MAX/MSP for the first time in this piece can be considered as a new point of departure in my composition, whose effects, nevertheless, follow and exceed the period of the pieces herewith presented.

II.ii.f *L.S. (waiting for changes)* - 2001

Instrumentation: orchestra
Genre: instrumental
Duration: ca. 10 Minutes

The piece, composed in 2001, was a commission by the *Luxembourg Sinfonietta* and the *Luxemburger Gesellschaft für Neue Musik.* Due to the particular and flexible instrumental formation of the *Luxembourg Sinfonietta,* the idea of composing a piece for an ensemble of nearly twenty instruments, with particular characteristics in timbre not available in other, more traditional formations, was quite an interesting compositional challenge at that time. The piece consists of an evolutionary form, divided in several sections without breaks between them. The following aspects are paramount to the conception of the piece:

(a) The characteristics of each of the instruments, in order to achieve some degree of virtuoso solo participation
(b) The unusual combination of instrumental timbres

(c) The diverse and rather complex harmonic results (colour) of combining different instruments in several registers

Before going further into the matter, there is an extra-musical and extremely personal connotation that needs consideration: the *changes* mentioned in the title. The year 2001 was a bad year for me, and the hope of changes to materialise at that particular point of my life led me to extend the concept of *changes* to the entire compositional process. The piece, and most specifically, its composition, had a liberating, almost cathartic effect. The *changes* take multiple shapes and meanings throughout: on the one hand, the changes of instrumentation in each of the different formal sections of the piece; on the other hand, the almost constant changes of tempo –and subsequently, change the mood- from section to section, complemented by extreme contrasts in the pitch registers. The main part of the title *'L.S.'* refers obviously to the group who commissioned the piece; the second part: '*waiting for changes*' implies a more personal, intimate intention. This said, dramaturgically the piece is obviously linked to my personal psychological condition during those months in 2001. The need for changes was parameterised primarily in the compositional items tempo, metric, harmonic density, instrumental timbre and register. The idea of disintegration is also consciously parameterised in the treatment of the some of chords, which form part of the basic compositional elements of *L.S.* All these technical aspects are intended to be dramaturgically rather evident to the listener; however, as the context of those changes may not be clear without further information to hold on to, the emergent dramaturgy for each listener should be quite different in the end. There was no preconceived dramatic story behind the actual development of the form, only the main dramatic idea of changes, so that this work must be categorised as belonging to an *a posteriori* intrinsic dramaturgy, as described in Garavaglia, 2008. The listener is made aware of the type of dramatic line to be expected only by the second part of the title, the one alluding to changes. It is up to the listener, to understand how those changes work and what kind of dramatic narrative they can imagine through listening to the music. The narrative intention is limited to portrait in different ways the sense of change and disintegration.

In order to achieve the desired dramatic intention, complex harmonic layers of sound with various timbres were created, all of which were derived from the basic compositional elements selected for this piece. These included the usage of words to derive rhythmic and melodic patterns, some of which have also structural impact on the composition (see Appendix VI for a full explanation) and the usage of specific chords, which were based on another piece I composed in 2001. The latter create complex harmonic results, which are timbrically manipulated through the change of instrumentation and register. Even though there are eleven sections in the piece, each of which change the music parameters to express musically the concept of *changes*, there are no breaks between

them, which is consistent with my compositional techniques in other pieces regarding form and structure.

This piece is chronologically the last of the six presented for this PhD. In many ways, it resumes all of the attributes I had been developing up to that time (as listed in section II.i), and influenced quite significantly my further composition. Particularly at this point, the type of sound imprint in my music had become increasingly 'electronic'. *L.S. (waiting for changes)* was an attempt, an effort and an experimentation to obtain a general sound imprint of electroacoustic music from natural instruments, a characteristic that has persisted in time, and that can be observed even in my most recent compositions.

Section III
Conclusion

The six compositions, which represent the main body of work for this PhD, offer a rather rich variety of possibilities, which allow for the scrutiny of the connection between theory and practice with regard to a main common subject: the dramaturgy of music in composition. My main impulse to compose requires that the dramatic intention of my music should be understood (at least, to some extent) by its perception. This is explored in this dissertation from a philosophical perspective, which requires a profound reflection on my approach to the act of composing the six pieces herewith presented. The disparity in styles and/or genres between these six works is only apparent, as they all match the dramatic intention of each piece. Musical semiotics is at the foreground of my composition: compositional materials (the syntactic signs of the musical discourse in musical semiotics) are subordinate to the purpose of expressing a particular dramaturgy from the music. Apart from that, it was explained in the Introduction, that regulations at London Metropolitan University required that all of the pieces had to be published or be in the public domain within an academic context by the time of registration (2005). This fact and the two-fold inherent relationship between intention and reception via a musical discourse (which should include all of the compositional characteristics required to make possible that relationship, which were explained in section II.i), allow these compositions to present a coherent whole, in addition to an independent and original contribution to the discipline.

All of the pieces have a dramaturgic intention (openly or hidden), which can be grouped -according to the classification stated in Garavaglia, 2008- in the subtypes of intrinsic dramaturgy:

- *a priori* intrinsic dramaturgy: *Overture (in memoriam T.A.T.)* and *Arte Poética (I).*
- *a posteriori* intrinsic dramaturgy: *L.S. (waiting for changes), Spectral colours, Color Code and Gegensätze (gegenseitig).*

Section II.i showed five main characteristics of my composition, which are subordinate to the dramaturgic intention of my music. The first is the development of all compositional materials from primary, basic cells or principles. These evolve to allow the works to transmit their dramaturgic intention via the musical discourse. Additionally, the usage of minimal resources throughout an entire piece warrantees a unifying effect, with an impact on the character and on the dramatic effect of each composition. This common feature, though more evident in *Gegensätze (gegenseitig)* and in the two works for ensemble, is also present in the other pieces.

The sound imprint of my composition is given in most cases by the profuse usage of layers of sounds (in the electroacoustic pieces) or instrumental polyphony. The search for harmonic complexity rather than to focus on more linear, melodic or rhythmical aspects of music, is a constant in my work, and can be particularly observed in *Overture (in memoriam T.A.T.)* and

Spectral colours. This characteristic is essential for the creation of the mood of the piece, and therefore, to transmit its intention through the musical discourse.

Continuity of the musical discourse throughout a composition is paramount in my composition in order to obtain the intended dramatic results. None of the six pieces presented herewith have breaks or pauses between different sections. This is more noticeable in the longer pieces, such as *Gegensätze (gegenseitig) and Color Code*. It is worth mentioning, that this characteristic can be observed in most of my compositions and not only in these particular six works.

The recurrent use of words for compositional purposes is another characteristic, which is quite original in its variety of usage albeit not applied to all of the works herewith presented. In very different ways, words serve to develop the main materials for three of the compositions: *Arte Poética (I)*, *L.S. (waiting for changes)* and *Overture (in memoriam T.A.T.)*.

There is a clear tendency to have a main title and a secondary (this latter between parenthesis), which should be considered as a factor to hold on to. Four of the pieces presented for this PhD share this characteristic. The titles of other compositions in my work catalogue (Appendix VII) show a rather similar and constant tendency.

The semantic values (how the syntactic musical signs are combined and relate to what they refer to) as much as the pragmatic values (how the signs impact on the communication of the musical discourse) are those articulating the musical expression in my pieces. Signification occurs through communication, as the former cannot exist -following Caesar and Eco (Caesar, p.81 and ff)- if there is no human addressee interpreting the musical message.

My music carries a particular dramaturgy and every listener should be susceptible to its arousal, even though such arousal may have little resemblance with the main intention in the end (at least from a first impression). The listener's *phaneron* -according to Peirce- cannot be fully penetrated, as it is individual and unique. Although empirical research (such as the previously mentioned *Intention/Reception Project*) can shed light about this internal world, such research cannot penetrate completely the mind of a listener. Hence, from these six pieces, I would only expect a degree of concordance between intention and reception in the case of *Arte Poética (I)* and, in a lesser degree, in the case of the *Overture (in memoriam T.A.T.)*. As for all of the other four pieces, their intrinsic dramaturgy is not clear enough for the listener despite the inclusion of some factors to hold on to, such as their titles. Thus, the compositional materials and techniques employed can only serve the purpose of suggesting that there exists an intended dramatic narrative in the musical discourse; the narrative may be followed and enriched by each listener, but it may also be understood in a radically different way.

To conclude, I think it is important to remark that, for all of the reasons previously mentioned in the main text, it is my conviction, that there is a substantial aesthetic difference between composition where the aim is to embed the music with an intended dramaturgy, and composition where there is no further dramaturgical intention. Therefore, my personal aesthetical choice and the main characteristic that makes my pieces sound as a coherent whole -despite the diversity in genres- is to have in every single compositional act the necessity and consciousness of communicating through music, thus devoting my compositional activity to serve the dramaturgy of my music.

Appendices

Appendix I

App. I.1 *Gegensätze (gegenseitig)*: Technical Description.

Gegensätze (gegenseitig) is a large-scale piece, composed for two opposing groups represented by the alto flute on the one hand, and the electronics on the other. The electronics include a quadrophonic tape part and real-time electronics, both of which not only 'oppose' the alto flute, but also interact reciprocally with it, thus representing the main idea implied in the title. The piece is based on two general principles, which stand opposite to each other:

- Single-principle
- Totality-principle.

All compositional techniques applied to this work were inferred from this duality. These principles are the main generators of every event throughout the work and are mainly represented by two musical objects:

- 'Single-note-object'
- 'Glissando-object' respectively.

The entire structure of the work is based on *a numerical-row,* which was developed selecting its first three components explicitly; from the fourth element, however, the figures are the result of the addition of the last three numbers of the series (meaning that each figure in the row will be calculated from the *reciprocal action of the former three*). As a result, a bigger new value emerges, which stands opposite to the first. For example, the row begins with the figures 1 - 1 - 3 (those arbitrarily selected); the next value will be 5 as the result of the addition: 1+1+3; the next step will be 9 (1+3+5) and so on. In this way, each *single element* contributes in making a partial *new totality.* This row plays an extremely important role in the development of the pitches, the rhythms, the metronomic values and the form of the piece. Considering that most materials emerge from this numerical row, the similarity with the serialism of the 1950s cannot be overlooked. However, this link is more apparent than real, as the procedures barely respect the strictness of that period regarding the full serial control of all musical parameters and develop in a rather different direction. A detailed description of how the row works in this piece for most of the music parameters follows.

Form

The piece consists of five sections (five is the first result of the numerical row), each one based on one of the two basic principles:

1- Alto flute solo (based upon the 'single-principle'- score: pages 1 - 2)
2- Alto flute + tape (as opposites building a unity - score: pages 3 - 12)
3- Tape solo (based upon the 'single-principle' - score: page 13)
4- Alto flute + tape + live-electronics (the 'totality-principle', showing a reciprocal action of all three 'instruments' - score: pages 14 - 35)

5- Only live-electronics ('totality-principle' as result of the reciprocal action of all three 'instruments' - score: pages 36 - 41).[49]

Rhythms

Rhythms for *Gegensätze (gegenseitig)* were developed using a procedure based on the *numerical row* plus the tension emerging from the principle of opposites 'short-long', which relate from the first and third numbers of the row (1 for 'short' and 3 for 'long'). This can be clearly seen in bar two of the score. There is a unit value, the sixteenth (semiquaver), which after multiplication or division with numbers derived from the row (only 1, 3, 5, 9), result in twenty ratio combinations[50] as shown in Fig. I.1.1.

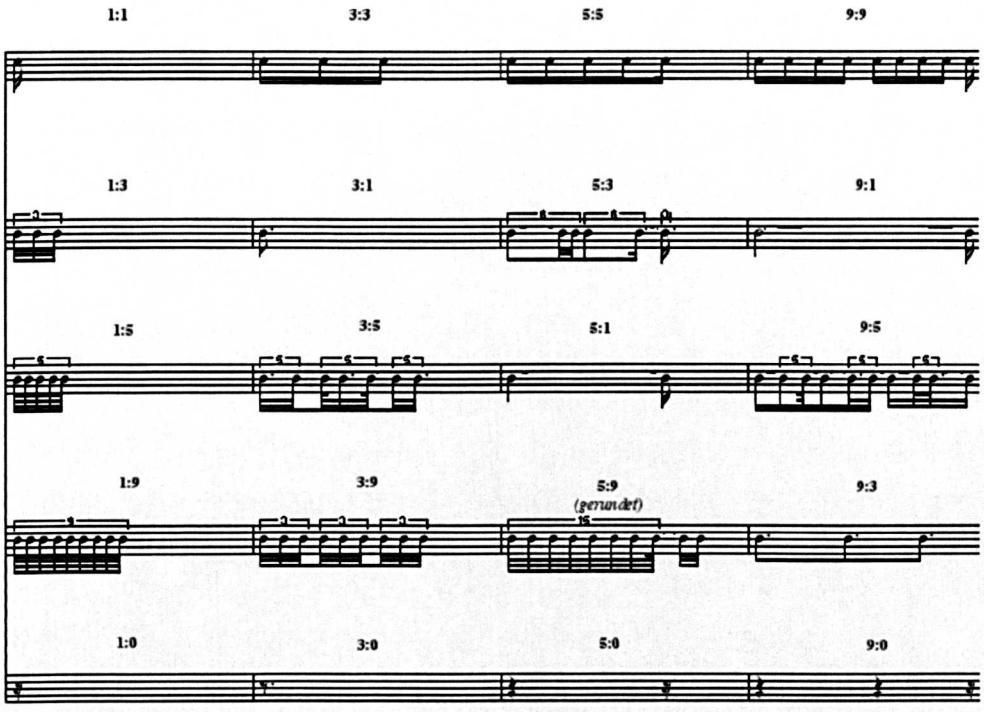


Fig. I.1.1 – Rhythmical patterns in *Gegensätze (gegenseitig)*: ratios derive from the basic numerical row.

Pitches

The pitch organisation is derived primarily from a chromatic scale, starting with the note G3 (the lowest pitch for an alto flute in G). This scale represents the *totality principle* and represents a meta-symbol of the 'glissando-object'. This latter plays one of the most important roles for every parameter in the piece, not only for the flute part, but also and mainly for the tape and the live-electronics (in sections 2, 3, 4 and 5).

[49] The fact that the tape is still on during this part (see the score), does not invalidate what has been stated here, as it was a mere technical feature of the *AUDIACSystem* of not having enough computing power to process what is called *TAKE 9* on the tape line. Therefore, and in order include the filtered effect (which brings the piece to an end), this reciprocal action was produced on tape.

[50] For example, ratio 9:5 represent nine equal durations instead of five sixteenths; ratio 1:3 results in a dotted eighth or quaver and so on.

The process of generating the pitches for the flute part followed a raster-algorithm capable of eliminating some notes so that in the end, the result leaves only one pitch. This is a process that begins from the *totality* of the elements (all twelve tones) to *one single* element, generating a tension between the two main basic principles.

For the second section (which begins simultaneously with the tape part), the chromatic scale is transformed through the previously mentioned algorithm, eliminating some pitches from the row. The algorithm's principle works as described below and is displayed in Fig. I.1.2:

1- The algorithm consists of three main steps or loops.
2- During the first step or loop, the algorithm rotates the chromatic scale beginning in G one note at a time to the right, transposing it one semitone upwards.
3- All of the twelve transpositions were arranged in three groups of four scales forming groups A, B and C in each step.
4- Each of these three groups has a total availability of 48 pitches.
5- The selection process takes place by applying a filtering process using the numbers 1-3-5 (taken from the general numerical row). Each of these numbers represents the interval (in semitones) in which the filtering raster moves to the right. Group A uses the combination 1,3,5 for the intervallic, group B: 3,5,1 and group C: 5,3,1.
6- The pitches falling under the process are marked with a cross and skipped. The same happens with any pitch below any of the crosses of this double array.
7- Once this process has undergone all twelve semitones, the second step takes place, applying the same procedure, this time with the results of the first step. The groups (now D, E and F) are rotated in the contrary direction (1,3,5, then 5,1,3 and 3,5,1).
8- As the filtering leaves continuously less availability in the pitches, while group E is reached, the pitches generated by group D begin already to be filtered.
9- Arriving to group F, the availability of pitches is so narrow, that pitches generated by this group begin to be part of the twelve rotating pitches.
10- The third step consists of only one group (G), where only the pitch D is repeatedly present.

The final result is a series of 158 pitches as shown in Fig. I.1.2.

Original Pitch	GROUP	G	G#	A	A#	*B*	c	C#	d	D#	e	f	F#	
	A / 1-3-5	x1	x2			x3								
2nd Transp.		*G#*	*a*	A#	B	*c*	C#	d	D#	e	*f*	*F#*	g	
		*	x6			*					X4	X5		
3rd Transp -		*a*	*A#*	B	c	*C#*	d	*D#*	*e*	f	*F#*	*g*	G#	
		*	*			*		x7	X8		*	X9		
4th Transp		*A#*	*B*	c	C#	*d*	D#	*e*	*f*	F#	*g*	G#	a	

		*	*		x10	x11		*	x12		*	*		**Total tones from GROUP A = 25 pitches**
5th Transp	**B / 3-5-1**	*B*	c	C#	*d*	D#	e	f	F#	*g*	G#	a	A#	
		x1			x2					x3				
6th Transp		c	C#	d	*D#*	e	*f*	F#	g	*G#*	*a*	A#	B	
		x5			*		x6			*	x4			
7th Transp		*C#*	d	*D#*	*e*	f	*F#*	g	G#	*a*	*A#*	B	c	
		*		x9	*		*			*	**x8**			
8th Transp		*d*	D#	*e*	*f*	F#	*g*	*G#*	a	*A#*	*B*	c	*C#*	
		*		*	x10		*	x11		*	*		x12	**Total tones from GROUP B = 26 pitches**
9th Transp	**C / 5-3-1**	*D#*	e	f	F#	g	*G#*	*a*	A#	B	c	C#	d	
		x1					x2	x3						
10th Transp		*e*	f	*F#*	*g*	G#	*a*	*A#*	B	c	*C#*	d	D#	
		*		x5	x6		*	*			x4			
11th Transp		*f*	F#	*g*	*G#*	a	*A#*	*B*	c	C#	*d*	D#	*e*	
		x9		*	*		*	x7			*		x8	
12th Transp		*F#*	g	*G#*	*a*	A#	*B*	*c*	C#	*d*	*D#*	e	*f*	
		*		*	x10		*	*		x11	x12		*	**Total tones from GROUP C= 24 pitches**

Total groups A, B and C= 74 pitches

Original Pitch	**GROUP**	*a*	*Bb*	c	C#	d	D#	e	f	F#	Bb	B	C#	
	.D/ 1-3-5	x1	x2			x3								
2nd Transp.		*d*	*D#*	e	g	Bb	c	d	f	G#	*c*	*D#*	F#	
		*	x6			*					X4	X5		
3rd Transp -		*a*	*c*	C#	D#	*e*	f	*F#*	*G#*	a	*Bb*	*C#*	d	
		*	*			*		x7	X8		*	X9		
4th Transp		*e*	*F#*	g	*Bb*	*B*	d	*f*	*G#*	Bb	*c*	*D#*	F#	
		*	*		x10	x11		*	x12		*	*		**Total tones from GROUP D = 25 pitches**
5th Transp	**E / 5-3-1**	*a*	c	e	f	F#	*g*	*Bb*	B	c	C#	d	f	
		x1					x2	x3						
6th Transp		G#	Bb	*c*	*d*	D#	*F#*	*fa*	c	C#	e	g	Bb	
		*		x5	x6		*	*			x4			
7th Transp		C#	e	*c*	C#	D#	*e*	*f*	F#	Bb	*B*	C#	*e*	
		x9		*	*		*	x7			*		x8	
8th Transp		*g*	c	*d*	*f*	G#	*F#*	*C#*	D#	*f*	*a*	d	*g*	
		*		*	x10		*	*		x11	x12		*	**Total tones from GROUP E= 24 pitches**
9th Transp	**F / 3-5-1**	*d*	Bb	F#	*c*	e	f	F#	Bb	*c*	C#	d	f	
		x1			x2					x3				
10th Transp		*Bb*	D#	c	C#	g	*Bb*	e	D#	*F#*	*Bb*	C#	c	

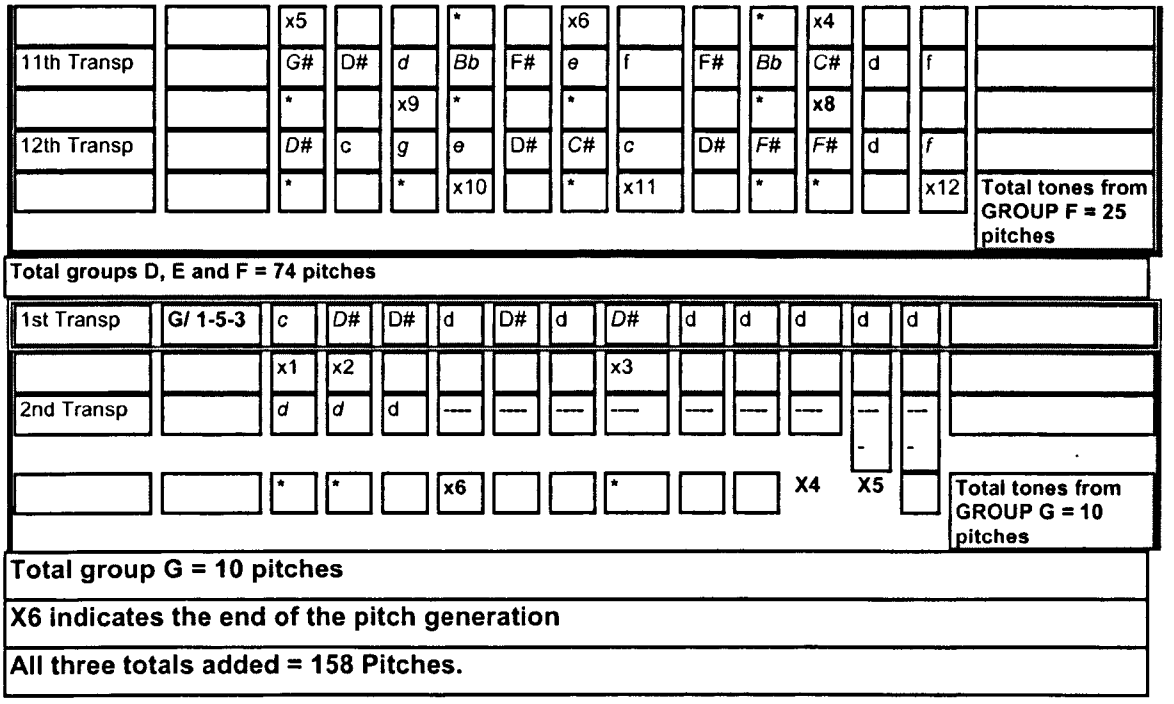


Fig. I.1.2 – Pitch generation algorithm: all three steps

Each of the groups (A, B, C, D, E, F, G) will be later assigned to a fixed register (freely chosen). Each rhythmic parameter will be also assigned to a particular articulation. Once all pitches have been used, the entire final series is mirrored in retrograde movement, however with the register and articulations set in opposite motion to the direct movement. In order to make the pitches appear in opposite registers, the pitch C#4 was chosen as reference. For the articulations, the principle worked by exchanging *staccati* and *portati* by *legati* and vice-versa.

Microtones have not been used systematically overall and their purpose is only to produce some slight variations in pitch, and therefore, in colour.

The entire treatment for pitch-generation in sections 1 and 2 of the piece can be found on the score as follows:

1- twice a chromatic scale beginning on G (written C), pages one and two in the score.

2- the results of the filtering algorithm with their retrograde and articulations in pages 3-10.

3- the last two pages before section 3 begins (pages 11-12) contain a retrograde of the same chromatic scale from the beginning, using again opposite registers. When section two ends, the entire pitch generation has taken the form of an arch, ending on the same pitch it began (G, written C), but four octaves higher. The pitches eliminated by the filtering algorithm however, are reserved for later use in section 4, whereby three improvisations take place, in which only rhythms and articulation are set free. These improvisations are set in counterpoint (and as a counterpart) to the live-electronics and even interact with them by using FM modulation in the third improvisation.

Flute techniques

These include classic and advanced techniques. Of the advanced techniques used, some were employed to improve the quality and reaction of the live-electronics processes (such as slap tones, multiphonics, key strokes and so on).

Metronomic indications

The metronomic indications were also composed based on the numerical row. The first section has a very slow tempo: ♩ = 10; section 2: ♩ = 30; section 4: ♩ = 50 and later, ♩ = 90. This makes the tempo increase in speed in direct proportion to the numerical row. Even though the tempi selected seem very slow, the composer is the view, that this system was consequent with the compositional techniques and concepts applied and not very complicated to read.

Electronic part

Tape

The sounds for the tape part were produced using two Yamaha synthesisers and are not related to the alto flute (hence, they stand opposite to it). Here too, the basic principles of *glissando* and *single tone* dominate most of the procedures. Regarding their own durations, the samples were composed and produced in a similar way as the rhythms for the flute (mostly using the concept 'short-long'). The quadrophonic tape part was produced using an analogue AEG 16-track tape machine and some other analogue (stereo, 4-and-8-track) tape machines. Different procedures and programmes such as *CommonMusic* (LISP), transpositions, filters, reverberation and the *AUDIACSystem* itself were used in the recording and mixing process. This twenty-minute long part acts as a counterpoint to the alto flute, it develops afterwards on its own (section two) and fades away slowly when the live-electronics start.

DSP/live-electronics

The live-electronics section four is divided in three subsections: 4A, 4B and 4C, which show a process of integration. For the live-electronics in 4A, the alto flute plays only isolated effects: air noise (breathing out into the instrument), multiphonics (three different) and slap tones. The *AUDIACSystem* stores and subsequently processes these sounds by rotating them among the speakers, amplitude-modulating them with themselves and finally transposing them. Without any break, part 4B follows, working with a more rhythmical pattern from the flute (a complete musical phrase) but still composed mainly with effects (all three multiphonics, slap tones, air noise and flutter tongue). The electronics react by still processing the sounds from part 4A while transpositions of 4B begin to replace them. The transposition ratios continue for a while, until they fade away, leaving the flute completely alone in a short intermezzo, which is

mainly a repetition of the piece's first bars, but this time acting as an introduction to the final part of the piece, section 4C. This section begins on page 31 of the score with three pitches on the flute around a whole tone (G, A and G#), which are stored and played back by the *AUDIACSystem* as a typical musical canon, which creates a virtual cluster. Two improvisations by the flute (opposite to the moving cluster of the live-electronics) follow, intercalated between another two short ascending passages in the middle and higher register, which are also stored and played back by the system similarly as before, without stopping the former storages of sounds (buffers), enhancing the cluster-character of the passage in three different registers. When the third improvisation starts, the flute frequencies modulate the 'moving-cluster', changing and developing it into a new passage. When the third improvisation is finished, the flute has also finished its part in the piece. What remains is the final section, containing the modulated cluster and a filtered sound on the tape. The former will be yet amplitude-modulated on channels two and four by the subsection 4B sequence played by the flute about five and-a-half minutes before, still stored in the buffer of the *AUDIACSystem* (score: pages 36-37). These sounds will be filtered, so that only one pitch will be heard at the end, the last note of the chromatic scale: F# (the opposite to the first note G, in both scale and register) before everything slowly fades out to finish the composition.

Spatialisation

Another important aspect of the work, as usual in acousmatic and electroacoustic works, is the output of the sound for the tape and the DSP live-electronics. This channel distribution, which determines the space diffusion of the sound in the concert hall was set for this piece clockwise for the circulation of sound for the tape, whilst the live-electronics were set anticlockwise, acting as its opposite. This is represented in Fig. I.1.3.

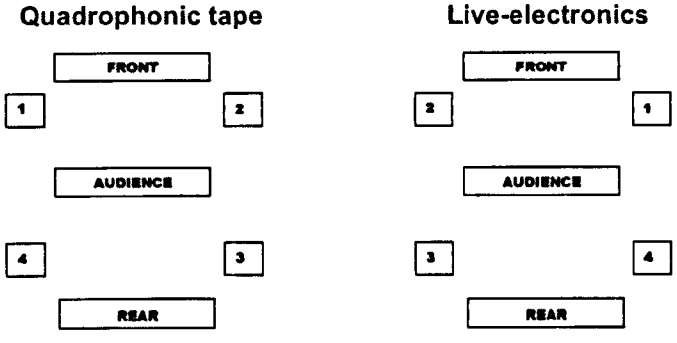


Fig. I.1.3 - Channel distribution for the quadrophonic output of *Gegensätze (gegenseitig)* regarding the tape and the real-time processes.

Special features

The stage production was also conceived with the concept of contraries. The stage should only be illuminated when the flautist has to play (parts 1, 2 and 4). In parts 3 and 5, where only

the electronics are present, the whole stage and the entire concert hall (if possible) should be in complete darkness.

App. I.2 Additional Data.

Public Performances of the Piece:

18.06.1994 - Rathaus Dortmund – Foyer, during the Spektakel '94. Flautist: Christianne Schulz - Sound regie: Markus Lepper and Javier Garavaglia, (World premiere) / Dortmund – Germany
17.01.1995 - Neue Aula - Folkwang Hochschule Essen - Flautist: Lesley Olson - Sound regie: Markus Lepper and Javier Garavaglia, / Essen - Germany.

Appendix II

App. II.1 *Arte Poética (I)*: Technical Description.

The acousmatic piece *Arte Poética (I)* is based on the first stanza of the poem *Arte poética* by Jorge Luis Borges. The entire dramatic intention is given by the stanza. The aim of the piece was to recreate musically and sonically the meaning of the first four verses of the poem. In these four verses there are two words related to water ('río'/river and 'agua'/water), two related to time ('tiempo'/time and 'recordar'/remember) and one implying contemplation ('mirar'/to look or contemplate) all of them whether present or suggested throughout the composition. From these five basic words, only the first two are of a tangible substance, the other ones are immaterial. The main challenge was to recreate the latter sonically, in order to establish an acceptable perception from the dramaturgical point of view.

The main sonic material for the entire composition was the human voice, in this case, my own. As the words are extremely important for the dramaturgical meaning of the entire piece, it was my aesthetical conviction and decision, that they should be present throughout, so that the audience could have some elements of the poem sonically represented, in order to better understand the intention of the composition.

In order to organise the materials and the form, several numeric combinations (multiplications, additions and divisions)[51] of the three most important figures derived from the structure of the poem (eleven for the numbers of syllables of each verse; seven for the number of stanzas and four for the number of verses within a stanza) were used. The results (avoiding repetitions) were arbitrary but convenient for having figures at my disposition, which could be freely combined and applied to micro-and-macrostructure parameters. It produced (after ordering it from low to high values) the following series:

0.36, 0.57, 0.63, 1.57, 1.75, 2.75, 3, 4, 7, 8, 11, 12, 14, 15, 16, 18, 21, 22, 28, 30, 33, 36, 44, 45, 49, 54, 66, 77.

The total duration of the piece is set at eight minutes. The entrance of each of the 'basic words' was set using numbers of this row (see the score, page 42 and following, where all generative algorithms for this purpose are shown) as well as most of the parameters set in the Csound Opcodes (see also the score, from page 12 onwards).

[51] Here are most of those calculations shown: 7+4=11; 4+11=15; 7+11=18; 7+4+11=22; all those results X2 are: 22,30,36,44. Again the same X3: 33, 45, 54, 66. The multiplications: 11*4=44; 11*7=77; 11*11=121; 7*4=28; 7*7=49; 4*4=16. The divisions: 11/4=2.75; 7/4=1.75; 11/7=1.5714; 4/11=0.3636; 7/11=0.6363; 4/7= 0.57143. The subtractions: 7-4=3; 11-4=7; 11-7=4; 11-4-7=0.

The piece is formally divided into two sections, each around four minutes long, where the first one relates to the element *water* whilst the second relates to *time.*

After the recording of the stanza and the entire poem, a process of isolation of the 'basic words' took place, so that they could be present throughout the piece, each one allocated to a different (albeit fixed) channel in the tape part.[52] These basic words are repeated throughout the work at programmed intervals. From the dramaturgical point of view, it was important that the words were extracted from the original recording of the entire poem and not recorded isolated and separately, mostly due to the prosodic cue involved in the complete reading, which should be kept for each word isolated, as belonging to the whole.

The rest of the recorded stanza was used in many ways to create, modify or trigger different synthesis processes on Csound. After the introduction with only the four words wandering in the space, the first water-like sounds appear. These were treated with the process known as *sample and hold*, using the transposition (four octaves down) of each of the verses of the stanza as 'train pulse' for the process. Added to these are other, based whether on amplitude modulation or frequency modulation (simple Chowning FM) processes and some extreme filtering processes on the recorded voice. These sounds cross the room through the quadrophonic diffusion, such as 'rivers of sound', recreating the image of water and rivers. The Csound files for this part can be found in the score, pages 12 to 33 ('*Water Files*').

When this section approaches the end (around minute four), the second part makes a cross fade to the former one. This new section describes sonically the concept of *time*; the sounds included in it were produced synthetically without exception, with no use of the human voice, to achieve contrasting dramatic results. The main process is again simple Chowning FM. This time however, my experimentation with Csound gave me the opportunity to develop a rather original algorithm, in which the ratio between carrier and modulator is given by a random generator working on a continuous table of values ('*ktabelle*'). The randomness of the function allows those values to literally 'jump', generating very fast glissandi (due to the continuous 'k' values); the result was an original sound, where the general FM generation was 'sparkled' with these short glissandi. As there were many files compiled with the same procedure, they give the feeling (at least in my view) of *timelessness*. These algorithms can be found in the score, pages 33 to 41 ('*Time Files*').

[52] 'Mirar' on Ch 1, 'tiempo' on Ch. 2, 'agua' on Ch. 3, 'rio' and 'recordar' on Ch. 4. See channel distribution at the end of this section.

The quadrophonic surround movements of words, water-like and time-like sounds were programmed using CommonMusic (Lisp).[53] The algorithms are shown in the score on pages 42 to 55. The channel distribution is set according to the German typical clockwise distribution, as shown below:

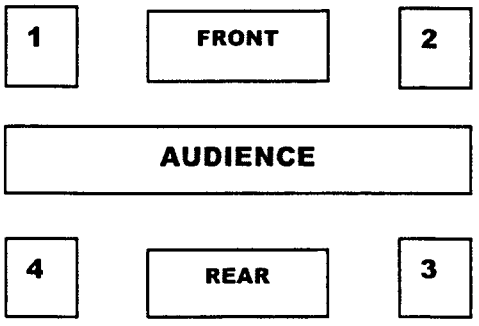


Fig. II.1.1 – *Arte Poética (I)*. Clockwise channel distribution of the quadrophonic tape.

The piece is the first of a cycle related to each one of the seven stanzas of the whole poem *Arte Poética* by Borges and was produced at *ICEM - Folkwang-Hochschule Essen* (Germany). The following equipment was used: human voice (the composer's), digitally recorded with the Sound Designer II; CSound; CommonMusic (Lisp); Akai Sampler S1000; Digital effects Lexicon 480L. The final master was mixed by the composer using ProTools 2.0. All computers used were *Macintosh* of the *Quadra* series (68040 Motorola Cisc CPU). However, some of the pre-mixes were performed on different four-and-eight-track analogue tape machines.

[53] CommonMusic is an object-oriented music composition environment, working with MIDI and signal sound processing, developed since 1989 by Rick Taube (CCRMA – University of Stanford, USA) and based on the programming language LISP.

App. II.2 Complete Poem (Spanish and Free English Translation)

ARTE POÉTICA

Jorge Luis Borges

Mirar el río hecho de tiempo y agua
Y recordar que el tiempo es otro río,
Saber que nos perdemos como el río
Y que los rostros pasan como el agua.

Sentir que la vigilia es otro sueño
Que sueña no soñar y que la muerte
Que teme nuestra carne es esa muerte
De cada noche, que se llama sueño.

Ver en el día o en el año un símbolo
De los días del hombre y de sus años,
Convertir el ultraje de los años
En una música, un rumor y un símbolo,

Ver en la muerte el sueño, en el ocaso
Un triste oro, tal es la poesía
Que es inmortal y pobre. La poesía
Vuelve como la aurora y el ocaso.

A veces en las tardes una cara
Nos mira desde el fondo de un espejo;
El arte debe ser como ese espejo
Que nos revela nuestra propia cara.

Cuentan que Ulises, harto de prodigios,
Lloró de amor al divisar su Itaca
Verde y humilde. El arte es esa Itaca
De verde eternidad, no de prodigios.

También es como el río interminable
Que pasa y queda y es cristal de un mismo
Heráclito inconstante, que es el mismo
Y es otro, como el río interminable.

To look at the river made of time and water
remembering that time is another river,
Knowing that we lose ourselves like the river
and that the faces flow like the water.

To feel that the vigil is another dream
dreaming that it doesn't dream and that death
Which our flesh is afraid of, is that death
Of every night, which is called dream.

To see a symbol in the day or in the year,
About the days of man and about his years,
Converting the ignominy of the years
in a music, in a rumour and in a symbol.

To see in death a dream, in the twilight
A sad gold, so is the poetry
Which is immortal and poor. Poetry
Comes back as the dawn and the twilight.

Sometimes in the afternoons a face
Looks at us from the bottom of a mirror;
Art must be like this mirror,
that reveals us our own face.

Some tell that Ulysses, tired of wonders,
wept of love as he saw his Ithaca
Green and poor. Art is that Ithaca
of green eternity, not of wonders.

It is also like the infinite river
That flows and remains and is a crystal of the
same inconstant Heraclites, who is the same,
And also another, like the infinite river.

App. II.3 Additional Data.

The composition has been issued twice in the public domain (commercially) on CD, as shown below:

1996

Arte Poética (I) on the CD: *'EX MACHINA – tangent '*, edited 1996 by *Cybele* (Germany) and the *Folkwang Hochschule Essen* (Germany). CD n°: 960.102 – 1996 / LC 3738, DDD.

2002

Arte Poética (I), on the CD *'Florida Electroacoustic Music Festival – VOLUME 1'*, edited by the EMF Media, Electronic Music Foundation ltd. New York USA and the Florida Electroacoustic Music Studios, University of Florida. EMF CD N° 031. CD Production by Healey Disc Manufacturing – 2002. DDD. Code: 6 53727 81192 5.

Since its world premiere on July 6th 1995 at the Folkwang Hochschule Essen (Germany) in a concert for the winners of the *Folkwang Musikpreis 2005*, the piece has been performed worldwide as indicated below:

31.07.1995 - II Brazilian Symposium on Computer music, Canela - Brazil.
07.07.1996 - Theater Foyer / Spektakel '96. Münster - Germany.
23.05.1997 - Electro nights in Seattle / Seattle - USA.
10.04.1998 - 7th Florida Electroacoustic Music Festival / Black Box Theater. University of Florida, Gainesville - USA.
07.03.2002 - Queensborough Community College - Queens – University of New York - NYC-USA.
17.06.2002 - Bulgarian National Radio - Studio 1 / Festival Musica Nova Sofia 2002. Sofia - Bulgaria.
03.03.2003 - *Twisted Multimedia Concert* / F12-22 the Fenway / Berklee College of Music – Boston, MA - USA.
14.10.2004 - HörZeit-SpielRaum/KlangWelten / *unsicht-Bar Berlin.* Berlin – Germany.
22.05.2008 - Habitación del Ruido / Universidad del Claustro de Sor Juana y Casa del Lago / UNAM / Concierto México-Alemania de Música Electroacústica / Casa del Lago Mexico DF - Mexico.

Appendix III

App. III.1 *Spectral colours*: Technical Description.

The main source for this composition was an acousmatic piece based on three notes played *sul ponticello* on a viola: C, B and D. This tape piece was modified to suit the purpose of the present work. All of the materials for *Spectral colours*, namely pitches, rhythmic values, formal structures, etc. were derived from the three notes used in the tape, but this time transposed to a low register (C1, B2 and D2), each with their first thirteen overtones.

The number *fourteen* has a decisive meaning for the entire piece: each note has *fourteen* harmonics and the instrumentation is for *fourteen* instruments. Apart from that, each chord/cluster in the composition builds up until it contains *fourteen* pitches, which are taken from the generative scale.

For the pitch generation, the harmonics were transported to a scale (which I call herewith *generative scale*) from the lowest tone (C1) up to the highest (the 14th harmonic of D a C6 [-]). Any repetition between harmonics of the three series was skipped in order to obtain a scale without redundancies. The total number of notes is equal to thirty-six, with thirty-five intervals between them.

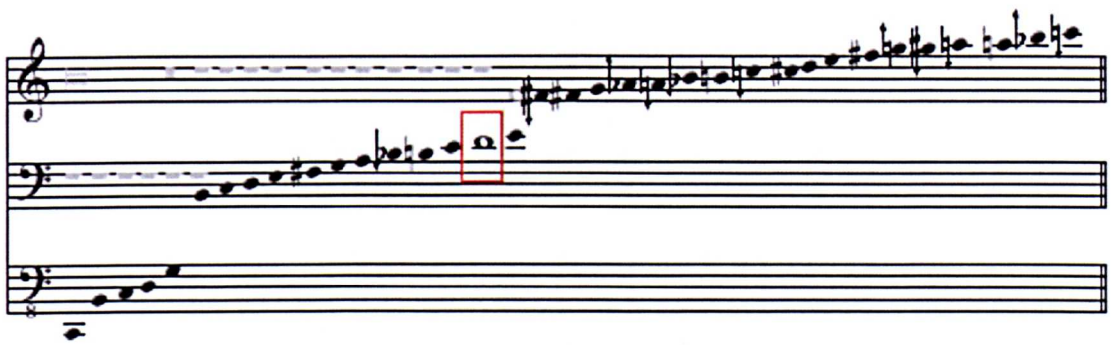


Fig. III.1.1 – Generative scale for *Spectral colours*

The proportions ruling the entire work (form, rhythms, etc) were taken from the relationship between the overtones.

The intervals between all thirty-six notes of the *generative scale* appear in the following number series (which considers a semitone as the unit and the octave as No 12). This is what I call the *interval scale*, as shown below:

11 (major 7th)
5 (a perfect fourth)
4 (a major third)

2 (a major second)

1.8 (slightly less than a major second)

1.2 (slightly more than a minor second)

1 (minor second)

0.8 (slightly less than a minor second)

0.2 (slightly more than a perfect unison)

The decimal values do not reflect the real acoustical relationship of the natural deviations for some of the natural harmonics (for example the seventh), but are useful for building rhythmical values and structures, in this case, multiplying them by one quarter note. Fig. III.1.2 shows the rhythmical values resulting from this multiplication:

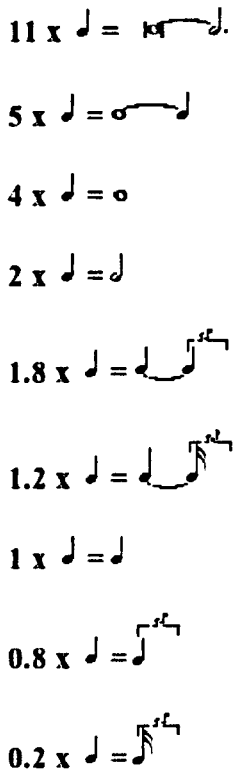


Fig. III.1.2 – Rhythms for *Spectral colours*

Summary of the Diverse Compositional Methods Used in the Piece:

Pitches:

The work begins almost in the middle of the *generative scale*, with the note D4 (marked with a rectangle in Fig. III.1.1).

The way each of the notes from the *generative scale* appear is built in a palindromic form: departing from the centre of the *generative scale* (D4), pitches are selected alternating notes upwards and downwards, until the upper and lower limits of the scale are reached (in this case C1 and c5 (-)). Once the first fourteen notes have appeared, then the 'coloured-spectral' different

clusters consist until almost the end of the piece of fourteen notes. When note No 15 (E3) from the *generative scale* appears, it simultaneously marks the end of note No 1 (D4) in the cluster; the start of note n°16 (B4 flat [-]), the end of note No 2 (E4) and so on. When all thirty-six notes have appeared, the 'spectral' cluster appears in two regions, located in the high and low registers of the spectrum (bar 118). This situation remains until bar 128, where the first note (D4) appears again (filling the central region), and then two of the remaining notes (n° 21 and 23 of the *generative scale*) disappear. This process goes further until note No 7, where all notes but the D4 fade out accordingly. The last bars (once the tape is almost over at bar 148) are a coda-like passage, where the tiny amplified percussion has the 'leading colour', built upon the first fourteen harmonics of D4 on the piano (plucked string).

Rhythms:

In *Spectral colours*, rhythm and therefore the rhythmical patterns listed above have the role of 'changing the colours' rather than implying movement. They are most of the time not perceptible as such and were composed together with the instrumentation. The very issue of having 'changing colours' relies on precisely this technique, which includes not only different instrumental combinations, but also frequently different advanced techniques on each instrument.

Form:

For the piece's form, the same numbers of the *interval scale* serve to set the duration of the different sections of the work, multiplying each of them by factor ten. Each of these values indicate not only the start of each of the thirty-six notes of the *generative scale*, but also the beginning and duration of each section with a particular instrumental colour combination. All this results in structural durations, which vary in duration from one minute and fifty seconds to only two seconds. The longest appear only once in the work, the shortest up to ten times. How often they appear, was a free compositional choice, which was based on considering the balance of all notes, rhythms and clusters in the overall process. As an example of this, we may analyse the procedure for the first note (D4): it is assigned to have the structure **10 ♩ x 11= 110 ♩**. This structure appears in *Spectral colours* because of its length (one minute and fifty seconds) only once, but certainly not *at* once, but rather divided in two unequal parts (sixty quarters at the beginning of the work and fifty quarters close to the end). This static structure consisting of only one note is internally 'coloured' with some of the rhythmic values shown above. The same procedure was applied to the notes that follow and the resulting clusters. This can be observed in the score between bars 1 to 15.

Instrumentation:

The instrumentation takes into account all the technical possibilities of the fourteen instruments, so that the most wide 'colour' palette possible is allowed to emerge. Because the instrumentation for each new entrance of each new note changes all the time, new 'colours'

come constantly from the ensemble. The score shows these procedures rather clearly between bars 1 to 24.

Tape part:

The tape was mainly produced with the three sounds mentioned before, which were played and recorded *sul ponticello* on a viola. These three notes were transposed and were treated with several filter chains, reverberation and envelope followers (mostly with Csound), so that the 'harmonic quality' of the *sul ponticello* notes could be maintained and increased also for the lower transpositions. The composition technique applied here is a pyramid-like construction of layers of sounds, which begins with the longest (and therefore lowest) transpositions and adds higher ones proportionally. This creates the dramatic effect of development 'to higher regions' and back fading away to the same situation as in the beginning.

The role of the tape is not only that of a foreign 'colour', which adds the spatial sense through the quadrophonic diffusion, also to enhancing the harmonic spectrum of the diverse instrumental clusters. This follows the German clockwise channel distribution set, as shown in Fig. III.1.3.

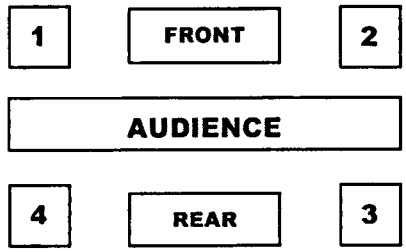


Fig. III.1.3 – *Spectral colours.* Clockwise channel distribution of the tape part.

In fact, the tape part is not quadrophonic, but rather its diffusion in the concert hall. This diffusion can be achieved by performing all channel changes as stated on the score 'live' on the mixing desk, where it is also possible to make a fixed quadrophonic recording of it following the diffusion written on the score. In any case, there will be only two channels active at each time. The tape, which begins in bar 15, starts its stereo image in the rear channels (3 and 4) and wanders through all possible pair combinations throughout the piece.[1] For the performance in Copenhagen (2007) however, a new system in 5.1. surround sound programmed on MAX/MSP was utilised, which differs from the one described in the score, enhancing the dramatic character of the piece. The original spatialisation written in the score though remains.

[1] The further combinations being channels 3-2 in bar 48; 2-1 in bar 82; 1-4 in bar 116, finishing the piece in this position, both channels on the left of the audience.

App. III.2 Additional Data.

Technical Data:

(a) **Ensemble** (14 instruments): flute, oboe, clarinet in b, Bass- clarinet in b (with low b), trumpet in c, horn, trombone, 1 percussion (see score for details), piano, 2 violins, viola, cello, double-bass.

(b) **Stereo tape** (DAT or CD), with quadrophonic projection (see score for details).

Further technical details:

One microphone for the percussion.

Time Code (SMPTE or DAT/CD time) visible to the conductor.

The world premiere took place at the Connecticut College, New London, CT, USA during the 8th biennial Symposium for Art and Technology 'Feedback: Perception and Interaction in the Electronic Arts' in 2001. A paper about the piece was published in the proceedings book of the symposium (reproduced in Appendix XVI).

Performances of the piece:

03.03.2001 - World-premiere at the Connecticut College, New London, CT, USA during the 8th biennial Symposium for Art and Technology. Connecticut Ensemble conducted by Michael Adelson.

27.08.2007 - European premiere - ICMC07 - Denmark.

Den Sorte Diamant - Queen's Hall - Det Kongelige Bibliotek Slotsholmen, Søren Kierkegaards Plads 1 - Copenhagen – Denmark. Ensemble Ars Nova conducted by André Chini

29.11.2008 - 'Festival Internazionale di Musica Elettroacustica'

Conservatorio di Musica Santa Cecilia di Roma / Sala Accademica. Rome – Italy

Ensemble dei Conservatorio di Musica Santa Cecilia di Roma conducted by Alfredo Santoloci

Appendix IV

App. IV.1 *Overture (in memoriam T.A.T.)*: Technical Description.

Most of the compositional procedures for *T.A.T. (a man's life)* were explained in a non-published paper I read on the matter in April 1999 at the 8th Florida Electroacoustic Music Festival at the University of Florida, USA. Except for the treatment of both solo instruments *T.A.T. (a man's life)*, which does not belong to the piece presented for this PhD, the main considerations for the programming of the algorithms and sounds treated are common for both the *Overture (in memoriam T.A.T)* and *T.A.T. (a man's life)*.

This is also the second occasion on which I worked with the harmonic-series-principle[2]. As the viola was almost a part of Tichauer's personality, I chose the note C (the instrument's basic or fundamental pitch) to organise the whole pitch-system for the work. For this purpose, the pitch organisation was based on two different harmonic series:

a) one positive (the real harmonics), representing the presence of life.

b) one negative or abstract (the inversion or mirror of the intervals of the harmonic series), representing the absence of life and symbolising Tichauer's death.

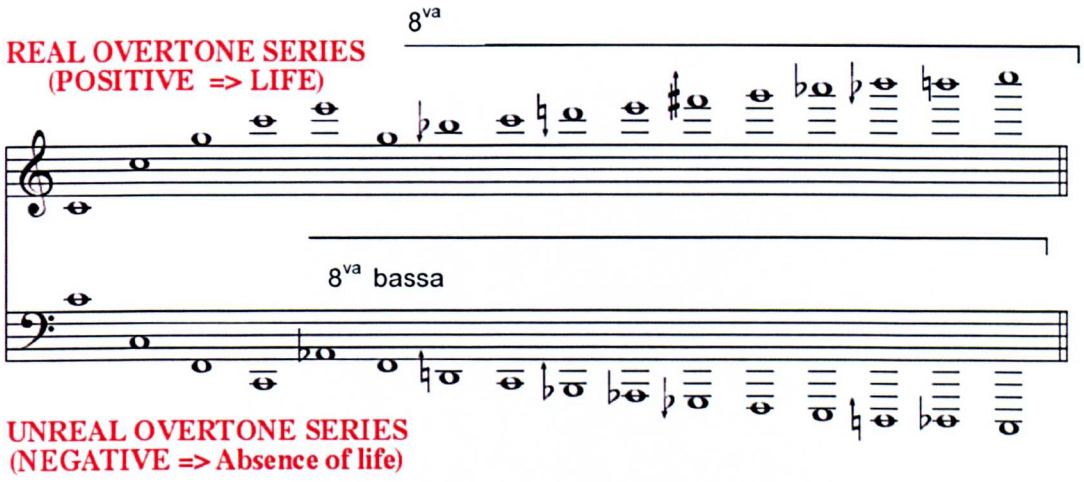


Fig. IV.1.1 –Two harmonic series used to organise the pitch parameters in both pieces.

By leaving the repetitions in both series and the octaves aside, this becomes a thirteen-tone-series with the following pitches:

[2] The first one was *Spectral colours*, composed in 1996.

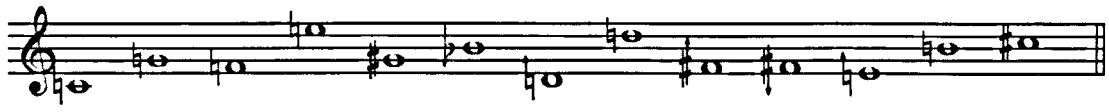


Fig. IV.1.2 – Effective series without repetitions of the harmonic series shown in Fig. IV.1.1 above.

By ordering the pitches in a scale form, a thirteen-tone scale is formed, as shown in Fig. IV.1.3:

Fig. IV.1.3 – Resulting scale from the positive and negative harmonic series (13 pitches).

The results from these two series (Fig. IV.1.3) combined with numbers related to Tichauer's life[3] are the key to develop parameters such as rhythm, pitch and the treatment of the electronic sounds (concrete and synthetic) for the quadrophonic tape parts for both *T.A.T.* and *Overture*.

Formally, the piece has four main sections, without any break:

- 1st Section: Introduction, from minute 00:00 to 03:50.
- 2nd Section: from minute 03:00 to 06:35, mainly a reverse mix of the former section with a 35 seconds overlap among both. The last thirty-five seconds of this section fade out during a short transition (06:00 to 6:35).
- 3rd Section: from minute 06:35 to 08:37
- 4th Section: Coda, from minute 08:37 to 10:38 (end of the piece).

These four sections constitute only the main frame of the piece, as the constant overlapping of different layers of sounds (virtually a counterpoint of electronic sounds), mostly those of the C major chord transformed (stretched or transposed) does not allow for the perception of those limits, something compositionally intended.

The sound materials for both productions of the 4-track-tape were the following:

[3] After transposing the scale to all its pitches (thirteen transpositions) the number of letters of each of his names were taken, programming a three element array with the numbers 5 (Tomás), 9 (Alejandro), 8 (Tichauer). These three numbers act like a raster, choosing from each of the thirteen scales always every 5th, 9th and 8th note and making from each scale a 39-pitch-series (three times 13). This means, that the raster goes 13 times with each number from his names through each scale. That results in a 508 pitches-array for the viola and the bass clarinet in *T.A.T. (a man's life)*. Please note, that 13 was the number of years that we knew each other until his death.

- an orchestral C major chord sample taken from the beginning of the Overture of the lyric drama *Die Meistersinger von Nürnberg* by Richard Wagner with a duration of about 1.5 seconds.
- three Viola samples (1x *pizzicato*, 2x *sul ponticello*) plus one clarinet sample with a duration of about two seconds each.
- treatment of the former mainly with granular and cross synthesis.

The C major chord was chosen for three main reasons. Firstly, its sonic and timbrical characteristics (a tutti from a Wagnerian orchestra) and its obvious relationship with the basic pitch of the viola. Secondly, Wagner was one of Tichauer's favourite composers (and mine too). The third reason was the chord's flexibility (due to its richness in timbre) to change its pitch and duration by pitch-shifting and time-stretching procedures, which mainly contribute to the dramaturgic intention of exalting somebody's life after death. The chord dominates most of *Overture (in memoriam T.A.T.),* and was treated using different DSP procedures, such as:

1- phase-vocoding (pitch-shift), transposing the chord according to the series of pitches from the overtone-series mentioned above, in both positive and negative directions.
2- phase-vocoding with time-stretching, where the C major chord was prolonged up to 180 seconds (about three minutes), mostly noticeable at the beginning and at the end of the piece.
3- short parts of this chord were also used as the basic material for granulation.

All samples are used in the introductory section, in which the structure is algorithmically programmed using *CommonMusic* and Macintosh Common LISP. A retrograde of this part with the addition of a large-hall reverberation preset (using a Lexicon 480L) constitutes the *Overture's* second section. The complete algorithm, which can be found at the end of this appendix, was programmed as a *merge*, that is, a group of algorithms that are triggered together by the merge function in *CommonMusic*, with a defined start time. The algorithm was programmed in such a manner, that pitches were concurrently transposed to higher and lower pitches, following the principles of the two harmonic series shown in Fig. IV.1.1. The programming of the rhythms in this section begins with long durations, which are constantly shortened over time (about 3:35 minutes), with a sense of compression (and even granulation) of all materials treated.[4]

Another important aspect of the work, as usual in acousmatic works, is the spatial diffusion of the sound. The quadrophony of the piece is based on the musical concept of four-voice counterpoint. The channel distribution was set according to the German typical clockwise disposition as shown in Fig. IV.1.4. The reduction to stereo for the CD versions in public domain releases try to respect this as much as possible, aligning channels one and four to the left and two and three to the right of the stereo-image.

[4] Minute 3:00 to 3:35 of the piece on the CD.

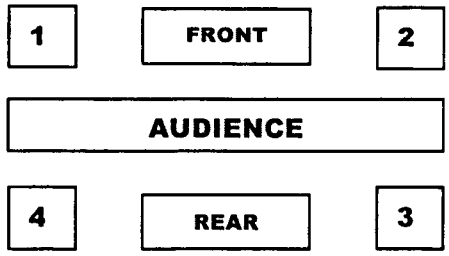


Fig. IV.1.4 – *Overture (in memoriam T.A.T).* Clockwise channel distribution of the quadrophonic tape.

App. IV.2 Additional Data.

The piece has been edited in the public domain commercially twice on CD, as shown below:

2003

Overture (in memoriam T. A. T.) on the CD:' *kontinuum...bruchlos- DeGeM CD 7'*, edited 2003 by Cybele (Germany) and DeGeM (Germany). CD n°: 960.207 – 2003 / LC 3738, DDD. Code: 8 09548 00832 and 4 040961 000837.

2001

Overture (in memoriam T. A. T.) on the CD:*'EX MACHINA – Volume 6 – the nineties'*, edited 2001 by *Cybele* (Germany) and the *Folkwang Hochschule Essen* (Germany). CD n°: 960.106 – 2001 / LC 3738, DDD. Code: 4 040961 000707. Volume 6 also is available in a box (deluxe Edition) with Volumes 4 & 5 under the same numbers.

Besides, the piece has been internationally performed since its composition as follows:

07.12.1997 - ZKM-KUBUS – Karlsruhe - Germany (World Premiere)
06.02.1998 - Alte Aula - Folkwang Hochschule Essen - Germany
10.04.1998 - 7th Florida Electroacoustic Music Festival / Black Box Theater. University of Florida, Gainesville-USA.

04.07.1998 - Neue Aula - Folkwang Hochschule Essen - Germany
21.11.1998 - Theremin Centre – Tchaikovsky Conservatorium – Moscow - Russia.
09.02.1999 - Concordia University Electroacustics - Oscar Peterson Concert Hall - Montreal, QC, Canada
29.04.1999 - Festival für elektroakustische Musik / *Klangraum Kreuzeskirche 99* – Essen - Germany
28.03.2000 - Aaron Copland School of Music (Queens College) Recital Hall – New York - USA
21.03.2001 - Concert - Lecture / Studio 'F' - New York University - New York - USA
22.03.2001 - Le Frak Recital Hall - Queens College - New York - USA
04.03.2002 - Frederik Loewe Theatre - New York University – New York - USA

07.03.2002 - University of New York - Queensborough Community College - Queens - New York - USA

03.03.2003 - *Twisted Multimedia Concert* / F12-22 the Fenway / Berklee College of Music – Boston, MA - USA.

27.06.2003 - Summer Show / Concert / Room 100- London Metropolitan University. London - UK

30.01.2004 - Akademia Muzyczna Im. Fryderyka Chopina / Studio S-1 – Warsaw - Poland

03.03.2004 - *Concerti Dei Docenti 2004* / Tavola Ototipica / Concerto acusmatico / Conservatorio Giuseppe Tartini / Sala Tartini.Trieste - Italy.

From 05.06.06 to 10.07.06 - Daily on the ISCM World Music Festival on DEGEM WebRadio – Germany - http://biblio.zkm.de/DegemWebradio/Radiostream.html[5]

15.11.2006 - Recital Hall / School of Music / University of North Carolina in Greensboro. Greensboro, NC - USA

19.11.2006 - Fulton Hall, University of Chicago / Chicago, IL – USA

15.11.2009 - 'Festival Internazionale di Musica Elettroacustica' - Conservatorio di Musica Santa Cecilia di Roma / Sala Accademica. Rome – Italy

05.12.2009 - MUSIKFABRIK - Schlüsselwerke-Festival. Cologne - Germany

[5] 56 kbit/sec: http://www.ima.zkm.de:8000/degem_56kbit.m3u
96 kbit/sec: http://www.ima.zkm.de:8000/degem_96kbit.m3u
192 kbit/sec: http://www.ima.zkm.de:8000/degem_192kbit.m3u
or
56 kbit/sec: http://www.ima.zkm.de:8000/degem_56kbit
96 kbit/sec: http://www.ima.zkm.de:8000/degem_96kbit
192 kbit/sec: http://www.ima.zkm.de:8000/degem_192kbit

App. IV.3 *Overture (in memoriam T.A.T.)* - Algorithm for Pitch Generation of Samples at the Beginning of the Piece (Programming Language: LISP).

```
;; FILE: TATMerge-CommonMusic.lisp

(Merge TATpart1 ();;;Duration 3:45

;; Samplesdauer on the Sampler (AKAI) ---> in Sec (C4->original pitch)

(loop for beg from 1 to 5
for n in '(09pizzdwn 08pizzdwn 10AmStegdwn CDurPHVoc Clarinet)
for begin in '(0 0 0 120 60)
for Anfangston in '(c4 c4 c4 c4 c4)
for kanal in '(0 1 2 3 4)
for FreqInk in '(100 1000 10 10 10)
for AlgDur in '(468 468 468 234 351)
do

(let*
((Noten Anfangston)
(knl kanal)
(FreqInkr FreqInk)
(Alg-Dur AlgDur))

(algorithm (name n) midi-note (start begin)
(vars (i 0) (FreqRatio 1) (decrement 1) (amp .4) (Länge 0)  (RhythmRatio 0) (k knl)
(Tatarrayla 0)(FreqInc 0)
(env1 '(0.01 0.005 0.26 0.25 0.51 0.34 0.77 0.47 1.00 1.00)))


(setf Länge Alg-Dur) ;; The number of the element of the Algorithm will be calculated
;;(Duration:3:50)

(setf Amplitude (interpl (mod count Länge) 0 amp (- Länge 1) .9))

(setf i (between 0 29))
(setf decrement (interp (/ count länge)
env1 :scale 30 :offset 1 :return-type 'integer))
;;decrement will be used to make the rhythms shorter and shorter due to the envelope and
;;to make the frequencies lower and lower

(setf Channel k);;MidiChannels 1 2 3 (Samples)

(setf FreqRatio (item(items 0.5 4 0.33 2.25 0.5 1.77 0.6 1.5625 0.66 1.44 0.714285 1.3611
0.75 1.30 0.77 1.265625 0.8 1.2345 0.8181 1.21 0.83 1.19 0.8461 )))
(setf FreqInc (* FreqRatio FreqInkr))
(setf Note (item (steps 1 from Noten):kill länge))
(setf Note (item(pitches (steps 1 from Noten))))
```

```
(setf note (/(* note  FreqRatio) decrement));;the frequencies will be transposed lower and
;;lower.
(if (< note 30) (setf note (+ note 50)) (setf note note))

(setf tatarrayla (make-array 29
:initial-contents '(1/1 2/1 1/2 3/2 2/3 4/3 3/4 5/4 4/5 6/5 5/6 7/6 6/7 8/7 7/8 9/8
8/9 10/9 9/10 11/10 10/11 12/11 11/12 13/12 12/13 14/13 13/14 15/14 1)))

(setf RhythmRatio  (aref tatarrayla i))
(setf rhythm (item(rhythms 1 2 1 1 1.32 1.32 1.32 1 3 )))
(setf Rhythm (/(* Rhythm RhythmRatio 1.0 )  decrement))
(setf Duration (* rhythm 2) )


(print (list count Channel Duration note))
);;End of algorithm
);; end of Let* (of Loop)
);;of loop1

(loop for beg from 1 to 4
for n in '(09pizzup 08pizzup 10AmStegup Clar)
for begin in '(0 0 0 60)  ;;Start wird von der GesamtDauer von c4 (Akai S1000 + Yamaha
TG77)
for Anfangston in '(c4 c4 c4 c4)
for kanal in '(0 1 2 4)
for FreqInk in '(100 1000 10 100)
for AlgDur in '(468 468 468 234)
do

(let*
((Noten Anfangston)
(knl kanal)
(FreqInkr FreqInk)
(Alg-Dur AlgDur))


(algorithm (name n) midi-note (start begin)
(vars (i 0) (FreqRatio 1) (decrement 1) (amp .1) (Länge 0)  (RhythmRatio 0) (k
knl)(Tatarray1b 0) (FreqInc 0)
(env1 '(0.01 0.005 0.26 0.25 0.51 0.34 0.77 0.47 1.00 1.00)))


(setf Länge Alg-Dur) ;; The number of the element of the Algorithm will be calculated
;;(2106=26*9*9)

(setf Amplitude (interp1 (mod count Länge) 0 amp (- Länge 1) .7))

(setf i (between 0 29))
(setf decrement (interp (/ count länge) env1 :scale 30 :offset 1 :return-type 'integer))
;;decrement will be used to make the rythms shorter and shorter due to the envelope and to
;;make the frequencies lower and lower
```

```
(setf Channel k);;MidiChannels 1 2 3 (Samples)

(setf FreqRatio (item(items 0.5 4 0.33 2.25 0.5 1.77 0.6 1.5625 0.66 1.44 0.714285 1.3611
0.75 1.30 0.77 1.265625 0.8 1.2345 0.8181 1.21 0.83 1.19 0.8461 )))
(setf FreqInc (* FreqRatio FreqInkr))
(setf Note (item (steps 1 from Noten):kill länge))
(setf Note (item(pitches (steps 1 from Noten))))
(setf note (*(* note  FreqRatio) decrement));;the frequencies will be transposed higher
and higher
(if (> note 3800) (setf note (*(/(* 3800 (- note 3800)) note)1.0)) (setf note note))

(setf tatarray1b (make-array 29
:initial-contents '(1/1 2/1 1/2 3/2 2/3 4/3 3/4 5/4 4/5 6/5 5/6 7/6 6/7 8/7 7/8 9/8
8/9 10/9 9/10 11/10 10/11 12/11 11/12 13/12 12/13 14/13 13/14 15/14 1)))

(setf RhythmRatio  (aref tatarray1b i))
(setf rhythm (item(rhythms 1 2 1 1 1.32 1.32 1.32 1 3 )))
(setf Rhythm (/(* Rhythm RhythmRatio 1.0 )  decrement))
(setf Duration (* rhythm 2))

(print (list count Channel Duration note))
);;End of algorithm
);; end of Let* (of Loop)
);;end of LOOP2
) ;; End of Merge
```

Appendix V

App. V.1 *Color Code*: Technical Description.

Contrary to the usual role of the 'composer' or 'sound designer' in this type of project, I did not have to produce the sound and music for a given visual product; it happened in exactly the inverse manner. After having composed three acousmatic stereo pieces for tape, the group decided that they would create image based on that music. The duration of the pieces are respectively 8'30', 3'20' and 8'16'.

As the project should also include live interaction, an instrument (viola) was added to interact via a computer (using the MAX/MSP environment). I finally composed two pieces of around five minutes each for viola and MAX/MSP, acting as intermezzi between the three tape pieces, with an overall duration of thirty minutes. The image is very active in the tape sections; in the interactive sections however, it mainly fades out from very bright to very dark and vice-versa, to give room for the live performance to have enough attention from the audience.

The main form of the piece is as follows:

Akt I: quadrophonic tape and video. Colours on the video: blue, white and black.

Intermezzo I: viola and computer (MAX/MSP) and video. Video fades out along 5 minutes imperceptibly from very bright to very dark.

Akt II: quadrophonic tape and video. Colours on the video: green is added to the former ones.

Intermezzo II: viola and computer (MAX/MSP) and video. Video fades in along 5 minutes imperceptibly from very dark to very bright.

Akt III: quadrophonic tape and video. Colours on the video: All other colours are added to the former ones.

Visually the project aims to work primarily with basic colours and their graduations, which are only possible to be produced through the meticulous use of computer graphics (with a definition of millions of colours). There are no geometric forms in the design of the graphics, only lines or strips with the different colours. Hence, it was agreed, that the music and the sound design should also work with elemental principles. The sounds for the tape part were produced only through synthesis procedures, and then developed using a variety of processes. The main sounds were produced using simple Chowning FM or additive synthesis (via Csound). The further treatment of these basic sounds mostly used convolution (cross synthesis through the multiplication of two or more sound spectra via FFT and IFFT), time stretching, filtering and granulation. All three acousmatic parts were produced from a total of 150 different sounds, including the basic ones and their further developments.

The same approach was followed for the interactive part for viola and computer. The first *Intermezzo* works with only delays and amplitude modulation. The delays change their setups dynamically through time (such as feedback degree, etc). As the buffer size of the delays changed dynamically, a Doppler effect was the result, which has an interesting interaction with the projection on the screen, which is only white at this point, producing a dramatic effect of movement of sound with no correlation to the image. The Amplitude Modulation used a cosine waveform as a carrier (with its frequency dynamically programmed from 1 Hz to 120 Hz to loop every 150 seconds) and a modulator, similar to the carrier, but with its frequency range from 10 Hz to 1200 Hz looped every four minutes. The input of the viola is then amplitude-modulated and passed through the delay lines.

The second *Intermezzo* works mainly with the process of convolution. The input of the viola is convolved with two alternate samples in two different buffers. The results of the convolution are again amplitude-modulated with the viola. The dry signal of the viola and the results of the convolution-AM are sent direct to the output and also to a comb-filter. The reason for more complex sound synthesis processes in the second *Intermezzo* is to pre-announce the introduction of the rich palette of colours of the visual part in the following section (*Akt III*).

The output of the live-electronics of both *Intermezzi* is in stereo with an automatic panorama movement. Quadraphonic diffusion is obtained by crossing signals between rear and front.

The quadrophonic tape part is set according to the German typical clockwise distribution, as shown below:

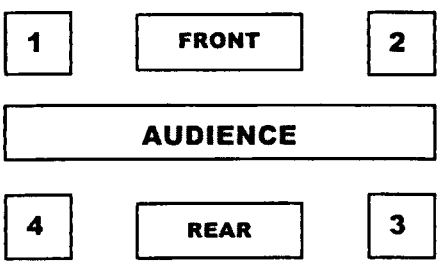


Fig. V.1.1 – *Color code.* Clockwise channel distribution.

Technical data:

- Projection on two screens, opposed to each other (installation version), or both animations on one screen (concert version) through normal projectors, BETACAM video or through real-time generation of the graphic data by means of a computer (originally a Silicon Graphics O2). Nowadays it can be projected from a laptop and uncompressed video from a video/audio sequencer.
- Quadrophonic tape
- Interaction of viola and live-electronics (MAX/MSP)

App. V.2 Additional Data.

Public Performances of the Piece:

26.11.1998 - 7. International Vilém Flusser-Symposium / Oetker Halle / Kleiner Saal. Fachhochschule Bielefeld - Germany. (World Premiere)

30.10.1999 - Mediennacht ExMachina / Neue Aula /. Folkwang-Hochschule Essen - Germany.

02.12.1999 - 'Artificial Art' Konzertreihe / TO-260 Universität Bielefeld - Germany.

06.04.2000 - 9h Florida Electroacustic Music Festival - Black Box Theater - University of Florida, Gainesville - USA.

30.08.2000 - International Computer Music Conference - ICMC2000 - Akademie der Künste – Berlin - Germany.

04.02.2001 - Konzertreihe Neue Musik und Bildende Kunst, GNMR. Alte Synagoge Essen - Germany.

28.10.2001 - *Open Systems* - Festival für Zeitgenössische Musik & Kunst in Ruhrgebiet. Flottmann Hallen Herne - Germany.

10.11.2001 - November Music 2001/ 30 Jahre ICEM / Neue Aula / Fokwang-Hochschule Essen - Germany.

04.03.2002 - Frederik Loewe Theatre - New York University – New York - USA.

09.10.2004 - Jubiläumsmarathon '15 Jahre Gesellschaft für Neue Musik Ruhr e. V.'15 Stunden 'Time for Changes' / Philharmonie Essen - Foyer – RWE Pavillon. Essen - Germany.

01.08.2009 - University of Miami's CAS Art Gallery - 1210 Stanford Drive - Coral Gables *12 nights - Electronic music and art: Electroencephalogram, Images and Sounds* featuring works by Claudia Robles & Javier A. Garavaglia. Florida – USA

App. V.3 Members of the Group Animato (Stand 1998):

Fachhochschule Bielefeld

Prof. Gottfried Jäger: project leader and artistic conception

Prof. Karl Martin Holzhäuser: artistic conception and development

Dr. Martin Deppner: Scientific adviser

Jürgen Fricke: data integration and network management

Thomas Noak: sound.

Universität Bielefeld:

Prof. Dr. Andreas Dress: mathematic paraphrasing

Peter Serocka: visualising.

ICEM – Folkwang Hochschule Essen

Javier Alejandro Garavaglia: music composition, sound design, live-electronics programming and live-performance.

Appendix VI

App. VI.1 *L.S. (waiting for changes)*: Technical Description.

Pitches and rhythmic values for the basic compositional materials were primarily derived from the words *Luxembourg Sinfonietta* as explained below.

Rhythms:

The rhythms developed from the structure in Fig. VI.1.1, which is actually a possible (but not the only) rhythmical way of spelling both words.

Fig. VI.1.1 – *L.S. (waiting for changes).* Generative rhythm pattern.

This pattern is based on a subdivision for a short syllable given the rhythmical value of a sixteenth (unit) and it appears throughout the piece, with derivations and developments: the unit can be augmented or diminished to a tuplet's[6] eight, an eight, a quintuplet's sixteenth, a quarter note, a half and a tuplet's half, etc. as the four examples in Fig. VI.1.2 show:

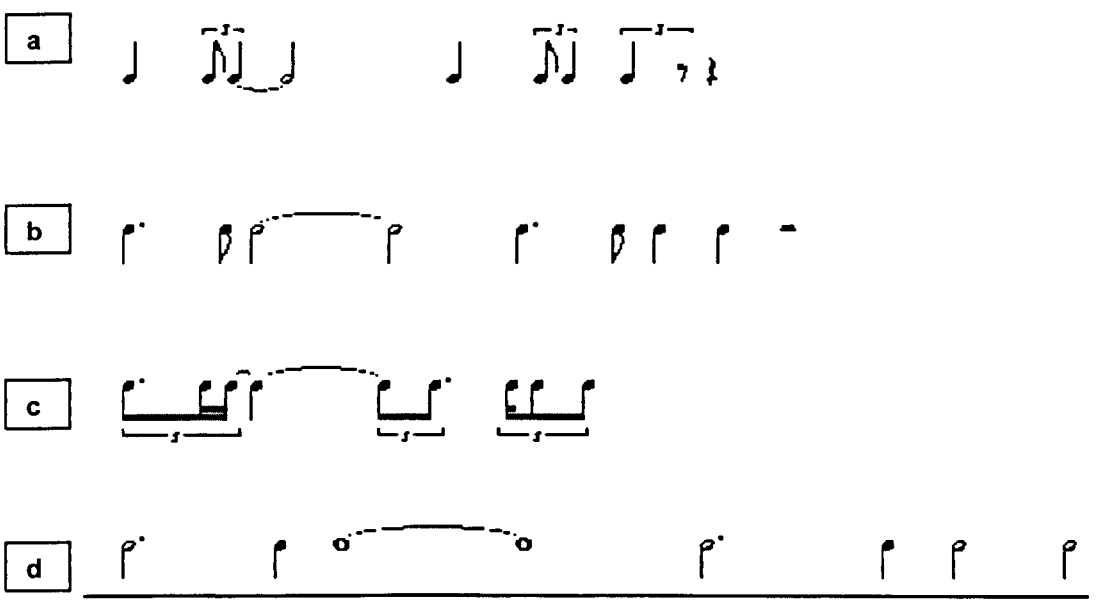


Fig. VI.1.2 – *L.S. (waiting for changes).* Development of the basic rhythm pattern with respectively a tuplet's eight (a), an eight (b), a quintuplet's sixteenth (c) and a quarter note (d).

[6] This word, taken from American English, signifies an irregular subdivision of rhythms (in this case in three parts)

To show a brief example of how this is used, the very beginning of the piece is based on example 'b' of Fig. VI.1.2, where the first duration is on the accordion, the second on the first violin, the third on the second violin, etc. (see score, bars 1 to 4).

Pitches:

The generation of pitches has two sources: the first is divided into two subgroups and derived (like the rhythms) from the words *Luxembourg Sinfonietta*, in this case utilising only those letters associated with a note (Fig. VI.1.3)[7] and grouping them in scale order (Fig. VI.1.4) avoiding repetitions, where a second group is generated by the remaining pitches, also in scale order (Fig. VI.1.5).

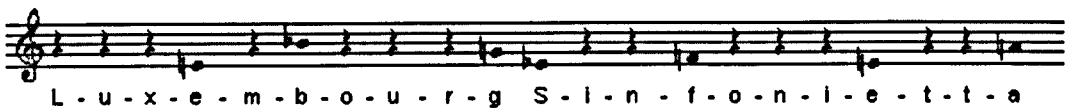


Fig. VI.1.3 – *L.S. (waiting for changes).* Pitch generation – first source (subgroup 1) derived from the words 'Luxembourg Sinfonietta'.

Fig. VI.1.4 – *L.S. (waiting for changes).* Pitch generation – first source (subgroup 1) derived from the words 'Luxembourg Sinfonietta' in descendent scale order and without repetitions.

Fig. VI.1.5 – *L.S. (waiting for changes).* Pitch generation – first source (subgroup 2), showing the rest of the notes of the whole chromatic scale in ascending scale order.

Each of these groups (not counting the repetitions) consists of six pitches.

The second source consists of four chords taken from an earlier piece of mine (*Interzones [A/E-B]*), as shown in Fig. VI.1.6:

[7] In German, the note Es (S) is E flat and B is B flat, as H is for the note B.

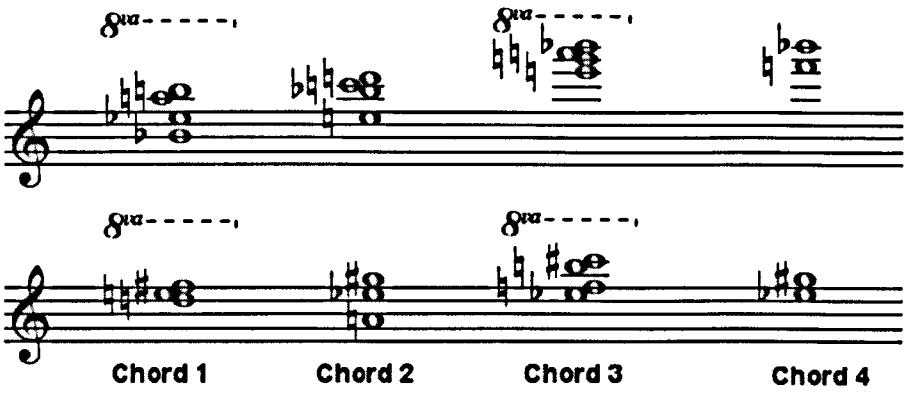


Fig. VI.1.6 – *L.S. (waiting for changes).* Pitch generation – second source, all four chords

It was a personal decision to use these chords, which bear no relationship with the two six note series. The reason for this can be found in their particular timbre and high position in pitch, which served the musical thematic ideas of chord disintegration in many parts of the work (typical examples are bars 6 and 9 of the score)

The series from the first source is used in a preferably melodic manner, for example building melodic clusters through the accumulations of melodic and sustained patterns, as shown by the development in bar 16 (see vibraphone). Here, the other instruments 'colour' those attacks with microtones and the other six tones form a very smooth accompanying chord with piccolo, flute, clarinet and harmonics on the strings, which begin to develop the main rhythmic patterns from bar 17 (the rhythmical pattern has been augmented here with a unit equal to a tuplet's half note). Another example is the canon-like development from bar 110, which uses both pitch series with all different rhythmical patterns, beginning with the piccolo, flute and both violins and progressively enhancing the harmonic density and texture with other instruments.

The chords, on the other hand, build a harmonic field, which is static. They appear mostly in their original form, but there are transpositions (see bar 71 and following) and a process of disintegration of the chords, which, based on the rhythms shown in Fig No VI.1.2, makes changing parts of the chords appear with different instrumentation, in a Hocket-like manner (good examples of this are bars 6, 13, 60, 74 and 170).

Form:

The form of the piece consists of an introduction, nine sections and a coda. The nine sections act as a series of variations, not about a precise theme in the classical sense, but exposing and developing different materials, with very abrupt changes of mood, instrumentation, tempo and pitch for each section, with the intention of alluding to the changes meant in the title. The entire structure looks as follows:

(i) Introduction (bar 1)
(ii) 1st section or variation (bar 14)
(iii) 2nd section or variation (bar 37)
(iv) 3rd section or variation (bar 59)
(v) 4th section or variation (bar 71)
(vi) 5th section or variation (bar 85)
(vii) 6th section or variation (bar 93)
(viii) 7th section or variation (bar 100)
(ix) 8th section or variation (bar 101)
(x) 9th section or variation (bar 110)
(xi) Coda (bar 170)

The duration of each section was not established *a priori*: it was given by the combination of the different rhythmical patterns previously described. The only exception to this rule is section No 7 at bar 100, which is free in tempo.

Instrumentation:

The instrumentation had to be that provided by the *Luxembourg Sinfonietta*. I decided to include all instruments available, to better serve the dramaturgical intention of 'changes'. The orchestra looks as follows:

Piccolo
Flute
Clarinet in Bb
Bass clarinet in Bb
Alto saxophone in Eb
Baritone saxophone in Eb
2 trumpets in C
Horn in F
Tenor trombone
Tuba
Percussion (1 player): including 2 Cymbals, 3 Tom-Toms, Gran Cassa and Vibraphone
Accordion
Piano
2 Violins
3 Cellos

App. VI.2 Additional Data.

Performances

30.11.2003 - World -premiere at the *Cercle Municipal Luxembourg*, Luxembourg performed by the *Luxembourg Sinfonietta* conducted by Marcel Wengler.
Recorded at this concert by the National Luxembourg Radio and broadcasted in Luxembourg in 2004.

Appendix VII

List of all Relevant Work in the Public Domain

Publications:

2010:

- **Article in book:**

  Title: *'Raising Awareness About Complete Automation of Live-Electronics: a Historical Perspective.'* in ***Auditory Display, 6th International Symposium CMMR/ICAD 2009, Copenhagen, Denmark, May 2009. Revised papers. Lecture Notes in Computer Science - LNCS 5054,*** Springer Verlag. Berlin, Heilderberg (2010), pp. 438-465

  ISSN 0302-9743

  ISBN-10 3-642-12438-0 / Springer Verlag. Berlin, Heilderberg, New York.

  ISBN-13 978-3-642-12438-9 / Springer Verlag. Berlin, Heilderberg, New York.

2009:

- **Paper in Proceedings Book:**

  15th International Conference on Auditory Display **ICAD 2009 – *TIMELESS SOUND* — Copenhagen - Denmark**

  Title: *'Full Automation In Live-Electronics: Advantages and Disadvantages'*

  Published on: *Proceedings of the 2009 ICAD Conference*

  Edition: Kristoffer Jensen. May 2009. Publisher: Re:New – Digital arts Forum (Denmark)

  ISBN: 978-87-7606-033-6

- **CD**

  RE-NEW 09 Festival – Denmark – Official CD

  Piece: ***farb_laut E - VIOLET*** for viola & MAX/MSP

  Version: Recorded live on April 4th, 2009 at the C.U.N.Y. Graduate Center, NYC, USA.

  Viola: Javier A. Garavaglia.

- **Article in Book / Excerpts of composition's recording on attached Audio CD**

  Internationales Klangkunstfest *farb_laut - Ausstellung, Konzerte und Symposium*

  Herausgegeben von Thomas Gerwin

  Book contains: Garavaglia's CV and programme notes to the piece ***farb_laut E - VIOLET*** for Viola & MAX/MSP (in German).

  Attached Audio CD contains (Track 2) excerpts (7 min and 34 sec) of the premiere of the piece ***farb_laut E - VIOLET*** for Viola & MAX/MSP in Berlin (Nov. 1st 2008, Teehaus im Englischen Garten).

  Viola: Javier A. Garavaglia.

ISBN 978-3-00-026998-1

- **Article in Online Journal**

  JMM - The Journal of Music and Meaning

  http://www.musicandmeaning.net

  JMM 7, Fall/Winter 2008

  Invited Paper:

  Javier Alejandro Garavaglia*: 'Music and Technology: What Impact Does Technology Have on the Dramaturgy of Music?'*

  (NOTE: this is an enhanced and enlarged version of my previous paper at the CMMR/NTSMB 2008. It can be downloaded from http://www.musicandmeaning.net)

- **Article in Book**

  Title: *'Live-electronics: Procesamiento del sonido en tiempo real. Perspectiva histórica - Distintos métodos y posturas.'*

  Escritos sobre Audiovisión - Lenguajes, Tecnologías, Producciones – LIBRO 3 - Compilation by Susana Espinosa - Colección Humanidades y Arte / Serie Audiovisión - 2008 - Ediciones de la UNLa (Lanús, Argentina) p. 161-174

  ISBN 978-987-1326-20-4

  (Article published in Spanish)

2008:

- **Paper in Proceedings Book:**

  CMMR/NTSMB 2008 - *Genesis of Meaning in Digital Art*

  Denmark – Copenhagen

  Title: *'Music and technology: What impact does technology have on music's dramaturgy?'*

  Published on: *Proceedings of the 2008 Computers in Music Modelling and Retrieval (CMMR) and Network for Cross-Disciplinary Studies of Music and Meaning Conference (NTSMB) - Genesis of Meaning in Digital Art.* Edition: Kristoffer Jensen. May 2008. Publisher: Re:New – Digital arts Forum (Denmark)

  ISBN: 978-87-7606-027-5

2007:

- **Paper in Proceedings Book:**

  ICMC 07 – Denmark – Copenhagen

  Title: *'Sound&Media Studios @ Londonmet, Commercial Rd.'*

  Published on: *Proceedings of the 2007 International Computer Music Conference, Volume 1.* Edition: The International Computer Music Conference Association (USA) and Re:New – Digital arts Forum (Denmark). August 2007. Publisher: Suvisoft Oy Ltd, Finland.

ISBN: 0-9713192-5-1

2005:

- **CD**

  Piece ***Granular Gong*** for octophonic tape on the CD: '*Festival Internacional Sonoimágenes 2005 – VOLUMEN 1 / Colección SONIDOS Y VISIONES DEL SUR / Música electroacústica de compositores nacionales e internacionales*', edited 2005 by the Universidad Nacional de Lanús (Argentina).

2003:

- **Paper in Proceedings Book:**

  9th biennial Symposium for Art and Technology: 'Transparent technologies' (Connecticut College - New London CT, USA).

  Title: *'An approach to Music's dramaturgy with the interaction of technological devices. A composer's review of 'Ninth (music for Viola and Computer)' (2002) for Viola and MAX/MSP'*, published by the Center for Arts and technology, Connecticut College, New London, CT, USA, February 2003.

  NO ISBN.

- **Article in Journal**

  'NINTH, FOR VIOLA AND MAX-MSP'. Published on 'MITTEILUNGEN 44' of the Deutsche Gesellschaft für Elektroakustische Musik. Edited by PFAU Verlag, Saarbrücken (Germany). February 2003.

  ISSN: 1435-5884

- **CD**

  Piece ***Overture (in memoriam T. A. T.)*** for quadrophonic Tape on the CD:' *kontinuum...bruchlos- DeGeM CD 7'*, edited 2003 by Cybele (Germany) and DeGeM (Germany).

  CD n°: 960.207 – 2003 / LC 3738, DDD. Code: 8 09548 00832 and 4 040961 000837.

2002:

- **CD**

  Piece: ***Arte Poética (I)***, on the CD '*Florida Electroacoustic Music Festival – VOLUME 1'*, edited by the EMF Media, Electronic Music Foundation ltd. New York USA and the Florida Electroacoustic Music Studios, University of Florida.

  EMF CD N° 031. CD Production by Healey Disc Manufacturing – 2002. DDD. Code: 6 53727 81192 5.

2001:

- **Paper in Proceedings Book:**

8th biennial Symposium for Art and Technology: *'Feedback-perception and interaction in the electronic arts'* (Connecticut College - New London CT, USA). Title: *'Composition principles for "Spectral colours" '* for Ensemble and tape (1996), published by the Center for Arts and technology, Connecticut College, New London, CT, USA, March 2001.
NO ISBN.

- **CD**
  Piece: ***Overture (in memoriam T. A. T.)*** for quadrophonic Tape on the CD:*'EX MACHINA – Volume 6 – the nineties'*, edited 2001 by *Cybele* (Germany) and the *Folkwang Hochschule Essen* (Germany). CD n°: 960.106 – 2001 / LC 3738, DDD. Code: 4 040961 000707. Volume 6 also is available in a box (deluxe Edition) with Volumes 4 & 5 under the same numbers.

1999

Programme Notes to:
Overture (in memoriam T. A. T.) in the book *KlangRaum Kreuzeskirche 99 – Programmbuch* – (pages 119-120), edited by: PFAU Verlag. Postfach 102314 – 66023 Saarbrücken.- Germany. Book edited in German.
ISBN: 3-89727-065-X

1996

- **CD**
  Piece: ***Arte Poética (I)*** for quadrophonic Tape on the CD:*'EX MACHINA – tangent'*, edited 1996 by *Cybele* (Germany) and the *Folkwang Hochschule Essen.* (Germany).
  CD n°: 960.102 – 1996 / LC 3738, DDD.

1995

- **Paper in Proceedings book:**
  2nd Brazilian Symposium on Computer Music (SCBII) in Canela (Brazil).
  Title: *'THE NECESSITY OF COMPOSING WITH LIVE-ELECTRONICS. A short account of the piece 'Gegensaetze (gegenseitig)' and of the hardware (AUDIACSYSTEM) used to produce its real-time processes.'*
  Proceedings Book published by the 2nd Brazilian Symposium on Computer Music (SCBII), August 1995 - No ISBN. (abstract available at: http://gsd.ime.usp.br/sbcm/1995/papers/Javier_Alejandro.html)

Catalogue of Premiered Compositions, including Date and Place of the World Premiere:

(1) *Timbres (después de 4 Piezas)* for oboe, viola and Piano (Argentina, 1989)

(2) *4 Piezas* for oboe, viola and piano (Argentina, 1989)

(3) *Laberinto '.... palabras, poemas...'* for 4 singers and chamber ensemble, based on poems by Jorge Luis Borges, Marcelo Gasparini and Alejandra Pizarnik. (Germany, 1991)

(4) *'T.T' (Spiel für Tommy und seine Bratsche)* for viola solo. (Germany, 1991)

(5) *'M.H.0.C' (Spiel 2 über ein Jazz Thema und 5 Töne)* for bass wind quintet. (Germany, 1992)

(6) *Spiel 3 (über ein Jazz Thema)* for wind quintet. (Germany, 1993)

(7) *Spiel 3 b (über ein Jazz Thema)* for string quintet. (Germany, 1993)

(8) *pizz* for quadrophonic tape (Germany, 1993)

(9) *Gegensätze (gegenseitig)* for alto flute (G), quadrophonic tape and live-electronics. (Germany, 1994)

(10) *'Poème du temps qui ne passe pas' (..'del otro lado del muro'..),* chamber opera for soprano, bass-baritone, piano, flute, cello and percussion, based on poems by Jorge Luis Borges, Alejandra Pizarnik and Louis Aragón. (Germany, 1994).

(11) *Arte Poética (I),* for quadrophonic tape, based on the poem *'Arte poética'* by Jorge Luis Borges. (Germany, 1995)

(12) *Arte Poética (II. Stanza),* for quadrophonic tape, based on the poem *'Arte poética'* by Jorge Luis Borges. (Germany, 1996)

(13) *Contraries (resonances)* for alto flute (G), quadrophonic tape & live-electronics. (Germany, 1997)

(14) *Am Steg (Spaces)* for stereo tape (Brazil, 1997)

(15) *Overture (im memoriam T.A.T.)* for quadrophonic tape (Germany, 1997)

(16) *Arte Poética (stanzas III to VII),* for quadrophonic tape, based on the poem *'Arte poética'* by Jorge Luis Borges. (USA, 1998)

(17) *Color Code*, concert-installation for quadrophonic tape, viola, live-electronics (MAX/MSP) and computer generated graphics on two screens. (Germany, 1998)

(18) *T.A.T. (a man's life)* for viola, bass-clarinet quadraphonic & live-electronics (USA, 1999)

(19) *Poppekstive* for octophonic tape (USA, 1999).

(20) *Spectral colours* for ensemble (14 instruments) & electronics (USA, 2001)

(21) *Granular Gong* for octophonic (USA, 2001)

(22) *NINTH (music for viola and computer)* for viola and MAX/MSP (USA, 2002)

(23) *DJ (1): about Riffs and Noises* for computer (MAX/MSP) (USA, 2003)

(24) *L.S. (waiting for changes)* for ensemble (20 instruments) (Luxembourg, 2003)

(25) *Ableitungen des Konzepts der Wiederholung (for Ala)* for viola and MAX/MSP (USA, 2004)

(26) *Hoquetus* for Tárogató or saxophone and MAX/MSP. (USA, 2005)

(27) *Interzones (A/EB)* for piano, double bass and electronics (USA, 2007)

(28) *Pathétique*, acousmatic work (Portugal, 2007)

(29) *Intersections (memories)* for clarinet in B and real-time electronics with 5.1 sound diffusion (USA, 2008)

(30) *farb-laut E - VIOLET* for viola and MAX/MSP (Germany, 2008)

Appendix VIII

Award Best Paper Dealing with the Conference Theme for CMMR/NTSMB 2008 - *Genesis of Meaning in Sound and Music* (Denmark)

JMM The Journal of Music and Meaning

www.musicandmeaning.net

The Refereed On-Line Journal for Multi-Disciplinary Research on Music and Meaning

is pleased to present the award for Best Paper dealing with the conference theme for CMMR/NTSMB 2008 - *Genesis of Meaning in Sound and Music* - to

Javier Alejandro Garavaglia

for his paper

Music and Technology: What Impact Does Technology Have on Music's Dramaturgy?

Copenhagen, May 22, 2008.

Cynthia M. Grund
Editor-in-Chief,
JMM: The Journal of Music and Meaning;
Director, NTSMB (Network for Cross-Disciplinary Studies of Music and Meaning), www.ntsmb.dk;
NTSMB Program Chair for CMMR/NTSMB 2008

Kristoffer Jensen
General Conference Chair,
CMMR (Computer Modelling and Music Retrieval)/NTSMB 2008

JMM: The Journal of Music and Meaning is a multidisciplinary journal committed to the presentation and discussion of different approaches to the investigation of meaning in music. *JMM* is an on-line journal, available without subscription to any interested reader. *JMM* is peer-reviewed by referees drawn from a large international group of experts and is published semiannually from the Institute of Philosophy, Education and the Study of Religions, University of Southern Denmark at Odense, Denmark with funding from the Danish Research Council for the Humanities. Please visit our site at

www.musicandmeaning.net

Appendix IX

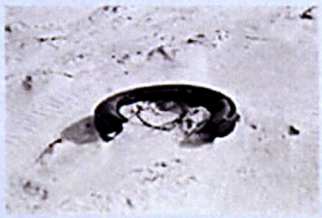
Overture (in memoriam T.A.T.) and *Arte Poética (I)*

In Commercial CDs, as Announced on the Publishers' Websites

DEGEM CD7 - kontinuum...bruchlos

1: **Garavaglia, Javier A.** (* 1960): Overture (in memoriam T.A.T.) [10:38] - > Soundexample
2: **Mittendorf-Labiche, Hans** (* 1952): Invisible Worlds [5:53]
3: **Koch, Sven-Ingo** (* 1974): saxl [9:07]
4: **Roland, H-Ed** (* 1950): N.A.M.A: „booty!" don't walk [8:48]
5: **Cee, Werner** (* 1953): Cities' Drift (Auszug) [10:09]
6: **Gerber, Karl Friedrich** (* 1954): Stream [6:47]
7: **Niehusmann, Frank** (* 1960): Arbeit [6:45]
8: **Hartmann, Friedhelm H.** (* 1963): Electric Symphony (Fuge) [5:40]
9: **Doati, Roberto** (* 1953): Felix Regula IV [13:33]

Musicians: Garavaglia, Javier Alejandro (electroacoustic composition)
Mittendorf-Labiche, Hans (electroacoustic composition)
Koch, Sven-Ingo (electroacoustic composition)
Roland, Harry-Ed (electroacoustic composition)
Cee, Werner (electroacoustic composition)
Gerber, Karl Friedrich (electroacoustic composition)
Niehusmann, Frank (electroacoustic composition)
Hartmann, Friedhelm (electroacoustic composition)
Doati, Roberto (electroacoustic composition)
CYBELE CD 960.207 - Total playing time: 77:21
Booklet languages: English, German (28 pages in total)



Motor-car tire in the sand

More about this CD | Biographies | Reviews | Comments

Taken from http://www.cybele.de/

EX MACHINA - Tangent (Vol. 2)

1: **Reith, Dirk** (* 1947): verSTIMMUNG [8:42] --> Soundexample
2: **Garavaglia, Javier A.** (* 1960): arte poética (I) [8:18]
3: **Ollertz, Ralf R.** (* 1964): cral'une [4:51]
4-5: **Hartmann, Friedhelm H.** (* 1963): portraits of a woman
teil 2 [5:42] - teil 3 [3:10]
6: **Brümmer, Ludger** (* 1958): dele! [17:49]
7: **Eckert, Gerald** (* 1960): diaphane [10:53]

Musicians: Reith, Dirk (electroacoustic composition)
Garavaglia, Javier A. (electroacoustic composition)
Ollertz, Ralf R. (electroacoustic composition)
Hartmann, Friedhelm H. (electroacoustic composition)
Brümmer, Ludger (electroacoustic composition)
Eckert, Gerald (electroacoustic composition)
CYBELE CD 960.102 - Total playing time: 59:25
Booklet languages: English, French, German (32 pages in total)

ICEM Essen

More about this CD | Biographies | Reviews | Comments

Taken from http://www.cybele.de/

EX MACHINA - The Nineties (Vol. 6)

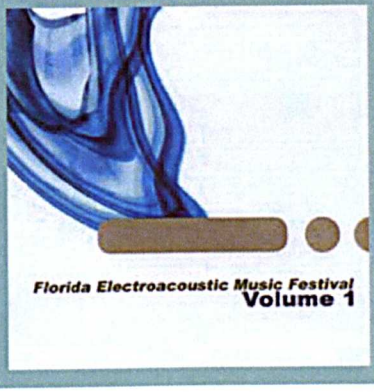
1: **Ollertz, Ralf R.** (* 1964): Pyrócua (1994) [7:36]
2: **Hartmann, Friedhelm H.** (* 1963): exSamples mechanique (1992) [11:34]
3: **Seidl, Hannes Galette** (* 1977): re: bounce (2001) [4:17]
4: **Garavaglia, Javier A.** (* 1960): OVERTURE (in memoriam T.A.T.) (1997) [10:37]
5: **Yang, Yong Joon** (* 1966): grau & blau (1999/2000) [9:28]
6: **Koch, Sven-Ingo** (* 1974): saxl (1999) [8:58] --> **Soundexample**
7: **Pfeifer, Roman** (* 1976): Dem Grau der Nacht enttaucht (2000) [6:56]
8: **Reith, Dirk** (* 1947): Dialog: Mécanique Mon Amour (1993) [14:13]

Musicians: Ollertz, Ralf R. (electroacoustic composition)
Hartmann, Friedhelm H. (electroacoustic composition)
Seidl, Hannes Galette (electroacoustic composition)
Garavaglia, Javier Alejandro (electroacoustic composition)
Yang, Yong Joon (electroacoustic composition)
Koch, Sven-Ingo (electroacoustic composition)
Pfeifer, Roman (electroacoustic composition)
Reith, Dirk (electroacoustic composition)
CYBELE CD 960.106 - Total playing time: 73:49
Booklet languages: English, German (36 pages in total)

ICEM Essen

More about this CD | Biographies | Reviews | Comments

Taken from http://www.cybele.de/



Florida Electroacoustic Music Festival

Catalog number: EM131

This CD celebrates the first ten years of the Florida Electroacoustic Music Festival, organized every year by James Paul Sain at the University of Florida at Gainsville, with a sampling of compositions by guest composers who have at one time or another visited the festival. The compositions are: Ron Parks' 'Residual', Pete Stollery's 'Squirt', Stephen David Beck's 'Sarah-nade (After Brahms)', Javier Garavaglia's 'Arte Poética (I. Stanza)', Joel Chadabe's 'Spring' (from 'After Some Songs'), Ben Thigpen's 'h', Marvin Johnson's 'Compendium II', James Paul Sain's 'Tåg till ...', and Hubert Howe's 'Improvisation No. 3'.

Taken from http://www.emfmedia.org/items/em131.html

Appendix X

Reviews for *Overture (in memoriam T.A.T.)* and *Arte Poética (I)* on CD by Stefan Dress (Germany)

Taken from : http://www.stefandrees.de/kritik/065.html

(Note: the parts concerning the two pieces are highlighted in yellow).

Zur elektronischen Musik und ihrer Entwicklung

Dass die zahlreichen Facetten zeitgenössischen Komponierens von den etablierten Plattenfirmen häufig zu Gunsten populärer Massenware und zugkräftiger Namen verdrängt werden, ist eine bekannte Tatsache. In Anbetracht dieses Umstands ist es umso erfreulicher, wenn kleinere Unternehmen in die Marktnischen vorstoßen um sie mit einem spezielleren Repertoire aufzufüllen. Als wohl einer jener Bereiche schöpferischer Musikproduktion, der mit am schwierigsten die Zuhörerschaft erreicht, bildet die im Studio komponierte elektronische Musik einen Schwerpunkt des Programms von CYBELE. Daß gängige Urteile der elektroakustischen Musik den Abwechslungsreichtum traditioneller kompositorischen Handwerks absprechen, mutet dabei angesichts der Vielfalt von Ideen und Konzepten auf den bislang zu diesem Themenbereich vorliegenden CDs geradezu absurd an. Exemplarisch hierfür sind die bislang sechs in Zusammenarbeit mit dem ICEM (Institut für Computermusik und elektronische Medien) der Folkwang-Hochschule Essen - einem der führenden Instituten seiner Art - veröffentlichten Produktionen der Reihe «ex-machina», benannt nach dem gleichnamigen, im Jahr 1990 gegründeten Festival für elektronische und Computermusik, die einen Einblick in die dortige Komponistenausbildung geben und zudem neben dem aktuellen Stand der elektroakustischen Musik einen wichtigen Teil ihrer historischen Entwicklung dokumentieren.

ex machina, Vol. 1-3

In drei Einzel-CDs, in den vergangenen Jahren in loser Folge erschienen, widmet sich die Reihe jeweils unterschiedlichen thematischen Schwerpunkten. Vol. 1 - **«ex machina: le son qui s'arrêté - le son éclaté»** (CYBELE 960.101) - steht unter dem Generalthema einer Auseinandersetzung mit Körper, Raum und Zeit. Die einzelnen Kompositionen setzen mit sehr unterschiedlichen Verfahren am Ausgangsmaterial an, um den Eindruck einer Räumlichkeit zu simulieren, wobei die entstehenden Klangprozesse sich immer wieder vom Ausgangspunkt entfernen, verfremdet und vom klanglich Konkreten ins Abstrakte überführt werden Die drei künstlerischen Konzeptionen unterscheiden sich dabei in Ausgangspunkt, Charakter und Intention der aus dem Material entwickelten Zeitkonzepte stark voneinander. So versteht sich Gerald Eckerts *Aux mains de l'espace* (1993) für 4-Kanal Tonband als Studie über verschiedene Zustände generierter Klangprozesse, die zu verschiedenen Zeitpunkten des Stückes wieder auftauchen und in immer neue Umgebungen eingebunden werden; sie bewegt sich auf dem dünnen Grat zwischen Existenz und Vergehen, die geprägt ist vom assoziativen Gehalt der eigenartig wirkenden Verhallungen.

Dagegen ist Dirk Reiths *nahe zu fern* (1987) für 8-Kanal-Tonband eine subtile Studie über die klangfärbenden Eigenschaften von Räumen, die hier elektronisch simuliert und suggeriert werden, so dass in der Wechselwirkung der auskomponierten Klänge ein Spannungsfeld zwischen scheinbarer Nähe und Ferne - "zwischen Präsenz und Verwischung" erzeugt wird. Ludger Brümmer schließlich arbeitet in *la cloche sans vallées* (1993) für 2-Kanal-Tonband mit einer cantus firmus-Technik zurück, um einen Kontrast zwischen einer präexistenter Originalstruktur und der vom Algorithmus erzeugten Ableitungen herzustellen. Alle Klänge basieren auf der Verarbeitung und Veränderungen eines einzigen Samples der Komposition *La vallée des cloches* von Maurice Ravel, das immer wieder neu strukturiert wird und auf verschiedenen Ebenen der Erkennbarkeit die Komposition durchzieht sowie mit seinen zeitlichen Interferenzen die Form der Komposition bestimmt

Mit der Verknüpfung von Musik und Sprache beschäftigen sich die Werke von insgesamt sechs Komponisten auf Vol. 2 - **«ex machina: tangent»** (CYBELE 960.102) -, wobei die Wechselwirkung zwischen begrifflichem Sprachinhalt und abstraktem Klang auf äußerst unterschiedliche Weise thematisiert und einzelnen Werke verschiedene Möglichkeiten der Begnung zwischen sprachlicher Vorlage oder einzelnen Sprachstrukturen mit Musik aufdecken. Während etwa Dirk Reiths *verSTIMMUNG* (1995) für 4-Kanal-Tonband den Text eines Gedichtes von Angelika Janz sowohl als Klangrepertoire als auch als Strukturgenerator für den formalen Ablauf nutzt, transformiert Javier Alejandro Garavaglia in *Arte Poética (I)* für 4-Kanal-Tonband einen lyrischen Text von Jorge Luis Borges in klangliche Vorstellungen, die sich von den Textelementen Wasser und Zeit durchdrungen zeigen.

Ganz anders verweist Ralf R. Ollertz in *Cral'une* (1995) für 4-Kanal-Tonband auf die gestische Funktion der Singstimme, während Friedhelm H. Hartmann in *Portraits of a Woman - Part II & III* (1995) für 2-Kanal-Tonband basierend auf Samples von Sprachklängen unterschiedliche Klangprozesse ausbreitet, deren artifizielle Qualität schon von der Sprache weg weist . Mit am gelungensten ist Ludger Brümmers Manipulation von Samples schreiender und spielender Kinder in *Dele!* (1995) für 2-Kanal-Tonband, dessen abwechslungsreiche formale Dramaturgie mit den vielfältigen Möglichkeiten von Lautstärke und Klangdichte arbeitet. Gerald Eckerts *Diaphane* (1995) für 2-Kanal-Tonband schließlich verarbeitet konkretes Klangmaterial aus Perkussions-, Sprach- und Maschinenklängen und konstruiert daraus eine weiträumige musikalische Landschaft.

Die auf Vol. 3 - **«ex machina: trans»** (CYBELE 960.103) versammelten Kompositionen widmen sich der Entfaltung des Spannungsfelds zwischen realem und elektronischem Klang: Überraschend ist vor allem der Reichtum an Kontrasten, den die Musik hier durch unterschiedlichsten Umgang mit dem Medium Elektronik erfasst. Allen Arbeiten ist der Umstand

gemeinsam, dass sie ihre Spannung aus der differenziert ausgearbeiteten Konfrontation vorgefundener und erzeugter Klänge sowie aus dem Reichtum an Übergangsnuancen zwischen beiden Polen beziehen, wobei sie häufig mit der Sprachähnlichkeit des Materials oder mit der scheinbaren ertrautheit von Klängen spielen. In *5 kleine Stücke über die kleinen Laute eines kleinen* Menschen (1997) von Thomas Neuhaus bildet die menschliche Stimme eines Säuglings die Materialgrundlage, die - unverändert, gleichsam denaturiert oder ergänzt durch elektronisch erzeugte Klänge - aufgegriffen, weiterverarbeitet und dabei bis zur Unkenntlichkeit verwandelt wird.

Eindrucksvoll ist auch die Verwendung der menschlichen Stimme in Anna Ikramovas *Einstimmig...* (1997): Der Stimmklang wird hier unter den verschiedenen Aspekten seiner Wirkung analysiert und erhält durch diverse Bearbeitungsstrategien neue klangliche Eigenschaften. Besonders hervorzuheben ist die Verbindung und Vermittlung von musikalischen und gleichsam "szenischen" Sequenzen in Markus Antonius Wesselmanns *in the mix* (1991), die eine Assoziations realer Vorgänge provoziert; das teilweise aggressive Montageverfahren verleiht den verwendeten Sequenzen eine illustrative Qualität und läßt die Komposition - durch Bereitstellung einer imaginären Handlung - schon in den Bereich des Hörspiels gleiten. Ein weiterer Aspekt ist die Gegenüberstellung der Medien Tonband und Instrument, wie sie in Kilian Schwoons *Orpheus und Demokrit - eine Klaviermusik mit Tonband* (1997) eingesetzt wird; sie gewinnt ihr weites Panorama an Ausdrucksmöglichkeiten aus der Konfrontation einer klanganalytischen Verwertung von Instrumentalklängen mit ihren real erklingenden Pendants.

ex machina, Vol. 4-6

Im Jahr 2001 feierte das Unterrichtsfach Elektronische Musik an der Folkwang-Hochschule seinen 30. Geburtstag. Aus diesem Anlass veröffentliche CYBELE eine 3 CD-Box, deren Inhalt die Ergebnisse der künstlerischen Auseinandersetzungen mit dem Medium und seinen Möglichkeiten exemplarisch dokumentiert - eine Arbeit, die auch durch einen umfangreichen Essay von Dirk Reith, dem künstlerischen Leiter des ICEM, in Worten umrissen wird. Die Auswahl der Kompositionen illustriert eine Vielzahl kompositorischer und Ansätze, in der sich die ganze Spannbreite von der eher abstrakten konstruktiven Idee bis hin zu instrumentaler Klangsinnlichkeit, von der rein elektronischen Klangerzeugung bis hin zur Verwendung konkreter Klangmaterialien und vom Verbleib in der elektronischen Klangwelt bis zur Vermittlung von Instrument und Elektronik entnehmen lässt. Darübern hinaus ermöglichen die drei Produktionen aber auch Einblicke in verschiedene Stadien der historischen Entwicklung, die sich durch technische Neuentwicklungen ergeben haben. Somit hat die Sammlung den Stellenwert einer hervorragend gestaltete Dokumentation, die auch technologische Entwicklungen nachvollziehbar macht und daher interessante Einblicke in die jüngste Geschichte der elektronischen Musik vermittelt.

Vol. 4 - **«ex machina: die 70er Jahre»** (CYBELE 960.104) spiegelt etwas von der Aufbruchstimmung und dem Pioniergeist der frühen ICEM-Jahre; mit ihrer Einbeziehung von Verfahren, die heute längst im Bereich der Popmusik allgemeingültige Anwendung gefunden haben, vermittelt sie aber auch etwas von der Bedeutung und Rezeption elektronischer Musik. So ist etwa das Zerschneiden der unmutigen Aussage eines Konzertbesuchers, der sich abfällig über die neue Musik äußert, in Hans-Werner Schneiders *Wenn ich auf einem Instrument spiele...* (1974), die sich durch diverse Bearbeitungstechnik selbst in Musik verwandelt, als ironisches Spiel mit dem Klang angelegt: Der Satz "Das ist keine Musik" wird durch Kopieren, sinnentstellendes Schneiden, Abmischen und andere Verfahren musikalisiert und von der Sinn- auf die musikalische Ebende transformiert, wodurch er sich letztlich selbst ad absurdum führt .

Eine andere Art des Umgangs mit Sprache findet sich in John McCaugheys *Manche Lucias und Desdemonas...* (1974/75): hier wird überwiegend dokumentarisches Material benutzt, das während einer Gastprofessur der Sängerin Carla Henius an der Folkwang-Hochschule mitgeschnitten wurde. Die verschiedenen stimmlichen Farben und Schichten dieses Materials wurden zu einem hörspielartigen Zuspielband verarbeitet, zu der noch ein live Solo-Part für die Sopranistin entstand, der wiederum in die hier vorliegende Tonband-Fassung integriert wurde. Entstanden ist so eine Art von Hörspiel, in der Kommentare zur Musik zu einem festen Bestandteil der Musik selbst werden und der Weg gezeigt wird, der zur durchdachten Interpretation hinführt. Ganz anders arbeitet dagegen Max E. Keller in *Sie* (1978): durch die Gegenüberstellung zweier divergierender Klangwelten erzeugt er eine ironische Werbemusik für die Kernenergie, die einen kritischen Blick auf die Fortschrittsgläubigkeit der siebziger Jahre wirft, heute aber in ihrer Machart etwas angestaubt wirkt.

Nicht weniger abwechslungsreich gibt sich Vol. 5 - **«ex machina: die 80er Jahre»** (CYBELE 960.105). So beginnt etwa Nic Jemmings *Angélique, mais sans dieu* (1985) für 4-Kanal-Tonband mit einem dumpf pulsierenden Ostinato, das seine Fortsetzung in einem Aufbau voller künstlich erzeugter orchestraler Klangfarben erfährt. Spannend ist auch der Prozess, mit dem Thomas Neuhaus in *The Bad Boys Were Prodding the Bear Through the Bars of the Cage* (1985) zwei gegensätzliche Klang- und Satzstrukturen - eine durch lang andauernde weiche Klänge und Glissandi bestimmte Fläche und einen geräuschhaften, repetitiv-rhythmischer Satz - miteinander vermittelt und so ein ständiges Spiel mit Übergängen und Verdichtungen gestaltet.

Demgegenüber nutzt Claudius Brüse assoziative Vorgaben aus einem Text Lao-tses für den dialektischen Ansatz, der in *Kapitel 80* (1987) für 4-Kanal-Tonband der Errichtung eines quasi utopischen Klangkonstrukts dient; insbesondere die Generierung von klanglichen Gegensätzen wie vokal/instrumental, ausgehalten/perkussiv und lang/kurz erzeugen hier eine atmende Spannungsverteilung. Mit am eindringlichsten wirkt insbesondere Ludger Brümmers faszinierendes Werk *TroTropf OrT* (1988), dessen Titel auf die kompositorische Konzeption mit ihren tropfenden, durch Piano-Forte-Kontraste in einen weiten imaginären Klangraum hineinwirkenden Strukturen verweist; entstanden ist dabei eine Klangstudie von hoher Expressivität und irisierender Schönheit. Schließlich ist auch das spannungsgeladene Klanglabyrinth von Vladimir Djambazovs *No Contact III* (1989) zu erwähnen, dessen klangsynthetischer Ansatz von jenen Puls- und Herzschlaggeräuschen ausgeht, die das Stück permanent durchziehen.

Auch Vol. 6 der Reihe - **«ex machina: die 90er Jahre»** (CYBELE 960.106) fasst noch einmal kontrastreiches elektronisches Komponieren auf engstem Raum zusammen. In der Konzeption mit am überzeugendsten wirkt vor allem Ralf R. Ollertz mit dem Werk Pyrócua (1994), dessen zersplitterte, nahezu magisch aufblitzende Klangwelten durch eine ständige Wandlung der musikalischen Materie entsteht und dabei eine in gleichem Maße schroffe wie berückend fremde Schönheit erzeugt. Dagegen setzt sich Friedhelm Hartmann in *exSamples mechanique* (1992) mit den Möglichkeiten der

Artifizialität auseinander, indem er computergenerierter Daten und Samples mechanischer Musikinstrumente als Zeiten übergreifendes Konzept miteinander verschränkt.

Präexistente Klänge nutzt auch Javier Alejandro Garavaglia in seiner Komposition *OVERTURE (in memoriam T.A.T.)* (1997) für 4-Kanal-Tonband, deren Klänge mit ihren sphärisch flirrenden Klangbändern und klirrenden Geräuschketten aus dem ersten C-Dur-Akkord des Vorspiels zu "Die Meistersinger von Nürnberg" synthetisiert sind. Gleichfalls macht sich Sven-Ingo Koch vorhandene Klangmaterialien zu Nutze: *Saxl* (1999), beruhend auf den Wandlungen dreier Samples mit Saxofonklängen, stellt das Ausgangsmaterial in ständig sich ändernden Perspektiven dar, aus denen ein kontrastreiches Gebilde entsteht. Ganz anders dagegen setzt sich Dirk Reith in seinem *Dialog aus "Mécanique Mon Amour"* (1993) für Altsaxofon, Elektronik und Film mit den Klängen der in der computerisierten und digitalen Welt immer bedeutungsloser werden Maschinen-Welt auseinander. Entstanden ist dabei eine spannende Studie, in der mechanische Geräusche, elektronische Komponenten, perkussive Saxofonklänge und herkömmlich hervorgebrachte Instrumentalklänge als Mittel zur Artikulation formaler Vorgänge eingesetzt werden.

Appendix XI

Gegensätze (gegenseitig): Review from a German Paper

25. Januar 1995
Zeitung für Essen NRZ

Auch ein Schritt macht schon Musik

Im Institut für elektronische Medien

Jetzt hilf Kollege Computer auch beim Komponieren. Und das nicht nur bei seichter U-Musik. Wer sein klassisches Handwerk richtig erlernen will, der muß sich nach den besten Möglichkeiten umschauen und sich auch mit der computererzeugten Klangästhetik auseinandersetzen. Neben den Hochburgen Stanford, Berkley (USA) und Paris genießt das Essener „Institut für Computermusik/Elektronische Musik und Medien" (Leiter Professor Dirk Reith), kurz: ICEM, an der Folkwang-Hochschule seit Jahren einen internationalen Ruf.

Am Tag der offenen Tür wurden jetzt Führungen, Vorträge, Klanginstallationen und Bildende Kunst sowie viele Konzerte angeboten.

Die Komponisten-Schmiede für elektronische Musik hatte auf Empfang geschaltet: In den Studios gab es Informationen über die untzerschiedlichsten Geräte und „Instrumente", im Treppenhaus erzeugte der eigene Schritt mittels Lichtschranken musikalischen Nachhall („Klangschächte") und im Foyer zeigte der malende Komponist Gerald Ekkert zu eigenen Klängen eindrucksvolle, monochrome Materialbilder.

Daß Komponieren im stillen Kämmerlein heute auch heißt, mit verschiedenen „Computer-Sprachen" zu jonglieren, bewies unter anderem der Vortrag des Leiters der Softwareentwicklungsabteilung am Zentrum für Kunst und Medien (ZKM) in Karlsruhe, Rick Taube.

Am Abend gab es einen Genuß für Auge und Ohr: In der Neuen Aula demonstrierte Ralph Ollertz, daß man als Komponist auch choreografieren und tanzen kann. Als Musiker und Tänzer in einer Person vollführte er bei der Erzeugung der Töne mit Geigenbogen und Becken einen genau choreografierten Tanz („Cacradar"), der im sensiblen Einklang zur Musik steht.

Musik wie Tanz kommen dabei mit streng reduziertem Formenkanon aus. Von J. Garavaglia war „Gegensätze-gegenseitig" (1994) zu erleben, ein Werk für Altflöte, Tonband und elektronisches Gerät. Leslie Olson, bekannt als Interpretin für Neue Musik, spielte die Flöte, die in feiner Zwiesprache mit künstlichen Klängen stand.

Mit Ludger Brümmers „Le temps s'ouvre" fand die Veranstaltung ein glanzvolles Ende: Eine eigene Klangwelt bietet dieser Komponist, eine funkelnde und glitzernde, in der Passagen von einer Tänzerin (Calu Yanez) getanzt werden, Passagen zwischen Aggressivität und Stille. Ein eindrucksvolles Werk. DSG

NRZ, January 25th, 1995 – Essen, Germany.

Appendix XII

Color Code: Two Reviews from German Papers

Neue Westfälische, Nr. 279
Montag, 30. November 1998

LOKALE KULTUR

Konzertinstallation Color Code in der Oetkerhalle

Quickie für die Augen

Von Oliver Kipp

Bielefeld. Verstand und Gefühl sind zwei Grundbausteine dessen, was die Existenz des Menschen bestimmt, zwei Pole, in deren Spannungsfeld jeder quasi gleichschwebend nach Balance sucht. Diese Kluft zwischen Kalkül und Emotion zu überbrücken, Gleichgewicht im energieaufwendigen Kräftespiel zu suchen, ist seit Anbeginn philosophischer Denkansätze zur Suche nach dem Heiligen Gral geworden. Auf diese Suche begab sich die interdisziplinäre Forschergruppe Animato im für den Zweck wenig kommoden kleinen Saal der Oetkerhalle, und wandelte dabei auf Spuren des 1991 gestorbenen Medienphilosophen Vilém Flusser.

Auf dem 7. Internationalen Vilém-Flusser-Symposium wurde die Konzertinstallation „Color Code" uraufgeführt, die des Meisters Essay „Postmoderne Farben" zum Anlaß nimmt, zwischen rationaler und emotionaler Farbwahrnehmung den Brückenschlag zu versuchen: auf zwei sich gegenüberliegenden Projektionsflächen spielt sich Farbe im wahren Wortsinn ab. Den drei (physikalischen) Grundfarben Blau, Grün, Rot entspricht die optische Satzgliederung, akustisch wird das Farbenspiel von der elektronischen Studie mit Solo-Bratsche von Javier Alejandro Garavaglia begleitet, die dramatische Intermezzi in die fahl- bis grellweißen Pausen fallen läßt. Auf den Flächen wechseln minimalistische Farbfelder in bisweilen schroffen Gegensätzen, changieren, ihre Grenzen zerfließen, und im Strom von Licht und Farbe sitzt das Publikum (wegen des großen Andrangs aber durften sich nur wenige zu den „Erleuchteten" zählen).

Farbe um ihrer selbst Willen war zu sehen, referenzlos sollte sie sein, sich selbst bedeuten. Das wäre ganz in Flussers Sinn gewesen, funktionierte aber nur bedingt. Allzu selbstverliebt gab sich die exzellente Computierung in der Bevorzugung horizontaler Formgebungen und huldigte einer poppig-kühlen, geometrisierten Farbästhetik, die ebenso wie die allzuoft synchron ablaufende Musik Assoziationen zu wecken vermochte.

Und eben da gäbe es wieder Referenzpunkte. Farbe bedeutete nicht mehr sich selbst, sondern wurde idealisiert zum Gegenstand philosophischer Arbeitstechnik. Und letztlich war auch dies nur ein Pixel mehr in unserer blitzebunten Bilderwelt, ein weiterer Quikkie für die Stäbchen und Zapfen unserer Augen. Das Publikum quittierte die aufwendige und fraglos sehr ästhetische Inszenierung mit großem Applaus.

Neue Westfälische Zeitung, November 30th, 1998 – Bielefeld, Germany

Wenn es pfeift, brummt, dröhnt, flackert und lodert

Mediennacht „ex machina" bei Folkwang

Feuerorgeln und Thermische Flöten, angestrahlt abwechselnd in rot und blau, spucken Flammen und entlassen Töne, die animalischer nicht sein können. Die Gesichter der vielen Zuschauer, die sich auf dem Innenhof der Folkwang-Hochschule versammelt haben, leuchten im Schein des Feuers - Spannung ist auf ihnen abzulesen. Bizarr und unheimlich wirken die „Gerüste", mit denen der französische Künstler Michel Moglia und seine Crew den Auftakt der „ex machina" Mediennacht einstimmen. Es pfeift, brummt, dröhnt, flackert und lodert aus den Metallröhren. Im Hintergrund erhebt sich mystisch leuchtend und erwürdig der Westflügel der Hochschule. Ein beeindruckendes Bild- und Klangerlebnis.

Wie den Menschen selbst hält Michel Moglia seine Klangperformance für unvollkommen und immer in Evolution, eine Metamorphose durchlaufend. Die ungewohnten Klänge, die mit Hilfe von kleineren Flammenwerfern den metallenen Röhren entlockt wurden, ließen das Bild eines brodelnden Urwaldes vor den Augen des Zuhörers entstehen.

Sie waren so ursprünglich und animalisch, dass man beim sonoren Brummen aus den meterhohen Klanggebilden leicht einen riesigen Dinosaurier assoziierte, der bedrohlich aussehend über den Erdboden stampfte. Um ihn herum loderte das Inferno.

Aus den kleineren Thermischen Flöten drangen Walgesänge aus den Tiefen der Meere und surreal klingende Vogelstimmen; vielleicht Stimmen von einst existierenden Urvögeln. Die Flammen schossen wild und heiss aus den runden Öffnungen und warfen ihren Glanz um sich. Ein starker Kontrast zu dem schwarzen Dach über einem; sehr unheimlich und sehr faszinierend. Auch die kleineren Zuschauer waren begeistert, standen mit großen Augen vor dem feurigen Spektakel und staunten.

Ein letztes fantastisches Aufbegehren aller entstandenen singenden Vögel, Wale und feuerspeienden Dinosaurier verstummte abrupt, wurde vom Dunkel der Nacht geschluckt; und mit ihm die Phantasiegedanken.

Dunkel blieb es anschließend in der ausverkauften Neuen Aula, wo das Klangspektakel weiter ging. Das Projekt „color code" der Gruppe „Animato" griff auf den Text „Postmoderne Farben" des Medienphilosophen Vilém Flusser zurück und versuchte diesen in eine adäquate Bild- und Tonsprache zu übersetzen.

Die akkustischen Effekte, mit denen das Publikum rundherum konfrontiert wurde, verschmolzen mit den Farbspielprojektionen zu einer untrennbaren Einheit.

Die Intermezzi auf der Viola entführten in eine andere Klangwelt; mal leise gezupft, dann wieder äußerst schräg, aber immer faszinierend gespielt von Javier Garavaglia.

Die Opera Media „chthon" für zwei symmetrisch gebaute, verstärkte Klanggruppen entwickelte musikalische und optische Chiffren, die die Natur im weitesten Sinne zum Vorbild haben; gedacht wurde an Wachstums- und Vergehensprozesse.

Das präzise Spiel der beiden Orchestergruppen interpretierte exakt die Videoinstallation, die in Island und Norwegen aufgenommen wurde: Wasserspeiende Geysire, enorme Fontänen und heiss sprudelnde Quellen. Die Künstler ließen eine beeindruckende Symbiose entstehen.

Die vielen „Bravo" Rufe und stehenden Ovationen am Ende bestätigten trotz der anstrengenden Länge des Abends die Begeisterung des Publikums und die Faszination, die das gesamte Klangerlebnis der Mediennacht auslöste.

Auf Grund des enormen Andrangs zu Beginn, verschoben sich die Projekte zeitlich, so dass das finale Feuerwerk entfallen musste.

sab

Werdener Woche Zeitung, November 5th, 1999 - Essen, Germany

Appendix XIII

Accompanying Audio CD and Video DVD. Details

Audio CD

[1] ***Gegensätze (gegenseitig)*** for alto flute, quadrophonic tape and live-electronics (1994)

Alto flute: Christiane Schulz

Live-electronics: Javier A. Garavaglia and Markus Lepper

Recorded at the ICEM Studios, Folkwang Hochschule Essen (Germany), March-May 1995.

Mastering and recording: Javier A. Garavaglia.

Duration: 32:30

[2] ***Arte Poética (I)*** for quadrophonic tape (1995),

Based on the first stanza of the poem 'Arte poética' by Jorge Luis Borges. Produced at ICEM (Folkwang Hochschule Essen, Germany) during the fall of 1994 and the beginning of 1995.

Duration: 8:16

[3] ***Spectral colours*** for Ensemble and tape (1996/7).

Tape part produced at ICEM (Folkwang Hochschule Essen, Germany) in 1996/7.

Live recording at Connecticut College, New London (CT- USA), Ammerman Center [Arts & Technology], Evans Hall, February 27th, 2001.

Ensemble Connecticut College – Conductor: Michael Adelson.

Duration: 11:30.

[4] ***Overture (in memoriam T. A. T.)*** for quadrophonic tape (1997)

Dedicated to the memory of Tomás Alejandro Tichauer.

Produced at ICEM (Folkwang Hochschule Essen, Germany) during 1997.

Duration: 10:40

[5] ***L.S. (waiting for changes)*** for small orchestra (2001)

Commission: Luxembourg Sinfonietta and the Luxemburger Gesellschaft für Neue Musik.

Live recording at the Cercle Municipal Luxembourg, November 30th 2003 by the Luxembourg National Radio.

Luxembourg Sinfonietta conducted by Marcel Wengler.

Duration: ca. 10:29

Video DVD

[1] ***Color Code***, concert-installation for video projection on 2 screens, quadrophonic tape, viola and live-electronics (MAX/MSP) (1998) by the GRUPPE ANIMATO, based on the text 'Postmoderne Farben' (1988) by Vilém Flusser.

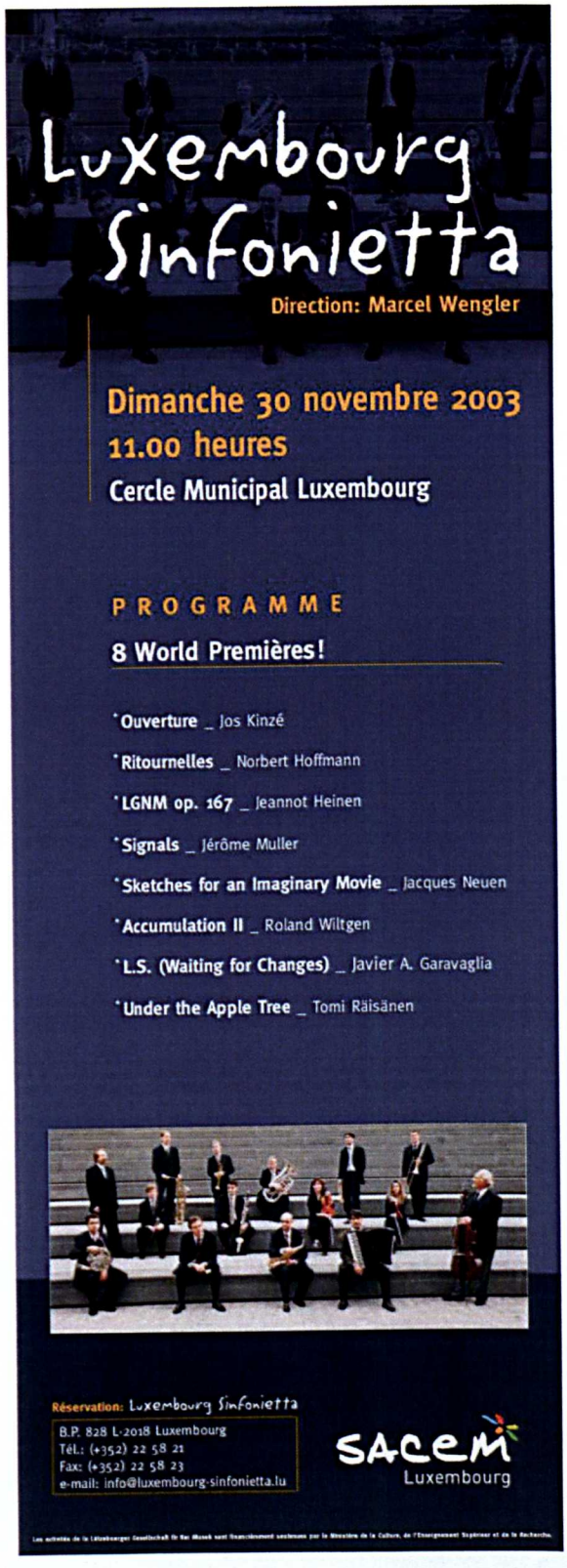
Graphic design: Gottfried Jäger and Karl Martin Holzhäuser
Image computer generation and programming: Peter Serocka;
Music, sound design and programming: Javier Alejandro Garavaglia.

Live recording (audio) of the world premiere at the Fachhochschule Bielefeld, Oetker-Halle, Kleiner Saal (Bielefeld, Germany) during the 7th Vilem Flusser Symposium 1998, November 26th 1998 (opening event).

Viola: Javier A. Garavaglia
Recording: Thomas Noack.
Duration: 30:10

Appendix XIV

L.S. (waiting for changes): original poster of the concert for its world premiere



Appendix XV

Paper: *THE NECESSITY OF COMPOSING WITH LIVE-ELECTRONICS*

A short account of the piece Gegensätze (gegenseitig) and of the hardware (AUDIACSYSTEM) used to produce its real-time processes.

This paper was read (but not published) at the 5th Annual Florida Electroacoustic Music Festival (University of Florida, USA) in April 1996 and is very similar to the paper published in the proceedings book to the SBCII in 1995, which is shown in Appendix VII.

THE NECESSITY OF COMPOSING WITH LIVE-ELECTRONICS
A short account of the piece *Gegensätze (gegenseitig)* and of the hardware (AUDIACSYSTEM) used to produce its real-time processes.

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ABSTRACT

The aim of this paper is to speak about my piece *Gegensätze (gegenseitig)* [Contraries (reciprocally)] for alto flute, four channel-tape and live electronics (1994), making an account of how and why the work was conceived. The hardware-and-the-software environments responsible for the real-time processes (AUDIACSystem, a research project carried by the ICEM (Institute for Computer music and electronic Media), Folkwang Hochschule – Essen, and the company Micro-Control GmbH & Co KG, both in Germany) will be described. Finally, some examples and passages of the piece will be explained.

"CONTRARIES "

Gegensätze (gegenseitig) was the result of an idea that I had for a long time: to compose a piece in which contraries should be shown not only against each other (implying a negative connotation), but also that they could be able to build some type of unity by creating something completely new, constructive and positive.

My first problem was how to put this into music without using a text about the subject. At the beginning I simply wanted to make the contrast evident by using an instrument and a pre-recorded tape, but it didn't seem like being the solution to the problem because it could only show the contraries themselves but not the reciprocal action of both elements. The instrument should make with the electronics something new and I realised that this should happen in real time and not with recorded material. To achieve this goal, I first began to work on the tape itself, programming sounds with two Yamaha synthesisers (TX 802 - TG77); these sounds =should not have any relation with usual acoustic instruments. I produced and composed accordingly a piece for stereo-tape alone, from which I later took the materials for the definitive version of the piece. Once the tape materials for the final work were selected, I decided that the instrument should be an alto flute, due to its soft sound, which would contrast with the synthetic sound of the tape. The next step was to decide how the "reciprocal action" should be composed. By now, I was convinced, that the only way to achieve this was by using live-electronics. This decision conduced me to the next problem: what type of live-electronic processes did I need in order to convincingly express in music the main idea and further, which system should I use? There are nowadays basically two ways of working with live-electronics: on one hand, those whose aim is to create a new conception of how the live instruments could be projected into a particular space or room, normally using only delay lines and spatialisation; on the other hand, more complex systems, in which the sound will be processed in real-time (through FM, AM, filters, envelope generators, envelope-followers, transpositions, etc) up to the point in which the sound of the instrument could not be longer recognised. At ICEM, Folkwang Hochschule Essen (Germany), there is no IRCAM board (IPSW), but a different project, which has been developed in the past eight years at ICEM by a group of German composers and engineers: the AUDIACSystem, about which I shall speak later in this paper.

Once all three instrumental groups were selected (alto flute, 4-channel tape and the 4-channel live-electronics), I continued by applying the same concepts of 'THESIS-ANTITHESIS working together to create something new' to each music parameter (from the micro-up to the macro-structures). In this way, at any point of the piece the intended main idea can be expressed. For this purpose, I chose two principles opposite to each other: a "single-principle" and a "totality-

principle". Both principles would turn out to be the main generators of every event throughout the work and are mainly represented everywhere in the piece by two objects: "glissando-object" representing the "totality-principle" and "a single-note-object", representing the "single-principle".

For the entire structure of the work, I designed a particular numerical-row: its first four components were explicit selected, but from the fifth component onwards, they should always be the result of the addition of the last three numbers (i.e. the next figure in the row, will be constituted with the reciprocal action of the former three). The result is a bigger new value that stands as a contrary to the first; for example, the row begins with (1 1 3 5) -which are the numbers that I arbitrary selected- so the next value will be 9 (1+3+5), the next 17 (9+5+3) and so on. Each single element contributes to make a partial new totality. This row plays an extremely important role in the composition of the pitches, rhythms, metronomic values, form, and the stage-production of the composition.

The form (structure) of the piece consists of five parts, each one showing the principles already mentioned:

1- Solo alto flute ("single-principle")
2- Alto flute + tape (as opposites)
3- Tape alone ("single-principle")
4- Alto flute + Tape + live-electronics ("totality-principle"- reciprocally action of all three instruments)
5- Live-electronics alone ("single-principle" as result of the reciprocally action of all three instruments)

The rhythms were also composed with the numerical row. There is a unit value which is the sixteenth, which is multiplied or divided with the numbers 1, 3, 5, 9, in all possible combinations within these four numbers (for example, ratio 9:5 means that 9 equal durations should be instead of 5 sixteenths; ratio1:3 results in a dotted eighth, etc.).

The stage-production is also works with opposing elements: the stage should only be illuminated when the flautist has to play (parts 1, 2, 4 and 5). In part 3, where only the 4-channel-tape is present, the stage and the hall (if possible) should be dark.

The materials for the pitches were derived from a chromatic scale beginning with the pitch g3 (the deepest note for the alto flute in G), representing a "totality" object, a meta-symbol of the "glissando-object". This object plays one of the most important roles throughout all parameters in the piece, not only for the flute-part, but also and mainly for the tape and the live-electronics. The process of generating all pitches for the flute part is by means of an algorithm that filters notes in such a way that at the end, there is only one pitch left. The result is a process going from the "whole" (all twelve notes) to a "single" element, generating a tension between the two main principles intended in the piece. The filtered pitches were later used in part 4, in an improvised manner (three improvisations), in which only the rhythms are totally free. These improvisations make a counterpoint to the live-electronics and also modulate them, as it is the case in the third one.

The 4-channel-tape part was produced using several and different methods, for example algorithmic composition using CommonMusic, transpositions and filters (mostly using Sound Designer II), reverb and even using the AUDIACSystem. The twenty minutes long 4-channel tape is at the start in counterpoint with the alto flute; then develops without the flute and as the live-electronics start it fades out very slowly. I think that at this point, the time has come to make a short description of the AUDIACSystem and its application for the live-electronics in the piece.

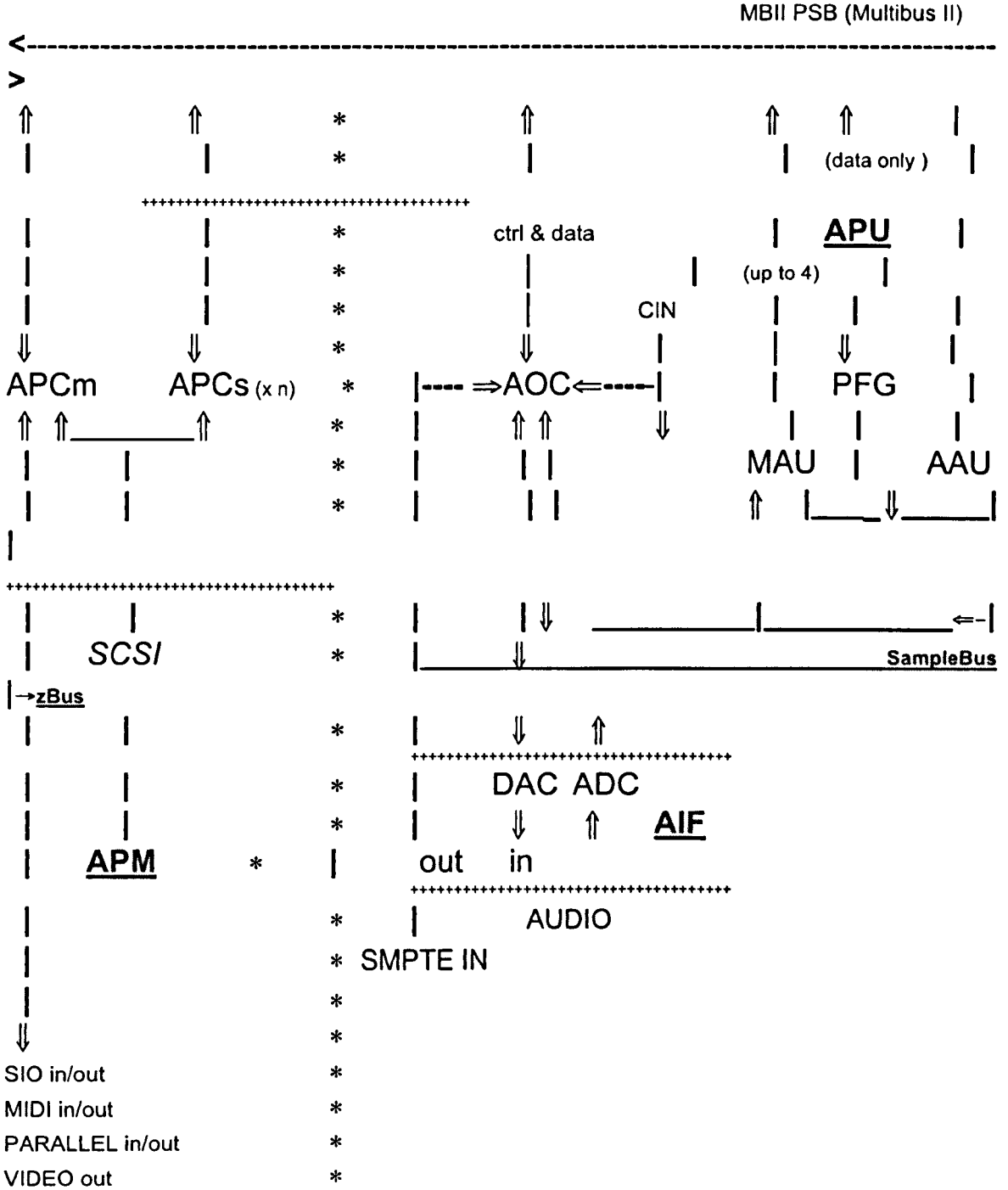
THE AUDIACSYSTEM

The AUDIACSystem is a project developed at the Folkwang-Hochschule in Essen (Germany) by ICEM (Institute for Computer music and Electronic Media) and the firm Micro-Control GmbH & Co KG. At present, the people involved in its design are: Dr. Helmut Zander, Dipl. Ing. Gerhard Kümmel, Prof. Dirk Reith Markus Lepper and Thomas Neuhaus. This research project began in 1987 and involves not only the hardware architecture, (its specially designed Audio Processor Unit has still today the power of 2.5x Pentium processors regarding only its audio processing capacities) but also the software to run it, which was exclusively created for this particular environment. The hardware configuration employed in my piece should be seen today as an already finished stage of its development, in the near future it will be actualised, replacing the current design with a new one, which shall result in a chain of Pentiums or most probable P6 processors, acquiring a RISC- processor configuration and making it smaller than today's one

cubic meter, with the plan of making it also compatible with the PowerPC platform (IBM and Apple computers).

HARDWARE CONFIGURATION

The hardware configuration of the AUDIACSYSTEM is shown on the following schematic representation:



The hardware architecture of the AUDIACSystem was conceived using the principle of the *specialised subsystems*: it has not only been made to generate organised forms for musical production, but also incorporates the generation and transformation of sounds in real-time. The

whole implies a huge measure of different demands in relation of its computing potential, which can only be solved with the already mentioned subsystems and their communication capacities.

The system can be described as the cooperation of a "von-Neumann" unit on one hand and a Signal-processing unit on the other. The former perceives configurations (devices), control and driving functions, which steer the processes of generating and working up of sounds from the latter. The communication is guaranteed with the help of the Multibus II. The "von-Neumann" part consists of an Audio Processor Manager (APM) and one or more control units, the APCs. They both communicate via SCSI.

The APM is an Intel 486 computer with a 66 MHz clock-rate, where the software specially designed for the AUDIAC runs. This software is the language APOS which means Audio Processing Operating System and which was specially created by German composer Markus Lepper for this purpose. APOS pursues three goals:

1- a monolithic system architecture, in terms that every hard-and-software levels could be described with the same language, from an individual bit of the hardware up to very complicated abstract compositional models;

2- an enlargeable, anthropomorphic surface, in the sense that each composer can use not only algorithms that are already defined but also can implement his/her own language for a particular use as well, hence "enlarging" the library of the language;

3- an abstraction from the technical necessities, meaning that composing should be allowed on a symbolic level, without caring about technical details.

APOS is an object-orientated language that works with two levels of interpreter: an outer interpreter, which receives the information in ASCII code, and an inner interpreter, which reads a series of object-references, which are references about objects that already exist and could be recognized as such. The software runs in protected-mode because of memory management reasons, and makes possible that some tasks -those which are necessary for the actual configuration of the system- can be perceived.

With regard to the APC (Audio Processor Controller), the system can afford from only one up to four units. These are Intel 186 computers which, due to the ATOS kernel (a real-time operating system kernel specially developed for musical applications) have got many functions at their disposal, which are needed for the multitasking operations. The ATOS configurations are created on the APM in APOS and will be later called by the APC, generating or transforming sounds. The APC and the Signal Processor run asynchronously. The heart of the APC is the APU (Audio Processor Unit), the real Audio Processor of the system. Apart from that, there is a number of auxiliary units, such as the AOC (a unit capable of transferring data and time-code between the APUs, also from one to other two simultaneously, all which could be programmed separately); the CIN (a low control interface with a 16 times multiplex A-D converter, through which up to 16 control voltage units could be brought in); and the AIF (the A-D and D-A converters). The APU consists of one Memory Unit (MAU=Memory Address Unit) and an arithmetic unit (AAU, a multiplier). It is possible to put up to 4 APU plus one AOC together, connected through a Z-bus. The data could be read and written on the Multibus II. The two memories of the APU (XMY and YMY) can be addressed alone or parallel. The in-and-out sample ports work with the FIFO principle and connect the APU with the out world through the A-D and D-A converters. The interface has two inputs and four outputs, which could be enlarged up to 32 and 64 respectively. The computing processes run parallel, which means that it could perform up to two additions (or subtractions), one multiplication, twice read and write from and to the D-RAM (or four times from the S-RAM) at once. The flexible handling of the signal-processing unit is guaranteed due to its totally free way of being programmed. The synthesis or transformation of sounds result from micro-programmes specially developed for this APU.

The Parameter-Functions-Generator (PFG), which is a computing unit in itself, works within the APU. It is coupled on one side to the APU and can (due to its complexity) be seen as an independent unit. Its multiple possibilities of application could be resumed in providing control instruments for the manipulation of sound: envelopes, spectral control, sound intensity, etc. For each parameter to be controlled, there can be placed pro time-unit one "value-pair" plus a bit-control. Each sample of every four can take a new PFG value. There are altogether 128 PFG free for each APU. The PFG has basically two operating modes: one, in which a "value-pair" INC/FIN makes a linear interpolation, building an envelope which makes a continuous alteration of the y values through the time axis; the other, which interprets a "value-pair" *y-dt*, where *y* takes one value and *dt* represents its duration, building discrete values. The control-bits allow a flexible and interactive influence to the corresponding value rows, for example: *back to the first value, mode switch, segment-switch, interrupt* and *hold function* (fermata). Interrupts are possible in the first

operating mode over each FIN value: in the second mode, at the moment of any new y-value. Through the usage of these interrupt features, new support values can be called, resulting in more support values for only one parameter function.

MICROCODES

Within the AUDIACSystem, the biggest time unit is the Sampling Rate. The time between two samples is called *mini-cycle*. There are multiple "cycle calculations" within such a *mini-cycle*, which are coordinated to different process channels (PROK). One cycle calculation can be divided into a given number of *micro-cycles*, which correspond to that of the machine rate, which is normally set at 10 MHz. All calculations necessary for the generation of a sample must occur within a single *mini-cycle*. The cycle will be finished with a reset signal, which guides to the next step: the D-A conversion. With a sample-rate of 48 kHz, the duration of a *mini-cycle* comes up to around 20 microseconds.

WORKING WITH THE AUDIAC

The way in which the input data can be programmed, can be defined in two different ways: on the one hand, it can be done algorithmically; on the other hand however, a specially pre-composed material can be later imported into the system. Both possibilities do not exclude each other, but can be mixed throughout a composition, which is actually the case in my piece. The resulting score can be defined anew in two different ways: statically, creating discrete values for the structure or dynamically, in which the start and end points of each event are particularly significant, because any type of process can be programmed between both extremes (for example, transpositions, dynamical filters, etc). This data will be subsequently translated, resulting in a series of commands to be interpreted and fulfilled.

Coming back to my piece, the ca. thirteen minutes long live-electronics part is divided in three different groups: "LA", "LB", "LC", the letter "L" being used instead of the word *"live"*. For the programming in APOS, I had the invaluable help of Markus Lepper, one of the creators of this language.

With regard to the first part, "LA"-with a tempo of a quarter note = 50 and a measure of 3/4-the AUDIAC has to record three different types of single events played by the alto flute, namely: breath-out-noise, a multiphonic and a series of slap tones played separately. These recordings will be played back by the system with intervals of 9, 5 and 3 quarters, rotating these sounds from one channel to the other anticlockwise, in opposition to the tape's channel distribution, which is clockwise (1. front-left, 2. front-right, 3. right-back, 4. left-back)

The recording of the different sounds is made through an object defined in APOS as "recorder", which works as a normal recorder. It has a begin- and an end-buffer-time, an amplitude value, etc. The samples recorded will be played by another object, the "player" which also has a begin- and an end-buffer-time, an amplitude, an input to vary its frequency ("FINC" transposing the sample) and an input to loop the sample from a given buffer-time-point. *Gegensätze (gegenseitig)* works with four players, each one corresponding to each one of the four channels. Each recorded sound is assigned a different memory address, so that it can be retrieved at any time. For the time allocation of these events, the computer was asked to find the best possible distribution through all four channels between space and time, in order to force the events to meet quite often at the same channel. When this actually happens, one event will multiply the other, modulating each other (Ring Modulation). When all events (once breath-out-noise, once a multiphonic, and five times different slap-tones) have been played and recorded, the computer begins to transpose the information of three of the four players with different ratios (which are taken from the numerical-row). This transposition, made through the input "FINC" of each "Player", takes place dynamically, that means that within its time limits given in the score, the frequency will be varied every fourth sample, making "glissando-structures".

For the part "LB", there are two moments to be recorded, both 12 seconds long. This part makes a formal "crossfade" with "LA", and is about transpositions on all four channels of the recorded materials. The first of the two recorded materials of "LB", must be further stored, because it will be used in the next part "LC".

The APOS score for "LB" is programmed half algorithmically and half pre-composed, as the following APOS example shows:

```
new plstarts "pls2"  200
*  open pls-kanal 0
*;                ANZAHL       ABSTAND
*;                EINSAETZE
*  put pls2       1    *    17
*  put pls2       3    *     9
*  put pls2       5    *     5
*  put pls2       9    *     3
*  put pls2      17    *     1
*
*  apl pls2 110 to 150 [ if [[_1 mod 21] ?eq (110 mod 21)] ['@ .p0 _0 ok]
]
*  apl pls2 111 to 150 [ if [[_1 mod 19] ?eq (111 mod 19)] ['@ .p1 _0 ok]
]
*  apl pls2 112 to 150 [ if [[_1 mod 15] ?eq (112 mod 15)] ['@ .p2 _0 ok]
]
*  apl pls2 113 to 150 [ if [[_1 mod  9] ?eq (113 mod  9)] ['@ .p3 _0 ok]
]
```

All these lines describe each starting point of the four players. The last four lines use an explicit indication (pre-composed) of how the structure should finish; on the other side, the "put" lines use an automatic way of creating the starting points with an special syntax implemented for this purpose. This syntax is implemented with the following APOS source text:

```
 new latch "pls-kanal"
*   new latch "pls-Position"
*
*; 4 new methods are going to be defined for this purpose (dm)
*
*   dm [ put (any plstarts) @ (any integer) .p (any integer)
*>                            (any integer) * (any integer) ]
*>     [ apl 0 to [pred _6]
*>                ['@ pls-Kanal    ['[' _5 + __0] MOD 4] ;
*>                  @ pls-Position [' _3 + ['_8 * ['SUCC __0]]] ;
*>                  ~do _0_1 ]]
*;
*   dm [ ~do put (any plstarts) ]
*>     [ @ .p [pls-kanal] [@ _2 [pls-position]] OK ]
*;
*
*   dm [ open pls-kanal (any integer) ]
*>     [ @ _1_2 ; @ pls-position (INTEGER 0) ]
*;
*   dm [ put (any plstarts) (any integer) * (any integer) ]
*>     [ _0_1 @ [pls-position] .p [[SUCC[pls-kanal]]MOD 4] _r2 ]
```

The evaluation of both texts results in an abstract-time-structure, which could be edited either manually or automatically. In this latter case, it could be submitted to different processes of automatic transformation and interpretation, the actual generation of sound being only one of the multiple possible steps of such a chain.

The last part, "LC", begins with three eight-measure long statements of the alto-flute, which will be recorded and played by each speaker with an interval of three, five and one quarters (the corresponding tempo is now quarter= 90, the measure remains 3/4), making a canon that wanders all over the fur speakers. Between each of these eight-measure statements, the alto flute plays three improvisations, with durations of respectively of nine, seventeen and thirty-one seconds. The third variation modulates the frequency of the recorded signal of all three parts of the canon, and the result of this modulation will be anew recorded and again modulated by the alto flute. From this point on, the flute stops playing, and the resulting modulation will be amplitude-modulated -with the first element of "LB"- than it will be transposed dynamically. The transpositions will be gradually filtered with a *notch filter*, with a frequency around the pitch f#5 and a bandwidth, which will be dynamically narrowed up to that pitch. At the end there is only a filtered f#5 left, making an

opposition to the first note of the piece, which was g3 (last and first note respectively of the chromatic row used as pitch-material).

Gegensätze (gegenseitig) was the first piece of music using the AUDIACSystem in a real-time live performance. Until its premiere, the system had only been used to steer other type of pieces (all within the electronic music production), but none including live instruments and composed/programmed especially for and with the system.

To bring this paper to an end, I would like to clarify just one more point. The general conception of the work can be interpreted from several points of views, but my intention was to show the "Thesis-Antithesis" concept at the light of human, social and naturally also political relationships. I think that nowadays, a time in which Neo-nazi ideas and deeds wide out again (mostly in Europe and in the USA, but not only there), the concept of a reciprocal action of opposite elements may be considered as the contrary to intolerance, racism and discrimination. That does not mean neither that my piece has got a secret program nor that it is a political work (as in the case of many pieces by Luigi Nono, for example), but it may be able to recall this type of implications. The piece was first performed on June 18th, 1994 in the city of Dortmund (Germany) by the German flautist Christianne Schulz.

April 1996
Javier Alejandro Garavaglia

Appendix XVI

Paper: *Composition principles for "Spectral Colours", for ensemble and tape (1996)*

This paper was read at the 8th biennial Symposium for Art and Technology: *'Feedback-perception and interaction in the electronic arts'* (Connecticut College - New London, CT, USA) in Febrary 2001. It was printed in the Proceedings book of the Symposium, with no ISBN.

This paper was reformatted herewith to fit the delivery requirements for this PhD. For full details, see Appendix VII.

Javier Alejandro Garavaglia

Composition principles for "Spectral Colours", for ensemble and tape (1996)

Technical requirements:
Ensemble with 14 instruments: flute, oboe, clarinet in b, Bass- clarinet in b (with low b), trumpet in c, horn, trombone, 1x percussion , piano, 2 violins, viola, cello, double-bass.
Stereo tape (DAT or CD) with quadrophonic projection (see score for details).
One microphone for the percussion.
Time Code (SMPTE or DAT/CD time) visible to the conductor.

General description of the work:

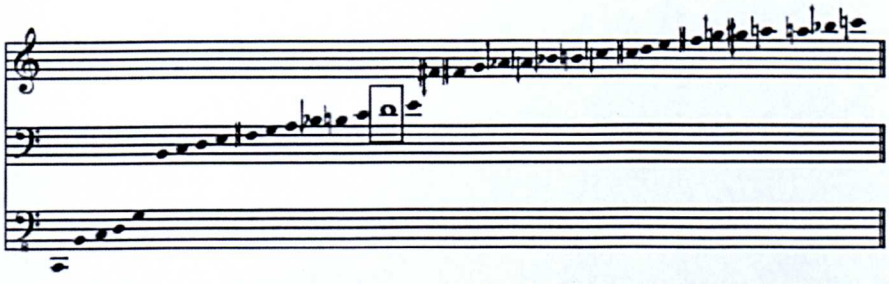
The conception and origin of "Spectral colours" can be found in my very first electroacoustic music project ("Räume" for stereo tape from 1992), where three notes played "Sul ponticello" on a viola were transposed and stretched. Because the row materials were recorded on the bridge, the sounds contained a very rich number of harmonics, which were particularly perceptible on the deep transpositions. In the year 1996, I revised this piece and planned a second one, this time for an instrumental group and tape, whereas the tape had some modifications. This piece became "Spectral Colours". We may describe "Spectral colours" as a "spectral" cluster-piece, in which the "spectral" clusters are built from an additive system, whereas the colour of the individual notes change permanently.

Materials:

The whole materials for the composition (pitches, rhythmic values, structures, etc) of the work are derived from the previously mentioned three notes in the very low register (C1, B2 and D2), and their first thirteen overtones.

For the pitch generation, the overtones were transported to a scale (I will call it from here on the **GENERATIVE SCALE**) going from the lowest tone (C) up to the highest (the 13th harmonic of D) whereas all repetitions between harmonics of the three overtones series were left aside (no redundancy at all). The total number of notes is then equal 36, with 35 intervals between them.

GENERATIVE SCALE



The number **14** has a decisive meaning for the whole, as stated below:

-14 harmonics,
-14 instruments,
- there are always 14 tones for each chord/cluster after the first 14 notes of the scale appeared.

The proportions that rule the whole work (form, rhythms, etc) are taken also from the relationship of the overtones themselves.

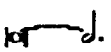
The intervals between all 36 notes of the GENERATIVE SCALE are the ones appearing on the following number series (taking the semitone as unit and the octave as n° 12). This is what I called the **INTERVAL SCALE**, which looks as follows:

11 (major 7th),
5 (a perfect fourth),
4 (a major third),
2 (a major second),
1.8 (a bit lower than a major second)
1.2 (a bit higher than a minor second)
1 (minor second),
0.8 (a bit lower as a minor second).

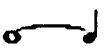
0.2 (the difference between for example **F** ♯ and **F** ♯)

The decimal values do not reflect the real physic-mathematical relationship of the natural deviations of some of the natural harmonics (for example the 7^{th}), but are useful for building rhythms values and rhythmical structures, multiplying them (in this case) by one quarter. The rhythmical values coming from this multiplication are shown in the following table. That is the only reason because I avoided writing exact microtonal notation, but only random and free deviations of the notes.

11x ♩ =



5x ♩ =

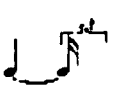


4x ♩ =

2x ♩ =

1.8x ♩ =

1.2x ♩ =



1x ♩ =

0.8x ♩ =

0.2x ♩ =

Summary of the diverse compositional methods used in the piece:

Pitches:

The work begins almost in the middle of the **GENERATIVE SCALE,** with the note D4 (marked with a rectangle on the GENERATIVE SCALE PICTURE).

The way notes will appear is very simply composed: it goes from the centre of the **GENERATIVE SCALE** (D4) alternative upwards and downwards, till the upper and lower limits of the scale are reached (in this case C1 and c5(-)). Once the first 14 notes appear, then the "coloured-spectral" clusters consist until almost the end of 14 notes. The begin of note n° 15 (E3) marks the end of note n° 1 (D4), the start of note n°16 (B4 flat(-) an so on. When all 36 notes had appeared, the "spectral" cluster has transformed himself, in namely two split regions, located in the high and low regions (bar 118). This state remains till bar 128, where the first note appears again (filling the central region), and then two of the remaining notes (n° 21 and 23 of the Generative scale) disappear. This process goes on till note n° 7, where then all notes but the D4 fade out. The last bars (once the tape is over - bar 150-) build a Coda-like passage, where the scarcely amplified percussion has the "leading colour".

Rhythms:

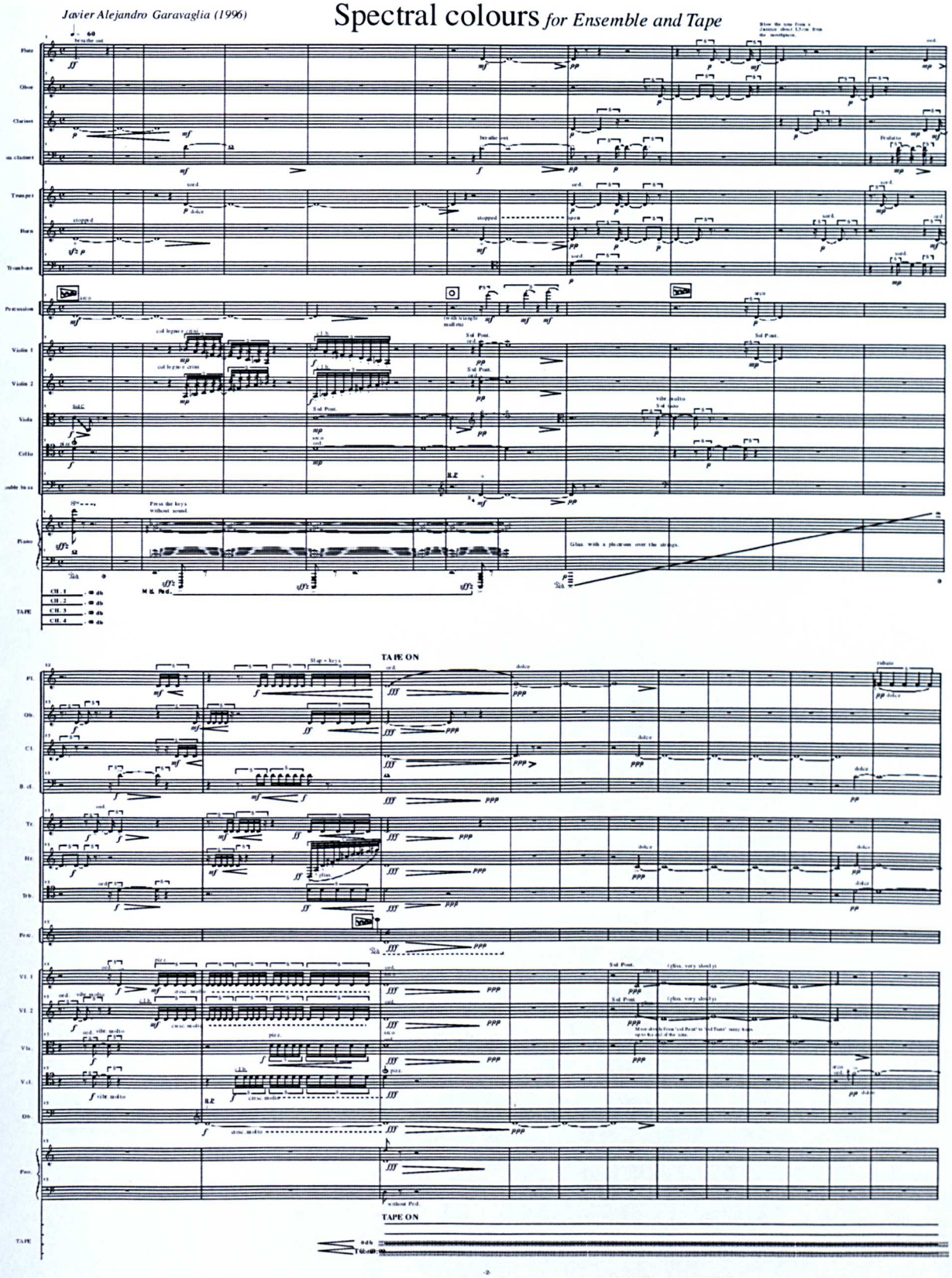
In "Spectral colours" the rhythms have the role of "changing the colours" rather than being movement. They are not that perceptible and are composed as a unit with the instrumentation. The values are mostly the ones printed on the list above.

Form:

If we want to analyse the FORM of "Spectral Colours", we see that the same numbers of the INTERVAL SCALE serve to build the different sections of the work, multiplying each of them by 10. *Each of these values mark not only the begin of each of the 36 notes coming from the GENERATIVE SCALE, but also the begin and duration of a particular instrumental colour section.* This results in structural durations that vary from 1 minute and 50 seconds to structures having a duration of only two seconds. The long ones appear only once in the work, the others appear up to 10 times. How often they appear, was a free compositional choice, based on taking into account the balance of all notes, rhythms and clusters in the overall process.

As example we may analyse the proceedings for the first note (D4): it is assigned to have the structure **10 ♩ x 11= 110 ♩**. This structure appears in "Spectral colours" because of its length (1' and 50") only once, certainly not <u>at</u> once, but divided into two to unequal parts (60 quarters at the beginning of the work and 50 quarters close to the end). This static structure having only one note will be internally "coloured" with some of the rhythmic values showed above, which make this part flow with very dynamic instrumental and internal rhythms changes instead. The same procedure was applied to the following notes and their resulting clusters

The following figures show the way in which the first note (D4) was composed at the beginning of the work (bars 1 to 15)



Instrumentation:

The instrumentation was composed taking into account all the technical possibilities of the 14 instruments (or instrument groups => percussion), so that the most wide "colour" palette possible could be exposed. Because the instrumentation for each new entrance of each new note

changes the whole time, new "colours" come constantly from the ensemble, which plays the anew always different spectral results, always different "spectral colours". In the two pictures of the score printed above (bars 1 to 24), it is possible to observe these procedures quite clearly.

Tape:

The tape was produced with the 3 sound-notes mentioned above played and recorded "sul ponticello" on a viola. These 3 notes were transposed and were treated with several filter chains, reverberation and envelope followers (mostly with Csound), so that the "overtone quality" of the "sul ponticello" notes could be maintained and increased also for the lower transpositions. The role of the tape is that of a foreign "colour", which nevertheless belongs to the whole adding the spatial sense through the quadrophonic diffusion.

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Appendix XVII

Paper: *An approach to Music's Dramaturgy with the interaction of technological devices. A composer's review of "NINTH (music for viola & computer)" (2002) for Viola and MAX-MSP.*

This paper was read at the 9th biennial Symposium for Art and Technology: *'Transparent technologies'* (Connecticut College - New London, CT, USA) in March 2003. It was printed in the Proceedings book of the Symposium, with no ISBN.

This paper was reformatted herewith to fit the delivery requirements for this PhD. For full details, see Appendix VII.

Javier Alejandro Garavaglia

An approach to Music's Dramaturgy with the interaction of technological devices. A composer's review of "NINTH (music for viola & computer)" for Viola and MAX-MSP (2002).

INTRODUCTION:

My principal concern while composing a piece of music is its ultimate perception. Here some questions about this subject:

-How does the relationship "creator - receptor" in music work?
-How does the receptor perceive a piece of music?
-What happens in his mind?
-What type of effect does the creator want to produce in the audience through a music composition?

Including technological devices into the creation and performance of music, technology may constitute itself as a way of artistic expression, coexisting with traditional aesthetics principles. *If this happens, a composer has to make some kind of reflection about how the audience perceives technology.* Here two possibilities:

1- The audience perceives the dramatic of the work as a *whole* or
2- Technology *does* create a new space in the perception, where it is possible to understand different level of dramatics during a musical piece performance.

With my final Diploma dissertation at the Folkwang Hochschule Essen (Germany) some years ago, I tried to categorize and systematize how music could be conceived and perceived, independently of what kind of music should be taken into consideration. *The common denominator is here the music's dramaturgy.*

With the uninterrupted and quick development of always-new ways of expression coming from the technological side, I ask myself if we should not begin to think about absolutely new aesthetics in the new multimedia times.

Let me clarify very quickly my point of view beginning with the meaning of the word:

Dramaturgy: *(from the Greek. dramatourgía)* means: theory of the external construction form of a drama and the laws of it's inner structure

and the word:

Drama *(from the Greek. drâma)* means: series of exciting events.

Music happens along time, it is an "on going process" (and if we analyze it from the *subjective* point of view, time should be here a *relative* value). If we take a look to the definition of *drama*, we cannot ignore here the word *event*. An event is an "on going process" too. The structure of every event is perceived by the "receptor" and is saved in his memory as a certain amount of information regarding the contemplated event (for example his own conception, his own "mental" snapshots, etc). This structure is the "dramaturgy" of the event. If we consider now that music is in fact an event, the description above for *drama* should be also applied to music.

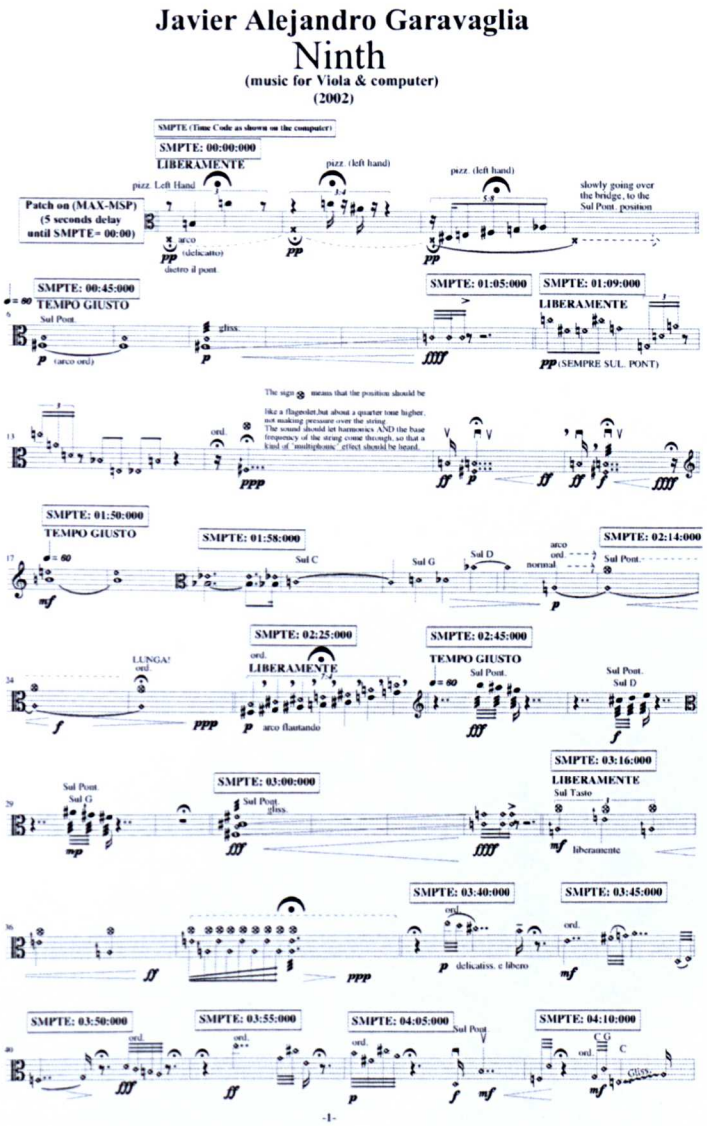
Ninth (music for Viola & computer). Short description:

In order to illustrate with one possible example my conception of dramatic interaction between technology and music, I' would like to introduce my piece "Ninth (music for Viola and computer)", for viola and MAX-MSP.

NINTH is a piece 12 minutes long piece involving only one viola and a computer, both interacting without any kind of other electronic devices.

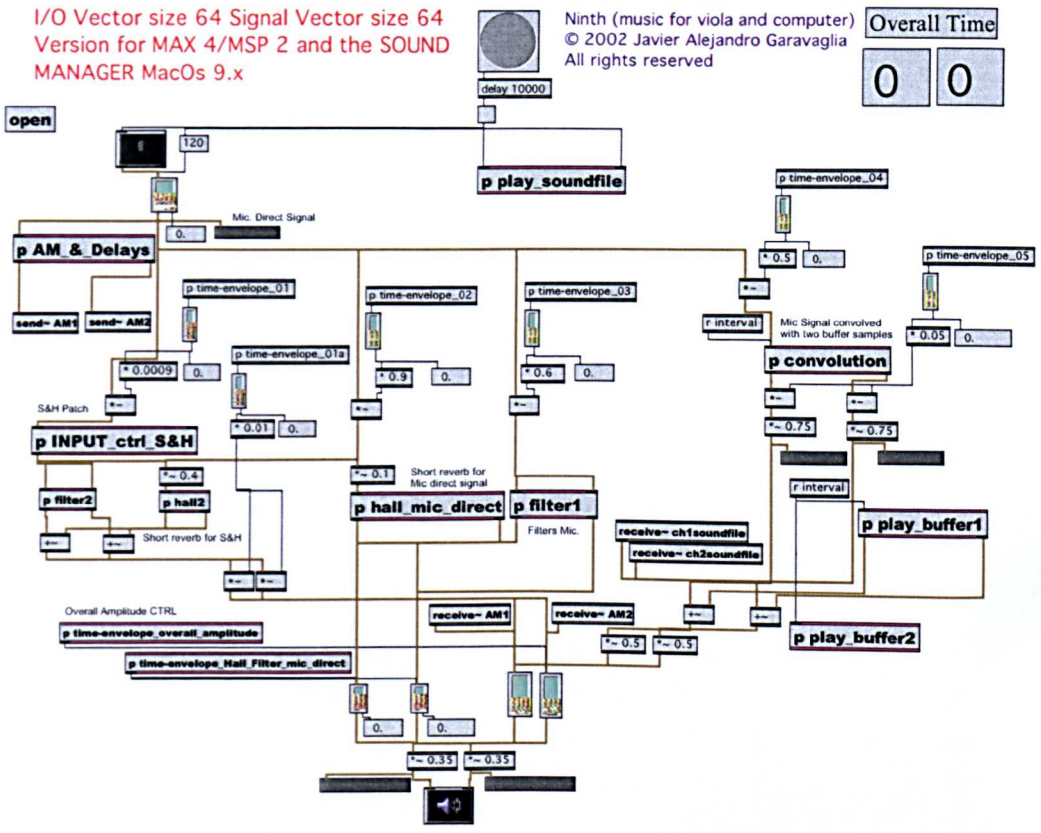
The compositional materials (sounds, rhythms and pitches) are taken from the third movement - Adagio- of Anton Bruckner's 9th Symphony in D minor. The composition for the viola part makes usage of advanced techniques and mostly all the pitches are played as flageolet (natural harmonics) sounds *[FIGURE 1]*, which has also a direct relation with the kind of live-electronics wanted for the piece.

The computer part of "NINTH (music for Viola & Computer)", was fully programmed with MAX-MSP. This is a DSP software developed by D. Zicarelli for the Macintosh environment, following the IRCAM ISPW (Ircam Signal Processing Workstation), which worked together in the 90's with Opcode's MAX on the Next computers. MAX-MSP uses the so-called patches, which are a combination of different objects, which have all different names and functions. There is a slight difference between MAX alone Objects (mostly used for MIDI and sequencing applications) and the MSP objects: the latter add a tilde (~) after the name, and are able to pass a DSP signal from one object to another. MAX objects, on the other side, can only pass normal data (including MIDI data).



[FIGURE. 1 - First page of the Score of "NINTH (music for Viola & computer")]

The MAX-MSP main patch for "NINTH" *[FIGURE 2]* has several Instruments, which make different Signal Processing routines, like filtering, a particular Sample & Hold type designed by me for this piece (triggered by the amplitude of the input coming from the viola), convolution, dynamic delays or Amplitude Modulation (all interacting with each other). Two samples stored on the Hard Drive of the computer, originally taken from the F# dominant chord on bar 17 of the general score of Bruckner's symphony, interact also with the viola and the developed MAX-MSP instruments within the patch. Both samples were previously modified through a time stretching treatment (Phase Vocoding) and slightly varying in its pitch.

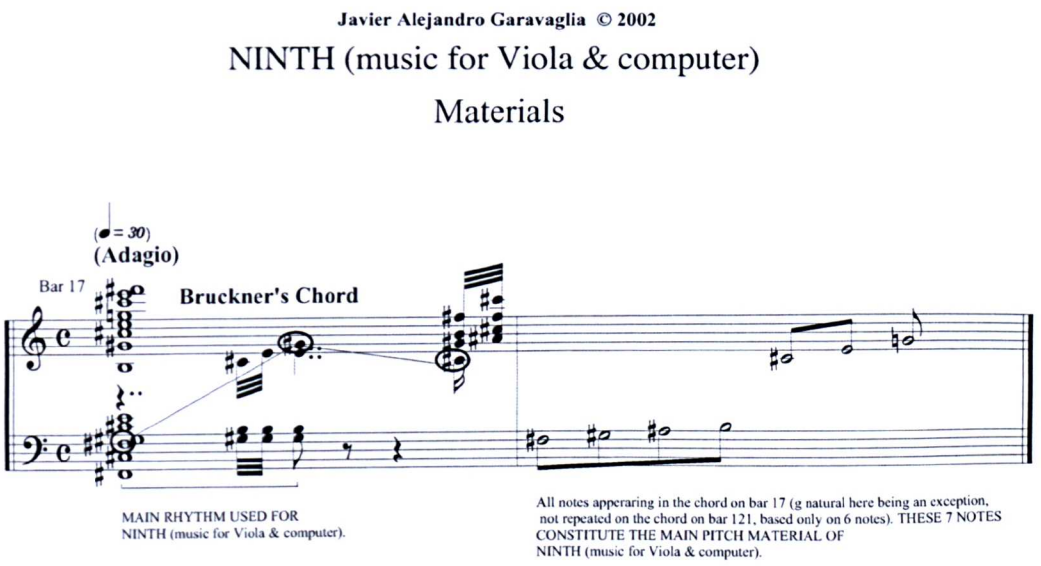


[FIGURE. 2 - MAIN MAX_MSP Patch for "NINTH (music for Viola & computer")]

The form of the piece, like Bruckner's Adagio, is a kind of ABAB like-form with a Coda. The title "Ninth" recalls not only Bruckner's symphony, but also the initial interval of its third movement (a minor ninth), that structures the whole movement.

Bruckner's 9th Symphony (D minor) / 3rd Movement: Adagio (E major)

The choice of this symphony has personal connotations, because this work is one of my favourite pieces of music. The kind of spiritual highness that Bruckner intended to reach in his life and music is transparently evident in this moment. The main thematic feature is the interval of a minor ninth (b natural to c natural) at the beginning of the movement that has (at least for me) the dramatic tension of recalling "longing". The central emotional focus of the movement lays on an F# dominant chord (II Degree of the main tonality - that is the dominant of the dominant) on bars 17 to 19 (with 7th and 9th, plus and aggregated 4th, the last both resolving in the A# at the end), which is repeated on bar 121 to 123, this time a semitone higher -on G- with an almost identical orchestration. All four Horns in F play the 9th interval melodically (f# and g#) the first time (and g and a the second time) during this chord. You can see this on the next Graphic *[FIGURE 3]*



[FIGURE. 3 - Bruckner's F# chord (9th Symphony - 3rd Movement. BAR 17). On the right side, the essential notes of the chord are extracted and serve as basic material for "NINTH (music for Viola & computer")]

The melodic 9th interval is the main material, developing the whole thematic from it (and it is the 9th Symphony indeed!). A very curious thing is, that the first chord (F#) has both ninths in it (minor and major, that means G# and G, this last only on the Clarinet). The second chord has only the major 9th (in this case an A). Because of this double use of minor *and* major ninth in this chord, is that I decided to use only the first version of it for my piece. The rhythmic distribution of the melodic interval of ninth in this case is => **Long note** (1x quarter note plus 1x eighth and plus 1x sixteenth) and **two short rhythms** (2x thirtyseconds). This Pattern - ONE long note followed by TWO short ones -, is recurrently used in my piece also ***[FIGURE 1]***.

Technical description of the MAX-MSP main Patch and sub-patches (instruments) in *NINTH*.

The main Patch in *NINTH* was conceived to be operated on the stage by the performer himself (the main ground being, that I like to play the piece myself). Because the player needs his hands almost the whole time on the instrument, he is not in the position to make changes on the computer while the piece is running. This fact added to the reason that I do not like (and this is only a personal decision) someone operating the computer during the performance, mostly because the complexity of the patch requires some time to get along with it, what normally doesn't happen during hectic performance and rehearsal times. Taking this into account, only pressing a button (BANG) on the patch, delayed 10 seconds, so that the performer may take the initial position is the only operation that is needed to perform the piece. From then on, there are several time envelopes crossfading the entrance or exit of the different DSP processes (the instruments or sub-patches) during the piece.

The first processes taking place are also the only ones taking place from the beginning to the end:

- **[Sub-patch hall_mic_direct]** => a short stereo reverb with 40 milliseconds on the right output and 50 milliseconds on the left one, with a dynamic feedback value oscillating between 40% and 75%, going inverse on both channels

- **[Sub-patch Play_soundfile]** => reading a sound file (Sample) stored on the Hard Drive, which will also be active from the beginning till the end. This is a mono file, for which a special panning in MAX-MSP was programmed. The original Sample is a recording of the F# dominant chord on bar 17. This was stretched in its length in two files: one up to 40 times and the other up to 20. These two files were then processed with cross synthesis and after that varied in its pitch very slowly (resulting in a very long, imperceptible "glissando") with a total duration of 11 minutes and 22 seconds.

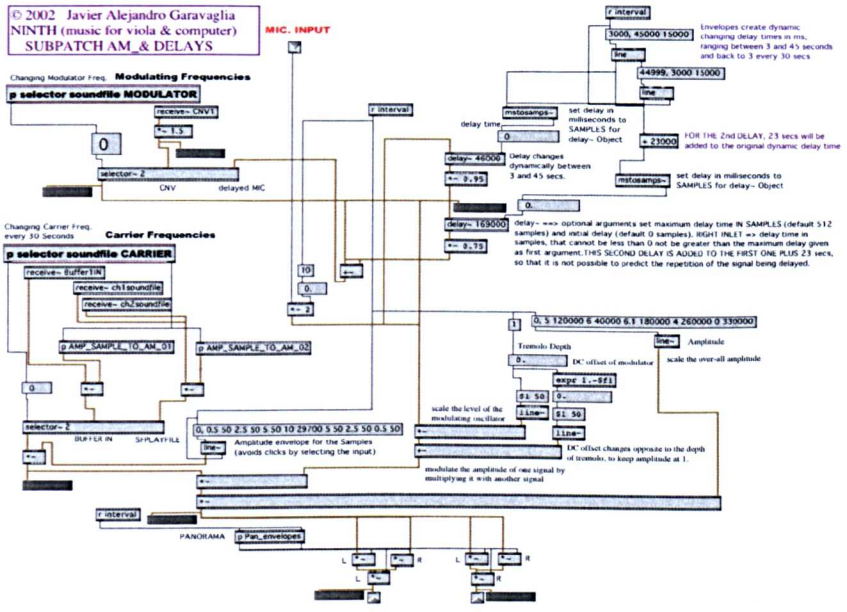
- **[Sub-patch Filter1]** => a dynamic resonance filter, where the central frequency and the Q values vary constantly and differently on both channels.

- **[Sub-patch play_buffer1]** => a short varied version of the first sample will be loaded in the memory and looped, panned, transposed and read forwards and backwards.

- **[Sub-patch play_buffer2]** => another short varied version of the first sample will be loaded in the memory and looped, panned, transposed and read forwards and backwards.

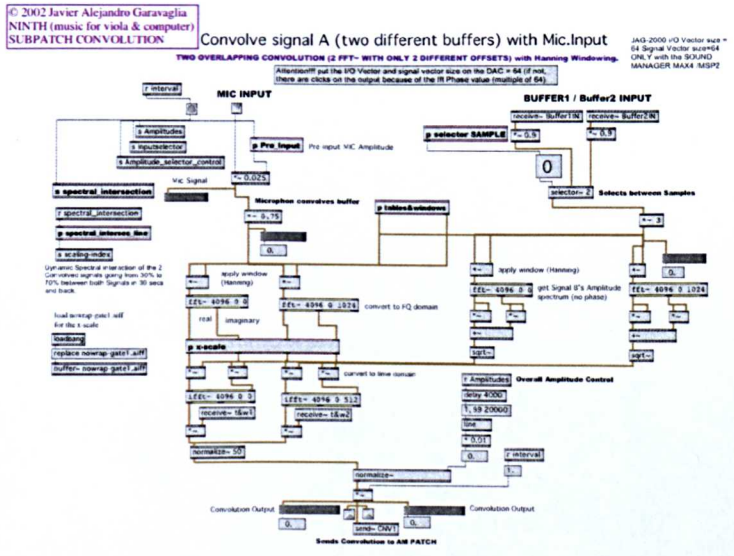
The two BUFFER sub-patches are needed for an interaction between themselves and the viola input signal in some of the next operations. The sub-patches that produce the main live-electronics in NINTH are:

- **[Sub-patch AM_&_DELAYS]** => used for imitation a repetition of live sounds. AM means here Amplitude Modulation, that is, the multiplication of signals (sample by sample) in the time domain. The 2 carrier frequencies for these patch are selected every 30 seconds between the main sample on the Hard Disc (coming from the [Sub-patch Play_soundfile]) and the buffer N° 1. The modulator frequencies on the other side are the direct INPUT from the viola or the convolution output, which are being selected every 22 or 55 seconds respectively. In the case of the direct microphone INPUT, two delay lines were programmed. Time envelopes creating dynamic changing delay times, ranging between 3 and 45 seconds and back to 3 every 30 seconds, make the first delay pass to be hold almost randomly between these limits. The 2nd delay pass is added to the first with the same range of delay time *plus* 23 seconds, so that it is not possible to predict the repetition time of the signal already delayed on the first pass. The second delay takes a different amount of samples to delay than the first one. This and the fact that this modulator is *not* always active (because it alternates with the convolved signal, explained in the next sub-patch), makes the repetition of these modulations (AM) seem extraordinary randomized and surprising also in the timbre, because the carrier frequencies also switch every thirty seconds. This sub-patch is present almost the whole time, being more predominant towards the middle of the piece, and fading out very slowly to the end. ***/FIGURE 4/***



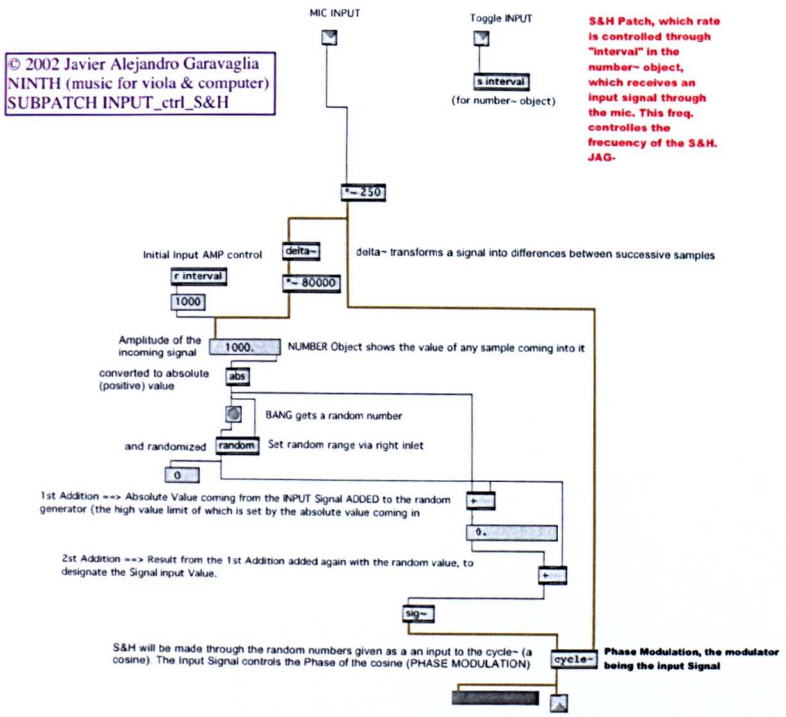
[FIGURE. 4 - MAX-MSP SUB-PATCH AM_&:DELAYS for "NINTH (music for Viola & computer")]

- **[Sub-patch Convolution]** => the 2 buffer samples stored in the memory under the sub-patches **play_buffer1** and **play_buffer2** are used as the input for one of the signals to be convolved. Convolution is a real time analysis and multiplication of the spectral contents of the incoming signals (in this case, N° 1 being the viola, N° 2 one of the samples) through FFT and IFFT (Fast Fourier Transformation and Inverse Fast Fourier Transformation) and is the equivalent to AM in the frequency domain. Because Convolution takes a very intensive calculation process (showed on the CPU utilization) and in order not to overload the real time processes, I used only two overlap Convolution That means that the "slices" of sound to be analyzed are shifted only once in the windowing analysis. The Convolution process begins at minute 2:00 and will be very slowly faded out until the end of the piece. The period going from minute two to minute five are the most relevant for convolution in *NINTH. **[FIGURE 5]***



[FIGURE. 5 - MAX-MSP SUB-PATCH CONVOLUTION for "NINTH (music for Viola & computer")]

- **[Sub-patch INPUT_ctrl_S&H]** => begins working first at minute 6:42. At this time, an envelope lets the viola signal go through the patch, triggering a lot of high frequencies as usual by the procedure called "Sample and Hold". S&H is a normal electroacoustic procedure, which "retains" some of the random numbers (usually generated by a Noise generator) a short moment of time (this rate - which can also be randomized, being given by the user), till another number will be selected. The output is usual a FM. In this case, I designed a Phase Modulated Random generation patch. The Input signal coming from the viola modulates the phase of the frequency values coming into the oscillator. This values are taken from randomized numbers coming from the *number~* object (which reads the value of the samples coming in). The effect, mostly with the high harmonics (and depending of the intensity with which they are played) of the viola part, is that of high metallic notes. This sub-patch is the main one in the second half of the piece. ***[FIGURE 6]***



[FIGURE. 6 - MAX-MSP SUB-PATCH INPUT_ctrl_S&H for "NINTH (music for Viola & computer")]

Conclusion

Coming back to the aesthetic point of this paper, the *dramatic* of this piece is very different in its aesthetics to Bruckner's work, though it may be very similar in the kind of emotions it might awake in the audience, in spite of the use of technology.

From my point of view, the challenge composing pieces like this - in which technology overtakes a musical and aesthetic role - is to combine the music you want to compose with the real-time computer processes you want to program, in order to sacrifice none of the main dramatic ideals.

In the case of *NINTH*, the resulting dramaturgy would not have been possible, if these two different worlds had not been able to work together. Thus, the effect upon the "audience" might not be achieved using other means *but* technology. And I still think, that there are two parallel and different kinds of dramatics taking place and interacting. You may judge these statements listening to the piece during the present festival.

NINTH (music for Viola & computer)
Technical Description:

- Duration: ca. 12 minutes.
- Viola with contact microphone (input direct in the computer)
- Apple PowerBook (Minimum G3 500)
- Stereo Output (sound manager or Digital Interface) A multi-track version up to 8-tracks is also planned, but not ready.
- Diffusion for at least 4 channels (better 6) and somebody in charge of the diffusion on the mixer.

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Appendix XVIII

Article online: *Music and technology: what impact does technology have on the dramaturgy of music?*

Enhanced and enlarged article based on the homonymous paper read at the CMMR/NTSMB 2008 - Genesis of Meaning in Digital Art Denmark – Copenhagen in May 2008.

The article can be read and downloaded without charge at http://www.musicandmeaning.net, JMM - The Journal of Music and Meaning
The article was reformatted herewith to fit the delivery requirements for this PhD.
For full details, see Appendix VII - List of all Relevant Work in the Public Domain and the Bibliography.

Music and technology: what impact does technology have on the dramaturgy of music?

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This article is a reflection from a philosophical perspective of how technology may impact on the dramaturgy of music, especially contemporary music[1]. It will propose a new categorisation for the general concept of music's dramaturgy and will further investigate how the impact of technology can be perceived from different perspectives, including those of the creator, the performer and mainly, the listener. From the point of view of the latter, Delalande's article "Music Analysis and Reception Behaviours: Sommeil by Pierre Henry"[2] will be briefly mentioned, acknowledging the 6 listening behaviours (3 main and 3 subsidiaries) discussed on it. The present work will propose an additional 7th behaviour to the former six. Further, the article asks questions about the impact of technology in music perception nowadays and proposes answers to some of them, categorising different emergent types of music creator[3]. The article concentrates on the how composers and performers approach technology and how this approach can be ultimately perceived by an audience in the context of music dramaturgy. It deviates from current research like the I/R project (Landy and Weale) by not applying a test-subject based research. By proposing an own categorisation of music dramaturgy instead, the main focus is set on what happens in the mind of listeners (reception) during a performance and afterwards rather than the creator's perspective (intention). Unlike the I/R project in its first phase, it includes other types of technology-dependent music than only acousmatic.

1. Introduction

As a composer and performer of contemporary music, my principal concern by composing or performing a piece of music is its ultimate perception, no matter if it includes or not technology at some degree.[4] The subject of music dramaturgy has been treated across time in different ways and from different perspectives; in the last years Leigh Landy and later Robert Weale have performed quite a fundamental research on the area; however this research rests solely on sound-based music[5] rather than music in a general and broader sense. Former research about the subject is sometimes problematic, as in many cases, the word dramaturgy is absent, even if referred to.[6] In any case, my activity as an active composer and performer (and as a listener as well) has lead me to take a particular interest in some fundamental questions about the subject dramaturgy of music, for example:

- How does the relationship "creator - listener" in music work?
- How does a performer interpret and transmit music to the audience?
- How does the listener perceive a piece of music? What happens in his mind?

[1] This term hereby used in a restricted sense, referring exclusively to Art music (term as defined by Jacques Siron (Siron, p. 242.)) from the last 50 years. In a general sense, the term can be defined as including all forms of music available in the present times.

[2] Delalande, François -1998

[3] 'Composer might not be a good word to describe the creation of all-sound-and-technology based art work, as it will be explained later in the article.

[4] Most of the times in the form of some kind of electronics, meaning both digital and analogue hereby.

[5] As defined by Landy (Landy, 2007, p. 17).

[6] Some authors: Budd (1994), Floros (1989), Goehr (1992) and Storr (1992) among others. Just as interesting is to read how composers refer to music's dramaturgy as well, also in many cases, without using the very word. See i.e. Musik Konzepte, 128 - Luciano Berio (several occasions, mostly in the interviews).

- What type of effect does the creator want to arise in the audience through a musical composition?
- Is there any difference between the composer's intention and the performer's interpretation of a piece of music and specifically in the case of interactive music?
- How all this affect music's dramaturgy?

More questions could be added to this list; some will be answered briefly and in a general way in this article, as not all of them completely belong to the subject proposed hereby. The present discussion is about the inclusion of technological devices both in the creative process and in the performance of a piece of music, to further analyse if technology may constitute itself a way of artistic expression, coexisting with traditional principles of aesthetics and therefore affecting music's dramaturgy. If this happens, both composers and performers imperatively need to make a deep reflection about how the audience perceives technology (or its results, depending on each case).

2. Different ways of perceiving technology in a music composition or performance

There are some questions that will need to find some answers at the end of this article. These are:

- Does technology have any influence on music's dramaturgy at all?
- If so: is there a new kind of technological-music-dramaturgy, as technology has been included in the creative-interpretative process?
- Should technology establish its own dramaturgy or should it be disguised within "normal" musical processes?

It can be said, that primordially and at first sight, we might find two, quite opposite possibilities, both referred to the perception space[7] that technology could or not create, concerning the whole dramatic[8] contents of a piece of music. These opposite views are:

1. The audience perceives the dramatic of the work as a *whole* (implying that *no* new perception space will be created) or
2. Technology *does create a new perceptual space*, where it is possible to understand different levels of dramaturgy during the performance of a piece of music. This might need some training from the audience (and performers) in order to understand this new type of perception.

Unfortunately and even if this article will try to cover a vast range of issues emerging from this problematic, there will be still some open questions in the end, mostly due to the extreme subjectivity intrinsic to the subject of discussion. This said, however, there is room for substantial, theoretical discussion about the issue, in order to shed more light on the problem.

One of my mayor concerns (as composer and performer) is how do composers and musicians deal with the subject 'dramaturgy of music' in general. In recent years, I have been trying to categorise and systematise the concept of music dramaturgy, independently of what kind of music should be taken into consideration. I am particularly interested in the area of perception *after* emotions take place (see Section 3 for a proposed complete chart of the whole communication chain for music dramaturgy). A substantial amount of publications have been written about the relationship between music perception and emotions (and many of them unfortunately focus only on western music of roughly around 1400-1900, considering the main object of measurement for emotions the musical parameter 'melody', many leaving most of the other parameters aside). From the point of view of music's dramaturgy in general, (and therefore not exclusively the type of music meant in this article), I am interested in a more comprehensive analysis, which would include the perception of all types of music, regardless of its genre, age, etc., and furthermore considering all or at least most of music's parameters[9] in a quite equal manner. Electroacoustic music, as defined at the EARS website,[10] a genre for which technology is part of its very essence, remains quite relegated when it comes to analyse how it can be perceived (and how it is perceived), despite

[7] Perception space defined here as the direction attention is given to and how it can be understood in the listener's mind.

[8] See definition of Drama and Dramaturgy on Section 3.

[9] Like timbre, rhythm, harmony, melody, sound layers, spatialization (the latter two for electroacoustic music), etc.

[10] Electroacoustic music refers to any music in which electricity has had some involvement in sound registration and/or production other than that of simple microphone recording or amplification. (Source - Leigh Landy (1999). Reviewing the Musicology of Electroacoustic Music. Organised Sound Vol. 4, No. 1. Cambridge: Cambridge University Press: 61-70) [http://www.ears.dmu.ac.uk/spip.php?rubrique125]

some substantial research done in the area in recent years like the Intention/Reception project by Weale and Landy.

3. Music Dramaturgy

Taking a look at the origins of the word "dramaturgy", we can find the following options:

Etymology: *German* Dramaturgie, *from Greek* dramatourgia *dramatic composition, from* dramat-, *drama* + -ourgia *–urgy.* ***Date:*** *1801.*

(a) the art or technique of dramatic composition and theatrical representation [11].

(b) the art or technique of dramatic composition or theatrical representation. In this sense English dramaturgy and French dramaturgie are both borrowed from German Dramaturgie, a word used by the German dramatist and critic Gotthold Lessing in an influential series of essays entitled Hamburgische Dramaturgie ("The Hamburg Dramaturgy"), published from 1767 to 1769. The word is from the Greek dramatourgía, "a dramatic composition" or "action of a play." [12]

So stated, and being this originally a compound word, it is impossible to avoid a closer approach to its first part, the word *Drama*:

Etymology: *Late Latin* dramat-, *drama, from Greek, deed, drama, from* dran *to do, act*

1- *a composition in verse or prose intended to portray life or character or to tell a story usually involving conflicts and emotions through action and dialogue and typically designed for theatrical performance:* ***PLAY.***

2- *dramatic art, literature, or affairs*

3- a: *a state, situation, or series of events involving interesting or intense conflict of forces.*

b: *dramatic state, effect, or quality <the drama of the courtroom proceedings>.*[13]

As we can see, the word "dramaturgy" has its origin in the German word "Dramaturgie" and its roots can be found in the ancient Greek word "*dramatourgia*". However, the main term to consider should be **Drama**: its meaning is always related to the concepts of "action" or "event". Aristotle, in chapter 3 of his *On the art of poetry*, describes drama as something "being done" [14] The word **Dramaturgy** implies the actual composition or "*arrangement into specific proportion or relation and especially into artistic form*"[15] as well as the knowledge of the rules for gathering these concepts onto a (normally) known and preconceived structure (originally, the Greek tragedy was meant here).

Ultimately, we can define the dramaturgy of music as the way in which the creator and the listener represent in their minds the flow of a musical occurrence (that is the development of one sonic-event coming from a previous one and leading to the next), which constitutes an entity (ontologically) that as such is unique in itself, as might also be its mental representation (psychologically); however, both cases of "uniqueness" might not be most of the time quite the same, as we shall see later. The series of sounds organised according to the rules of each and every musical 'being'[16] (the word 'being' is here used ontologically, meaning anything that can be said to BE immanently, as not always might we refer to a composition when confronted to music-listening, mostly if we consider music from outside the western culture), are the events involving an "*interesting or intense conflict of forces*", as seen above in one of the definitions of dramaturgy. And, as in the case of the original meaning of the word in ancient Greece, these forces *do* happen during a performance. The forces in place are the emotions/thoughts aroused by the sounds of the performance, which produce a mental representation of what is occurring in the piece of music: its emergent dramaturgy. Another issue that comes added to this is *expectation*: the brain adapts itself quite in an earlier stage in life, as early as inside the womb, and stores music information in the

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[11] Merriam-Webster's Collegiate Dictionary

[12] Encyclopaedia Britannica Library

[13] Merriam-Webster's Collegiate Dictionary

[14] „*Thus in one sense Sophocles might be called an imitator of the same kind as Homer, for they both represent good men; in another sense he is like Aristophanes, in that they both represent men in action, men actually doing things. And this, some say, is why their works are called dramas, from their representing men doing things*". (Aristotle - Dorsch 1965, p. 34). Later on this page, Dorsch points out in a footnote, that the word drama means literally "a thing done".

[15] Merriam-Webster's Collegiate Dictionary

[16] The word 'being' is here used ontologically, meaning anything that can be said to BE immanently, as not always might we refer to a composition when confronted to music-listening, mostly if we consider music from outside the western culture.

long term memory, what helps later in life to recall well known contours[17] learned (in the form of harmony, melody, rhythm, etc.), which can lead to expect due to previous knowledge similar results in new, never heard before but yet similar music contours. (see Levitin, Chapter 8 and p.104). The general cultural background of each individual will have similar results regarding how to imagine the music heard. If the models or contours are known to the listener, he/she can predict and even be predisposed to understand the dramaturgy of a given music by comparing it with previous experiences. Cognitive science describes this also as a mental schema: a framework within which the brain places (stores) standard situations, extracting those elements common to multiple experiences (Levitin, p. 115-116). *"[S]chemas.....frame our understanding; they're the system into which we place the elements and interpretations of an aesthetic object. Schemas inform our cognitive models and expectations."* (Levitin, p. 234). In music appreciation, familiarity (what creates the network of neurons in the brain forming the according mental schema) brings the listener's attention onto music styles that the brain might recognise or not. Even if the listener will generally not be familiar to every piece of music listened, those factors on which the brain can hold during the act of listening (as stated by Landy) might guide it to form new neural connections to recognise new elements with which it is, partially or totally, not familiar.

There cannot be any music dramaturgy present in the score of a piece of music (in the case of written music) but only in the actual mental representation of that music (generally across time, given by any type of performance, at least from the listener's perspective, as we will see later). This representation occurs not only during (and even after) the actual performance, but also during the creative process.

Music happens along time, it is an "on going process" (and if we analyse it from the subjective point of view, time must be considered -for this purpose at least- as a relative value too). If we take a look at the definition of *Drama*, we cannot ignore the word "event". An event is an "on going process" too. The structure of every event is perceived by the "receptor" and pertinent aspects of it are saved in his memory as a certain amount of information referring to the contemplated event (for example, his own conception, "mental" snapshots, etc). This structure is the "dramaturgy" of the event. If we consider now that music is in fact an event, the description for *Drama* given above should also be applied to music. Peirce's theory about the *PHANERON* is quite close to this view.[18]

This said, a musical event (or occurrence) can be considered as a *continuum* of sounds and breaks, a continuum which is in itself ontologically full of sense. This *sense* gives the outer (macro) and inner (micro) structural identity of a piece of music. If something changes this structure, the results on the receptor's side might not be the same: *the dramatic will change and so will its understanding.*

In order for music to be in a position to "express", a *communicative process* has to be established. In this way the creator of a certain kind of music (generally, but not exclusively, the composer), delivers through a process (the actual performance, meant here in a broad and generic way) a musical discourse, which will be perceived by an end-recipient (generally, an audience of listeners). Research in this area uses the words "arousal" (borrowed from psychology) or "activation" to the response of people to music.[19] The act of reception-perception should produce in the listener diverse reactions, which can mainly be circumscribed to emotions and thoughts. The communication chain in its first instance is represented in Figure 1 below:

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[17] Contour: 'the general form or structure of something'. Term used also, to determine some 'meaningful change in intonation in speech'. (Merriam-Webster's Collegiate Dictionary)

[18] "I propose to use the word Phaneron as a proper name to denote the total content of any one consciousness (for any one is substantially any other), the sum of all we have in mind in any way whatever, regardless of its cognitive value. This is pretty vague: I intentionally leave it so. I will only point out that I do not limit the reference to an instantaneous state of consciousness; for the clause "in any way whatever" takes in memory and all habitual cognition." (*The Basis of Pragmaticism in Phaneroscopy*, EP 2:362, 1905 - Charles Peirce). (www.helsinki.fi/science/commens/terms/phaneron.html)

[19] ***activation:*** *also called* ***arousal*** *in psychology, the stimulation of the cerebral cortex into a state of general wakefulness or attention. Activation proceeds from various portions of the brain, but mainly from the reticular formation, the nerve network in the midbrain that monitors ingoing and outgoing sensory and motor impulses. Activation, however, is not the same as direct cortical stimulation by specific sense receptors, such as being awakened by noises. It involves, rather, a complex of impulses that are both internal and external to the body.* – (Encyclopaedia Britannica Library - Encyclopaedia Britannica Deluxe Edition 2004). For more about arousal, see Chapter 9 (written by Simonton) by Juslin and Sloboda (2001).

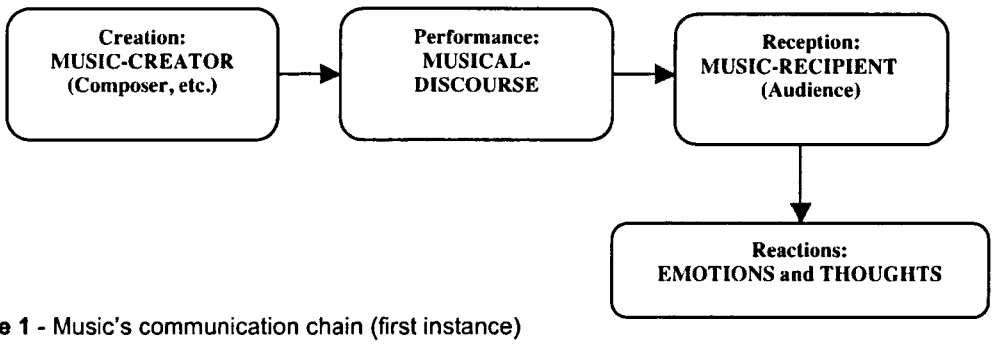

Figure 1 - Music's communication chain (first instance)

Therefore, two main different categories of music dramaturgy can be identified: the intrinsic (or inherent) and the extrinsic (or emergent) music dramaturgy. Let us see both in detail.

1- **Intrinsic (or inherent) dramaturgy:** the dramaturgy that the musical-discourse carries within itself; it is of an objective nature (planned however subjectively by the music-creator). Its origin can be set at *the very moment of conception of any kind of music* and therefore circumscribed to the creator's side of the communication's chain. It is independent from the actual pass of time, although time is intrinsically included, as any music is can only "be" only *during* time. The intrinsic type of dramaturgy can be divided into two subtypes:

a- **"a-priori"** *intrinsic dramaturgy*, where the materials for the creation of the piece (the composition's principles, which will rule the whole piece and determine its own dramaturgy) have their origin *before* the composition of the music itself takes place. The music tries to describe or transmit this main idea, which normally will be a literary subject like a libretto, a storyboard, a poem, etc. In this case, the dramaturgy is *preconceived* and can be known (but not perceived) before the actual representation or performance of the piece. Included in this subtype are pieces (and genres) like Opera, Lied, Symphonic Poem, etc. We can even include the Sonata form here, as its rules make it more or less predictable in how its flow will generally (but not specifically) look like.

b- **'a posteriori'** *intrinsic dramaturgy*, is the type of dramaturgy that does not owe a predetermined dramatic plan evident to the listener. It has its origin and development on principles and concepts directly linked to either pure musical aspects[20] and/or complete extra-musical contexts,[21] *both of which cannot give the listener a clear idea (or any at all) of the dramaturgy path intended in the piece.* The dramaturgy might be not preconceived at all or at least, might remain quite hidden without some given extra information -i.e. any of Landy's 'something to hold on factors'-, or even an exhaustive musical analysis. In this latter case, it is hardly possible for the composer's ideas to be interpreted by the audience as conceived unless the listener is granted access to further information outside the sphere of the music event itself (additional explanations, programme notes, etc.)[22]. In most cases, the listener might deduce a dramaturgy fully of his own, without any relationship with the one conceived by its creator, disregarding even the aid given by any SHF. There is a very wide spectrum of possibilities for the 'a-posteriori' intrinsic dramaturgy, going from pieces like the *Kunst der Fugue* by J. S. Bach (where we have a typical case of absolute pure music, music composed for the sake of music and music theory itself, without any predetermined dramaturgic path) to some "stochastic" music, pure improvisation or even chance music. This category can even include some programmatic music like Berg's *Lyrische Suite* (1926)[23], or Lutowslaski's *Cello Concerto* (1970)[24], where the structure might well be within the ranges of the "a-priori" preconceived dramatic types (Berg's piece is a string quartet in 6 movements), but both

[20] No extra-musical elements like a libretto or a text serve as a basis for its conception.

[21] For example, elements that the listener cannot be aware of and which come from a non-musical background, as some examples later will show, what Landy (1994) includes in his original categorisation of the 'something to hold on factors' (SHFs).

[22] Even though Landy and Weale include these and other items in the SHFs, as I will discuss this later, my view differs from this concept.

[23] A work apparently composed as a mix of events coming from Berg's own life, Schopenhauer's and Wagner's ideas and even including some musical quotations from other composers. (see Floros, 1981)

[24] In this work, hidden conflicts between the soloist and the orchestra should represent the "individual" against the communist society.

composers diffuse or even hide their extra-musical or concepts within a pre-conceived (or pre-determined) structure.

2- **Extrinsic (or emergent) dramaturgy:** it arises solely in the listener's mind by the act of listening and therefore, it is of entirely subjective nature. Circumscribed to *the recipient's side*, this is the dramaturgy happening in his mind *while and after the performance* (the musical drama, action or event), which requires the pass of time to occur. This dramaturgy arises only through the contemplation of music, and, as we will see later, can have an impact even a long time after the actual performance finished. This type of dramaturgy will in some cases partially (the degree is always variable for each audition and listener) coincide with the "intrinsic" type, in others however, it may be not related to it at all. We will see later on, that in the case of technology involved in the communication chain, there will be some cases in which the emergent dramaturgy is the only dramatic possibility for certain music. The emergent dramaturgy is ultimately and absolutely a *subjective act,* happening in the mind of the recipient but having however its source *outside* the subject itself and so, it might or not be independent from the ideas meant by the creator of that music, as the recipient's cultural, cognitive background, capacity to understand, expectation, etc. must be taken into consideration.

Now the graphic in Figure 1 can be completed with the whole communication chain, as shown below in Figure 2:

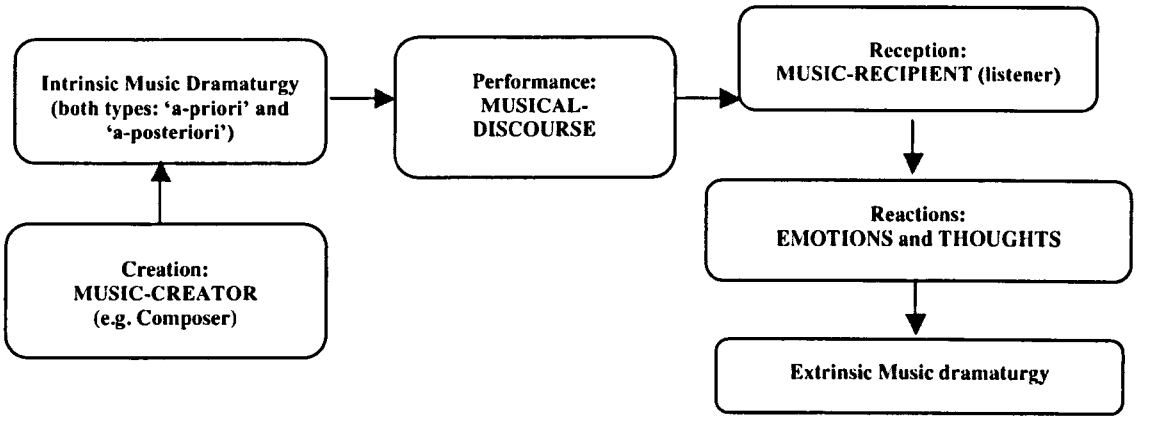

Figure 2 - Music dramaturgy: communication chain showing both the inherent and emergent types of dramaturgy.

Figure 2 shows that the emergent or extrinsic dramaturgy happens *after* emotions and/or thoughts have takes place. Listening to music can have mainly two different reactions, and emotions can be only one of them, even if the most common to identify by both listeners and researchers in the area (see Sloboda, 2001 for example). The other reaction can be thoughts and the ulterior reflection upon them. Some people do seem to listen to the same music through mainly one of these types of perception, although both might be present in the end and thus, the only difference being the degree of one type compared to the other. We cannot ignore, that it is an absolute personal decision (conscious or not) if a listener wants to get involved with music either emotionally, intellectually or both, and this can vary considerably from one situation to another. Ultimately, this does not relate directly if music dramaturgy can be perceived, as following the explanations given so far hereby, its perception should happen nevertheless after both cases.

Regarding music listening, emotions can be however two-folded, as they might predispose the music-recipient to understand the music in a particular way. Thus, they could define or at least influence how, during the act of listening, the music's intrinsic dramaturgy might be perceived. But if the listener is not (mainly) emotionally involved during the reception of a musical discourse, then thoughts invariably emerge. Even in this case, emotions might well play a role, as they might occur in a later step of the process, and therefore they could be the reaction of the understanding of that particular music. I consider this latter case of vital importance, as emotions would appear in this case not before but after the extrinsic dramaturgy has been perceived, as a consequence of the dramaturgy itself and not as an immediate reaction to music. And those emotions might impact in a different way in how the listening (and expectation) of the piece takes place in the future (by repeated listening) as if the emotions would have been the first reaction to understand the dramaturgy. The dramaturgy that emerges in the recipient's mind can be changing from time to

time depending on his moods, cultural background, experiences of life, etc. And when it changes, it might even change the type of emotion arousing while (or even after) listening. Hence, once a particular dramaturgy has been devised by the listener's mind, emotions could be a possible further reaction to that dramaturgy, resembling (but not necessarily) those emotions that arose that particular dramaturgy in the mind in the first place. This can be evident in cases in which the same piece of music (even in the same interpretation, as in the case of a recording) might produce different reactions in the same person at different times.[25]

Though both intrinsic and extrinsic types of dramaturgies (from outside or from inside the listener's own mental universe) might be similar in many cases, they do not have to be (and generally will not coincide at all).[26] Because every piece of music has the power to transmit its information and to produce in the listener certain amount of feelings and thoughts, the 'receptor' takes this information and translates it in its own conception. This is a subjective act, which has however its source outside the subject self. This process is absolutely independent from the ideas meant by the composer. And it is so subjective, that it highly depends on the receptor's cultural and cognitive background, including even the prosodic cue (conventions in language – and therefore a subject for the linguistics area – which state different types of intonation in every day's speech)

The most difficult subject in the field of analysing music dramatics is to be in a position to determine where one type of dramaturgy begins or where the other ends. There is almost always some kind of "cross-fade" between both main types mentioned above, not only during the conceiving moment of creation (i.e. while composing), but also during its actual performance and even beyond, as we shall see in the next section.

An extraordinary example of how, from its very conception to its final performance (and beyond) both types of dramaturgies are present and work together is Luigi Nono's *PROMETEO* (1984). Nono had undoubtedly a precise (intrinsic) dramaturgy in mind, but in the way the piece is performed[27], the extrinsic (emergent) dramaturgy will work differently for each member of the audience, not only due to personal reasons (cultural background, etc.), but also due to their physical position in the concert hall during the performance. I would call this work (from the point of view of its dramaturgy) a multi-dimensional piece, as it will "fit" differently in each listener's personal, own "universe", a concept close to Peirce's Phaneron.

4. Delalande's listening behaviours.

So far, we have defined two different types of music dramaturgy, intrinsic and extrinsic, each respectively considering the conception and perception perspectives (intention/reception) of music creation and its performance.

In his book *Understanding the Art of Sound Organization,* Landy[28] quotes and explains Delalande's six listening behaviours, which Delalande wrote in his article *Music Analysis and Reception Behaviours: Sommeil by Pierre Henry.*[29] This article was based on a particular piece by Pierre Henry, which belongs to the *Musique concrète* genre. However, these behaviours could be actually applied to *any* appreciation of *any* type music, including or not modern technology. They all happen on the listener's side and therefore should belong to the emergent or extrinsic dramaturgy type proposed in Section 3. They are:

1-***taxonomic***: distinguishing the morphology of structures heard.
2-***empathetic***: focuses on immediate reactions to what is heard.
3-***figurativization***: search for a narrative discourse within the work.
4-***search for a law of organization***: search for (given?) structures and models.

[25] Example: the common case of couples having a favourite piece of music. Normally that piece of music produces in the couple of listeners a feeling of comfort and closeness, something that can be easily be attached to the dramaturgic understanding of that piece of music. However, if one of them would die, it is unlikely, that the same piece of music, even the recording, might produce the same emotional effect as before, affecting also its dramaturgic understanding. This, regardless of the intentions (intrinsic dramaturgy) of the creator of the music.

[26] All this refers to music in general, including non-western traditions as well. Closer concepts exclusively related to music perception for sound-based music though are exposed in the next section.

[27] Even if it has been called an "Opera", hardly any work could actually compare to it, as the main idea is that the audience perceives it from its position in the concert hall as if being part of the event (a new kind of stage), and not mere listeners.

[28] Landy (2007)

[29] Delalande (1998)

5-***immersed listening***: feeling part of the context while listening.
6-***nonlistening***: lost of concentration or interest in listening.

In my personal analysis of these behaviours, there should be a 7th added to this list: ***after listening***. This would be the process in our memory of past-music-listening and the recollection of the experiences both lived *while listening* and *while remembering what was listened before*, which might alter our conception of the dramaturgy of that particular music by the next audition or even by each recollection (concurring to Multiple-Trace Memory models (MTT), as in Janata [1997]). Peirce's *Phaneron* appears here as an obvious analogy as well. This 7th behaviour is the one, which might allow the listener to have a particular approach to a particular piece of music and therefore condition in certain way (variable for each case, due its utter subjectivity) future auditions of the same music (whether a different version or even the same recording). Moreover, in many cases, listeners might only recall the impression (the understanding of extrinsic dramaturgy) that a piece of music made in their minds, without factually remembering any of its sound combinations (melodies, harmonies, layers, etc.)

From the point of view of music technology, behaviours number 2 and 5 might be quite relevant. Mostly the idea of „immersion" is relevant to multi-track music due to the actual 'immersion' of the listener in the spatial dimension of sound, no matter if the music is acousmatic, interactive or even an installation.

However, all these listening behaviours do not consider technology *itself* in the perception chain. I make this remark, not as a criticism to the research itself, but to see how technology itself might be ignored in some cases, even if this could be because the listeners who took part in Delalande's research did not identify technology as part of their listening behaviour, or, more likely, where not asked as this was not the main subject of research.

One of the main problems that both *Musique concrète* and the *Elektronische Musik* faced in the 50's (and in less degree, some other types of *Sound-based* music[30] since then), to reach the type of broad audiences and attention other types of music do get, might be that the presence of a living being performing is apparently missing.[32] This could in some cases *directly and immediately* derive in Delalande's 6th behaviour. In this case, technology not only would not create any new space in music perception (not to mention its dramaturgy), but would even kill its very possibility of existence. In the case of inexperienced audiences, one of the SHF (as specified by Landy) might be the performer and in the case of this one missing, a listener might consider what he is listening as something else rather than music. The *non-listening* behaviour might become apparent hereby, at least in the form of not listening specifically to music: therefore dramaturgy of music cannot exist if music itself is inexistent for the potential listener.

Granted, the last 50 years have brought incredible advances, and that not only in technology, but also in the way we all deal with it in a daily basis (and also in the way we accept more sounds as 'musical' as we did in the past). And this of course has also an impact on music primordially based on technology and subsequently on its perception. It is a paradox, that a big part of this development has taken place outside the so-called 'serious' or 'academic' music,[34] even if the problematic had its origin right in its core. But this has been beneficial, as it has made the usage of technology in music as something 'quite' normal for the past 50 years or so, and its perception is easier to detect, as well as its boundaries. While Stockhausen's or Eimert's research in pure synthetic sound in the early 50's had an impact only on a quite moderate number of audiences, given the disassociation in that time of principally serial music from the general public (and the same applies to *Musique concrète*, even if not linked to any serial concept), some other technological advances in the coming decades like the Moog synthesizer, the sampler or the *Chowning FM* principles on Yamaha synthesizers (included in the legendary DX7) had an immediate impact in a much broader audience, which shaped and changed the (mainly) pop music

[30] Sound-based regarded here as the opposite to pitch-and-rhythm-scored orientated music.

[32] The interpret of this type of music sits normally at the mixing desk, in charge of the balance, and many times is also in charge of the spacialization of the sound but. However it is generally difficult for inexperienced audiences to conceive the person in charge of the diffusion of a piece on a mixing desk as '"the performer"' of the music, mostly if the interpret cannot be seen at all, due to a completely dark concert hall or the mixing desk situated beyond the audience's eye reach. And even if visible, there seems to be. a real difficulty to consider this person as performing/interpreting the piece. A reason for this might be that inexperienced audiences might not consider a mixing desk as the equivalent of any musical instrument (*"a device used to produce music"* as defined by the Merriam-Webster's Collegiate Dictionary). In my teaching experience about these issues, I find recurrently this type of behaviour among students; quite remarkable, considering that this music is already more than 50 years old.

[34] Both terms referring to Art music, as defined by Jacques Siron (Siron, p. 242.)

of their times, and in many respects, the way people listened to music (and sound itself as well) or even produced it. Examples of this should include a substantial part of pop music from the 60's and 70's, in particular artists like the Beatles (i.e. introducing the Mellotron in 1966 with John Lennon's *Strawberry fields forever*, incorporated in the *Sgt. Pepper's* album in 1967) Jimi Hendrix (the three Studio albums of the *Jimi Hendrix Experience,* all of them introducing innovative recording techniques, new ways of using the electric guitar to produce unconventional sound – unconventional at least for the pop music scene-, etc.), Pink Floyd (in albums like *Meddle* or *Umma-Gumma*, mostly by the usage of noise and different effects in those albums), etc. Also worth mentioning here is Miles Davies's 'electro jazz-fusion' of the late 60's and early 70' (i.e. the album *Bitches brew*).

5. Music technology and its interaction with music's dramaturgy

Let us now turn our attention to the main topic of this article: *how* does the reception of this kind of interaction between the piece of music and the audience work, when technology is introduced in the process? Does it remain the same or does it *change*? And if it *does* change, how does it happen?

With the uninterrupted and quick development of always-new ways of expression coming from the technological side, it might be wise to *rethink* existing aesthetical and perceptual concepts for the current "multimedia times".

There are nowadays plenty of performance possibilities offered mostly by computers. Some of them decide through 'random' or 'chance' processes the course of a composition or improvisation, some others take decisions based upon probability (i.e. stochastic algorithms). Agreed: "chance" is nothing new in the music of the past decades. In more or less degree, it has been present in pieces by composers like Cage or Boulez[35] to quote only a few. However, the inclusion of computer steered algorithms during a performance (real-time DSP) is something that has been possible only since around the 90s, as both hardware and software were not before in a position to deliver the tasks required.

And this is one of the main aspects where I see a new dramatic meaning being introduced by technology: 'random' events in the performance of a piece, although determined by the composer (and/or programmer), are decided however in real time by the computer and cannot be totally controlled by the composer (or even the performer) during performance time. The composer must therefore have a precise idea of what he wants to happen with the *intrinsic* dramatic of the piece if he does not want this chance determined by the machine eventually might ruin the intrinsic dramatic conception of the piece. In other terms, the creator must programme/compose the algorithms in such a way, that they produce some type of 'controlled chaos'. This is of course in essence not different to the interpretation of graphic scores in the 50's (aleatoric music); the dramaturgy of these pieces depended strongly on how they were performed. But still, the performance was handed to a human being (the performer), to make its own interpretation, not to a machine.

In this case, the questions to ask are:

(a) from the perspective of extrinsic music dramaturgy: what happens with the audience's perception when technology (i.e. a computer) is in charge?

(b) from the perspective of the intrinsic music dramaturgy: which further possibilities for creative innovation, whether random or not does technology give to composers?

In the type of composition where chance dominates both the intention and reception of most of the musical result through the use of computers, the cultural and cognitive background[36] of the audience must play an eminent role, likely more than in other, more traditional types of music. If the listener relies on his/her long-term memories to expect what might come from this music, the actual results might contradict his/her expectations, and therefore the intended dramaturgy might not become apparent. Even if electroacoustic music works with pitches, durations, harmony, etc., these parameters are often disguised in the form of sound-files, samples, etc., created either synthetically or recorded.[37] In this case, a pertinent question might be if an average audience does perceive these parameters in the same way as pure instrumental music? I am aware that some pieces

[35] For example: Boulez's *3rd Sonata* for Piano or Cage's *Williams Mix*.

[36] As established in section 3.

[37] Sounds in acousmatic works, taken from concrete sources (i.e. water, wind, voice, etc.) will still have pitches and rhythms. However these might not be perceived as they might be when played by an instrument.

composed in the past 30 years exclusively for traditional instruments like a violin might also present a difficulty in perceiving pitches and rhythms; nevertheless, this difficulty is lesser (due to the association music-instrument=pitch) than trying to perceive, lets say, the pitch and rhythm of a water sound. Following Wittgenstein and Rosch, the cultural background of average western musical audiences will not normally include water in the category 'sound-to-be-sung' for example and might relate it with its source (river, etc.) instead, depending on the morphology of the sound itself. This way of categorisation will have an impact in the way the dramaturgy is understood. There are interesting results of the I/R project by Weale concerning inexperienced listeners (Weale 2006, p. 196) and acousmatic music, which I would encourage the reader to take a look at if interested.

Moreover: how does the performer react to this? Are performers in their current music education programmes in a position to understand how to interpret and react in these situations (no matter if fixed sounds coming from a medium like tapes or random processes running in real time from a computer)? The answer to this question might be of diverse nature and might not have a conclusive answer. There are institutions (conservatoires, etc.), which give priority to instrument students by putting a lot of effort in introducing them to different types of new music and their technologies. Some others are more traditional in their approach. However, the challenges from composers about how to use an always renewing and updating itself technology, makes a laborious task for instrumentalists to keep up with the latest advances in sound or mapping technology, for example. And even if this 'update' takes place by some very thorough and enthusiastic musicians, there is still the problem of similar or identical technologies being used in completely different ways by different composers. In my own experience, instrumentalists concentrate on some specific type of technology, but most are eager to learn new ways of playing new music. The clue seems to be in giving them a clear picture of how the performance should work, revealing them the 'intention' factor.

This said: has the computer and its annexed technology become a third member in the chain "creator - receptor"?

This is indeed quite difficult to answer because technology may assume very different types of roles. For example: what happens in some cases like interactive multimedia installations, where the audience may decide the dramaturgical steps of the work of art?[38]. These results are normally (depending on the degree of autonomy the algorithms might have been programmed with) quite dissimilar from case to case, even considering the same installation. And audiences in general react quite dissimilarly to the sonic results of them, depending on what is activated each time, how is activated and who is interacting.

Another case, very common nowadays, is the combination of sonic-art[39] with video, working as in most cases as a solid unit. In many cases, the morphology of sound (its spectral components) is intimately related with the morphological characteristics of the visual part. A clear case of this can be seen in the work by the American composer, multi-media artist and performer Silvia Pengilly. Also the introduction of *Jitter* to the MAX software package has brought the interaction between sound and image closer and with new and exciting possibilities, mostly in live-performance situations.

If we analyse in particular computer music and art in the last 20 years, there is evidence, *that technology might indeed open a new dimension in the perception of the dramaturgy of music.* Let us consider, as an example, the new generation of some *laptop performers*, who are also in some cases the creators of the algorithms producing their music. In this case, the computer performs quite alone, with some (or sometimes none) manipulation by the performer. If some manipulation however takes place, it generally does not have a big impact in the music results in the end, as it I generally more of handling nature rather than a true interaction, as the decisions might well be taken exclusively algorithmically. I am aware, that not all laptop performances are like this, but this is the type, which really makes a difference for the topic of this article. *And even in those cases, where the performer interacts with the computer, and even if t*he actual sounds from this kind of music might be already sampled or being produced by internal generators and further synthesis methods or even by some kind or interaction, the whole dramaturgy emerging from it is in most of the cases the result of how all events have been combined by a more or less acute degree of

[38] I should add here, that about 50 years ago, John Cage worked with this concept, without any technological aid at all e.g. in his piece **"4'33"**

[39] This term generally designates the art form in which the sound is its basic unit. A liberal view of sonic art would indicate it to be a subset of music. Sonic art is associated both with musicians as well as fine and new media artists. (taken from EARS: ElectroAcoustic Resource Site - http://www.ears.dmu.ac.uk/spip.php)

chance or randomness, where algorithms (or improvisation by the performer, or a combination of both) take control of the dramatic trajectory of the musical discourse, with an input from the performer, which could be in any degree, from none to full control. *In these cases, the extrinsic or emergent dramaturgy, as defined previously, is the only that can really exist,* as (in a higher degree than in simple improvisation), the course (or musical "discourse") of the dramatic contents of the piece of music are not coming from a human mind, only its triggering principles (the algorithms themselves).

Through this constellation, we may distinguish new types of composer's (or 'music-creator') categories (new in the sense of comparing with the traditional or orthodox meaning of the word):
(1) "composer-programmer": being the word "composer" at the beginning, the attention should be paid to the idea of a composer thinking still in terms of musical dramaturgy whereas the technological input is subordinated to the music. In this case, the composer uses technology within traditional archetypes. This is the case of most scored (with none to small improvisation contents, where most of the dramatic steps are clearly written in music notation) interactive music, like, for example, many interactive pieces by Cort Lippe. I would include hereby also most of my own pieces for live-interaction with computers (see type 4 below for some examples).
(2) "programmer-composer", where the technological input is normally at the foreground of the creation process, mostly as the result of the changes introduced by technology. Here it is sometimes very difficult to determine (for the composer as well as for the audience) if the musical dramaturgy of the piece is only established by the addition of running computer processes or not. This type may be clarified if we think about some multimedia installations, where the music sometimes plays (consciously) a subordinated role, and so does its dramatic too. In such works of art, the dramaturgy is carried out by the whole and not by one of its parts (a similar case of what happens with film music). Examples of this case can vary enormously. An early case would be Gottfried Michael Koenig's string quartet (*Streichquartett, 1959*), which, even not using technology devices (yet) for the random automatic calculation of all musical parameters, it sets out nevertheless the basis for Koenig's future computer programmes *Projekt 1* (1964) and *Projekt 2* (1966) for *computer aided composition.*
(3) "audience/composing-programmer": where 'a priori' and 'a posteriori' programmed processes interact in a new way, being very difficult to determine where the first and where the second type of dramaturgy begins or ends. This is the case of most interactive installations, when the audience itself interacts in the production of the sonic events in time and therefore creates the dramaturgy of the particular event. The ratio of interaction *audience:programmer-composer* can fluently vary to one side or the other.
(4) "interactive-performer": in this case, the performer, with the aid of some kind of equipment on the stage (sensors, etc.), may give new dramatic sense to the piece by every new performance, acting together with his equipment as "co-creator". Even if not a part of this article, as it would be exceeding its purpose, there are some issues referring the way performers deal and interact with technology vary quite substantially from piece to piece and from performer to performer. In many cases, performers are set under an enormous pressure, mostly by having to react to click-tracks, or be very frequented with the tape part, or react depending on what the algorithmic interaction dictates or even having to press lots of pedals, switches, etc. This can be in many cases distracting to both performer and audience in equal parts. In many cases, performers cannot concentrate completely in producing the music they want on the particular piece they play, due to the number of extra activities that technology dictates upon them. And this has a direct impact on how the audience perceives the dramaturgy of the piece (or not, as in some cases Delalande's 6th behaviour might be the only response, *if the interaction obscures with its complexity the musical discourse*). My personal solution to this, as a composer and performer, is the usage of automation in the composing/programming stages, as I have wrote i.e. in my article 'Live - electronics – Procesamiento del sonido en tiempo real. Perspectiva histórica – Distintos métodos y posturas.'[40]. Some of the pieces in which I used this solution are: *Hoquetus* for Soprano saxophone and MAXMSP (2005), *NINTH (music for viola and computer)* (2002), *Ableitungen des Konzepts der Wiederholung (for Ala)* (2004), (both for Viola and MAXMSP) and more lately in *Intersections (memories)* for Clarinet in B (2007-8) and *farb-laut E-Violet* for Viola (2008) both using real-time electronics in 5.1 Surround sound with MAXMSP.

[40] *Live-electronics. Real time sound processing. Historic perspective: Different methods and positions.* It will be published on the 3rd Book of the series "Escritos sobre Audiovisión" edited by Ediciones de la UNLa (Universidad de Lanús, Buenos Aires – Argentina) later in 2008.

(5) "composer-technician-producer". This is the case of musicians using technology to change the mix of a track of music in such a way, that it is the technology itself the one which might be changing the whole dramatic contents of that particular music, by for example, making alternative mixes of some piece of music in a studio (granted, this is more frequent in pop-music, where different mixes are thought for different situations, like dance, radio-mix, etc., but does not exclude in any case other, less commercial, types of music).

6. Conclusion

Regarding the technological advances of the past 20-30 years, a vast number of sound software is nowadays in a position to create sonic results (some innovative, some not), which however, cannot be obtained otherwise, or using that particular technology. And therefore, the perception of technology in itself turns up to be consubstantiated with the musical dramatic responses and results of the music carried by such technologies. This is in itself a remarkable characteristic of technology applied to music, and in this sense, it *does* indeed open new boundaries to music perception and its ultimate dramaturgy. We must not forget here the fact, that the reaction experienced by the audience is always different, depending on if it is frequented with the aesthetics of the work of art or not. In this last case, it may occur that some kind of new personal experiences might be awoken, as from the perspective of neuroscience, the brain is less prepared to expect results from music in which technology might decide part or the totality of the sound and dramatic scope. Expectation might not be available (regardless of this being a matter of less experienced listeners or experienced ones), as the sonic results (and their subsequent understanding) might be new.

As we saw in Section 3, expectation can be broken with surprise if new elements appear (elements unknown to the listener's brain), and depending on how they are combined in a piece of music, the schemas coming out of this appreciation might be stored in the brain and be recognised in future auditions of the same piece or even others, which share similar characteristics. Technology can be one of those new elements, which can enhance expectation through, i.e. an unknown or surprise factor, which will create a new perceptual space. In those cases where whether familiarity nor expectation can be aroused, it might be likely that the listener will not recognise the actual musical event as such, as in Delalande's 6^{th} behaviour, as explained in Section 4.

Even after the categorisation in section 5, it is however still difficult to tell precisely how music technology does create a space of its own in the perception of music's dramaturgy. The main difficulty of this issue depends mostly on each subject's listening behaviours and experiences and the way this type of music might be consequently interpreted. Further empirical research in which composer and listener experiences of technology-based music are mapped to identify the impact and effect of perceived technology on dramaturgy might be needed to yonder deepen on the subject.

However, emergent or extrinsic dramaturgy of music will always be present, so long as its power is able to arouse some kind of emotional and mental reaction by the audience. And here is an exciting point of the use of technology in music: it might give to the audience new elements of perception, which might even go beyond the mere listening of a performance, becoming also a totally new experience.

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Appendix XIX

Article: *Raising Awareness About Complete Automation of Live-Electronics: a Historical Perspective.*

The article can be read and downloaded (charges apply) at,
http://www.springerlink.com

The article was reformatted herewith to fit the delivery requirements for this PhD. For full details, see Appendix VII - List of all Relevant Work in the Public Domain and the Bibliography.

Raising Awareness About Complete Automation of Live-Electronics: a Historical Perspective.

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Abstract. The article raises attention to the advantages and disadvantages of complete automation in DSP processes (including the triggering of events) during the performance of interactive music. By proposing a historic summary divided in three main periods according to the technologies, methods and processes available during each of them, (including examples of key works and composers), it shows how the usage of automation in live-electronics was dependent on the development of new technologies, specially digital. Further, it explains how full automation works in two works of mine, describing the features and techniques involved. Considering those examples, the advantages and disadvantages resulting from the introduction of complete automation of DSP in live performance are finally discussed. Even though automation is not a new technique in the field, I am keen to dedicate special attention to completely automated events -including their triggering- given the impact that automation can have on performances.

Keywords: Automation, Interactivity, Live-Electronics, DSP, Halaphone, 4X, MAX/MSP, Spatialisateur, ISPW, AUDIACSystem, UPIC, Synlab, SMPTE.

1 Introduction

What does the term *live-electronics* mean? The "ElectroAcoustic Resource Site project" (EARS) defines it as:

> 'A term dating from the analogue age of electroacoustic music that describes performance involving electronic instruments which can be performed in real-time. The term is more commonly expressed today as music involving interactive instruments.' [1]

This generally implies the interaction, which transforms and/or processes live or recorded sound in real time. Interactivity is considered nowadays as inseparable from computers or even a network of computers but this has not been always the case. In the last forty years, several and different types of interaction have been identified as *live–electronics*; hence many types of musical pieces can be included in this category. Through my research and practice in the area, I find it very helpful to analyse the history of live-electronics *considering the historical development of the technologies available in each period.* Those technologies have marked each period with their own particular sonorities.

Following this perspective we may identify three main periods, which are not meant however to be inclusive or exclusive; their purpose is simply to give a general view of how interactive music has been changing in the past fifty years, with even contrasting aesthetics emerging in each of them. Further, they allow us to see how automation of real-time processes has evolved since the 1960s. The case that *interactivity* has not always been produced by computers but rather by several (and different) other devices, contradicts to some degree the definition at the EARS website, where it is described exclusively as a computer interaction.[1] In the early times, the implementation of interactive synthesis processes was operated by analogue equipment, and, in most of the cases, manually. Automation in all these cases was therefore mostly impossible. These facts are relevant to the type of sound, the different concert situations and the impact that music

[1] 'Interactivity refers broadly 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. Often, an interactive performance, composition or improvisation will involve the creation or programming of software that will respond to pre-determined aspects of a live performance. The software will then determine other aspects of the music, either generating synthesised sound, or modifying in some way all or some of the *live* sound.' Direct quote from [2].

had in its own time, with regard to both performance-related arrangements in concert halls and perception by the audience. Different technologies have also created particular (and up to some extend, I dare to say, classical) sonorities, which are typical of the period in which they were created and/or implemented. The following section discusses this more in depth, with examples of technologies, compositions and the role automation played in each period.

2 Brief Summary of the Historical Periods

The periods mentioned above run respectively from ca. 1960 to ca. 1970 in the case of the first one, the second, from 1970 to around 1990 and the third from ca. 1990 to the present times. The first period includes only analogue equipment; the second sees the transition between pure-analogue interaction and the slow but unavoidable incorporation of digital techniques, including the first generations of personal computers; finally, the third period includes mainly computers, alongside with other digital devices. We will observe through these periods how the usage of automation evolved, as digital devices were slowly introduced and further developed, whilst analogue devices were slowly abandoned and replaced by digital ones.

Among the several devices which marked the introduction of digital techniques and technologies in the second period, the following are worth mentioning: Dean Wallraff's *DMX-1000* (late 1970s), the *4X*, developed at IRCAM in the early 1980s and the *UPIC*,[2] devised by Iannis Xenakis and developed at the Centre d'Etudes de Mathématique et Automatique Musicales (CEMAMu) in Paris and completed in 1977 [4]. These devices allowed for the creation and/or implementation of new and/or existing sound synthesis procedures. Granular synthesis[3] is a good example of this: Barry Truax's piece *Riverrun*, composed in 1986, was solely based on granular synthesis (possibly the first piece doing so to such an extent) using the *DMX-1000* controlled by the *PODX* system, an interactive compositional software environment developed at Simon Fraser University (Canada) around this time by Truax himself [6].

The third period consolidates the developments of the former two, adding more digital technologies (which became cheaper and smaller every year since then) and procedures to the palette of real-time sound treatment and/or synthesis.

2.1 Analogue Live-Electronics: ca. 1960-1970

During this time, scarcely any digital equipment was available.[4] Even though some electrical devices such as the Theremin (which could be truly considered a real-time sound processing device) were already in use several years before 1960, it was not until the middle of the 1960s, that Karlheinz Stockhausen, (Germany, 1928-2007) began to experiment, compose (and even write detailed scores for the electronic part in his pieces), that we can truly refer to live-electronics as previously defined. The 1960s saw not only a rapid development of analogue equipment (arguably the most significant may be the Moog synthesizer, introduced in 1964), but also plenty of experimentation with a rich palette of sound synthesis methods. During this period, Stockhausen's pieces including live-electronics used invariably filters and different types of modulation, mostly ring modulation (RM).

Some key works by Stockhausen in the 1960s are:

1964: *Mikrophonie I* (Tam-tam, 2x microphones & 2x filters)
1964: *Mixtur* (5 orchestral groups, 4x sine generators & 4x modulators)
1965: *Mikrophonie II* (Choir [12x singers], Hammond & 4x modulators)
1970: *Mantra* (2x pianos, RM, sine generators)

[2] Unité Polyagogique Informatique du CEMAMu [3].
[3] The concept of granular synthesis was first introduced by Gabor in 1947 and later by Xenakis (1971), but at those times, the concept was still more theory rather than a real possibility [5].
[4] Even though computers did exist since some twenty years before, it was not until the mid-70s, that the microchip technology (which was successfully implemented already in 1958) with the *microprocessor* was implemented to create the *microcomputer* (or PC, for *personal computer)*. Most of the development in real-time processing was not possible before microprocessors were introduced in computers and related devices [7, 8].

From those compositions, it is arguably *Mixtur*, due to the time it was composed,[5] the most challenging of the four. The work exists mainly in two versions:[6] the first, for five orchestral groups and a later version from 1967, for a smaller ensemble (maximal 37 players) instead of the five orchestral groups. In it, the usage of live interaction between instruments and electronics opened back in 1964 a new world of new sonorities, setting the ground for all interactive music yet to come. In *Mixtur*, the interaction is set between four sine generators, which ring-modulate four of the instrumental groups, while the fifth group is only amplified. The five orchestral groups (which, as defined by Stockhausen, can have in the first version, any number of players within them) are divided in: wood instruments, brass, strings (*arco*), strings (*pizzicato*) and percussion. From them, the first four are used for the ring modulation with the sine generators; the percussion instruments however, are the ones only amplified. For the smaller 1967 version, Stockhausen required 22x microphones for the main 4x groups, 2x contact microphones for the double basses plus 6x more for the percussion, 7x mixing desks on the stage plus a bigger one in the concert hall, 7x loudspeakers in the front and 2 x 2 loudspeakers at the back. These latter receive the signals from the modulators (he required the signal to be rather soft and to be evenly distributed from right to left, to cover the whole stereo image); the former seven speakers receive the amplified direct signal from the instruments' microphones. The modulations to be heard at the back were carefully planned and written down in the score, for which the composer calculated precisely the spectrum results (differential tones) produced by the ring modulation for each note of each particular instrument. Moreover, the players in charge of the four sine generators have their parts written down: they have to play mostly glissandi at different speeds, which must reach certain frequencies at exact points for the modulations to sound as planned. *Mantra*, composed six years later for two pianos and electronics, still worked with the same principle of ring modulation, added to short wave sounds for one of the pianos. These latter however, do not interact with the pianos; they must be played similarly to tape music (actually, for some performances, a recording of short waves is played back).

Another development worth mentioning during this period is the *Groove machine* by Max Matthews, which dates from the late 1960s; it primarily consisted of controlling analogue equipment via algorithms. However, it was not commercially available, as it existed only in laboratory environment [4].

Between the 1960s and mostly, in the 1970s (and beyond), there have been several DIY ("do it yourself") synthesisers, such as the *Elektor Formant*, which would make a long list to mention in this article, and therefore, it should suffice here only to acknowledge their existence.

It should be rather clear by now, that automation (not to mention completely automated pieces) was not actually possible during this period, and that the results from analogue equipment for these and other pieces depended almost exclusively on manual steering of the devices during the performance. This fact slowly changed in the next period, with the introduction of digital technologies and the first hybrid (digital/analogue) devices, although reasonable and general automation was not possible until the late second half of the 1980s and, in fact, not successful before the second half of the 1990s.

2.2 Analogue and Digital Live-Electronics: ca. 1970-1990

During this rather long period, the path from pure analogue equipment to digital devices occurs. A crucial event in this period is the creation in 1974 (May 14th) of the *Institut de Recherche er Coodination Acoustique-Musique* (IRCAM) in Paris. It was a project initiated by Pierre Boulez (France, 1925) back in 1972, which became since its creation one of the most important and prestigious centres for electroacoustic music in the world.

As mentioned above, the first *Digital Signal Processors* (DSP) also appeared (such as the *DMX-1000* or the *UPIC*) during this period, mostly by the end of the 1970s. Even though these and other systems -such as the *4X* at IRCAM- were in a position to generate different sound synthesis

[5] Even though composed in July/August 1964 and therefore the first of these pieces to be fully composed, Stockhausen situated in his work catalogue *Mikrophonie I* before it, only because experimentation on the Tam-Tams for *Mikrophonie I* began as early as 1961; it also premiered in December 1964, while *Mixtur* had its premiere on November 9th, 1965 (Hamburg).

[6] There is a third revision, from 2003. Astonishingly, the revision is not about the electronics, but rewriting the score, to eliminate the indeterminacy (aleatoric) that the piece had in its two first versions. Therefore, the instrumentation is completely fixed, where no choices need to be taken by the musicians in the orchestra.

procedures, these were generally not performed in real time (mostly due to the slow reaction of computer chips at that time). This fact made them more suitable for the production of overwhelmingly tape pieces in studio. The piece *Riverrun* by Barry Truax is an excellent example (see above, section 2). Other important devices developed during this period were: the *Emulator*, with its versions *I* (1981), *II* (1984) and the *E-III* (1988),[7] by *E-mu Systems*; the *Fairlight* synthesisers/samplers;[8] the *Yamaha DX7* synthesisers (1983, using Chowning FM) and following models; the *Synclavier* with its different versions *Synclavier Digital Synth* (1977),[9] the *Synclavier II*[10] (1980), the *PS* model series and, at the end of the 1980s, the *Synclavier 9600 Tapeless studio*, the last model to come from the New England Digital company before it went out of business in 1991. Even though none of these devices were neither created nor used for real-time interaction, they were important, because, being digital (or hybrids), they marked a tendency towards a digital predominance in the market. From about 1975 onwards, there were some systems developed, which controlled analogue synthesisers via computers in real-time; some were programmed using the *BASIC* programming language. An example is the *PDP-11* at SYCOM (University of South Florida, USA), which needed paper tape for storage and input via teletype [4]. Between 1975 and 1978, the firm *Hofschneider* (Berlin) in collaboration with the Folkwang Hochschule Essen (Germany) produced the *SYNLAB*, a modular analogue synthesizer based on the design of the *ARP 2500*,[11] which could be controlled later also via computers, therefore becoming a hybrid device; the computers used across the years were: a *Tektronix 4051* Mini-Computer; then an *Apple II Plus* and finally an *APS 64/40*, built by the company *MicroControl* (Essen). There were only two models of the *SYNLAB* built, a small one in the Technische Universität Berlin and the biggest, at the Folkwang Hochschule Essen, which counted in total 80 modules [12]. The modules in the *SYNLAB* included envelope following, tone generators, noise and random generators, sample and hold units, FM and AM, apart from diverse filters. While studying at ICEM (Folkwang Hochschule Essen), I composed in 1992-93 an acousmatic piece called *pizz.* entirely using this device.

Whilst all these developments took place, Stockhausen concentrated by the end of the 1970s in his major project *LICHT* and rather abandoned the type of live-electronics he initiated in the 1960s in favour of the usage of synthesisers, tapes, live mixing and transmitters. Other composers, such as Luigi Nono (Italy, 1924-1990), took the inverse path, composing pieces for tape in the 1960s and early 1970s and turning to live-electronics from the end of the 1970s. Nono, together with other composers such as Boulez and Iannis Xenakis (Greece 1922-2001) began to experiment with interaction, particularly spatialisation. Boulez distanced himself from tape music accompanying instruments, because (as he profusely stated in several interviews)[12] he was not satisfied with the results, proving for him to lack the flexibility he demanded. After having experimented back in 1958 with tape music and instruments with *Poésie pour pouvoir* (orchestra/tape), he began work on a composition in 1971, which since then (with or without electronics) has seen at least five different versions: *'...explosante, fixe...'*. In its original conception[13] it was a schematic, aleatoric work in one page (without even the indication of the instruments involved) in seven musical fragments, which were labelled *Originel* and *Transitoires II-VII*, with an original seven-note cell (the basic musical material for the entire composition) and single line in *Originel* and introducing more instruments and musical materials in the following *Transitoires*. In 1973/4, Boulez presented a revised version for

[7] The *E-III* included a sequencer. With the *Emulator I*, breakthrough to digital sampling was achieved

[8] *Fairlight* was founded in 1975. The first product was the *Fairlight Qasar M8*, based on the *Qasar M8* by Tony Furse (Creative Strategies). The famous *CMI* -Computer Musical Instrument- was one of the first integrated synthesiser, sampler and sequencer. The *CMI Series I* appeared on the market in 1979 and was a digital sampler and synthesiser (additive synthesis). The *CMI Series II*, from 1982, added optional MIDI. Series III appeared in 1985, enhancing (among other improvements) the number of channels, sampling rate and bit resolution form 8 to 16 bits, but basically the same chip architecture as the former model. Several later models were based on the *CMI III*, such as *Waveform Supervisor* (1988) and the *MFX1* (1990). This development continued in the 1990s, with the *MFX3.48* appearing in 2000 [9].

[9] 'Originally developed as the "Dartmouth Digital Synthesizer" by Dartmouth College professor Jon Appleton, in association with NED founders Cameron W. Jones and Sydney A. Alonso, - and subsequently under the marketing guidance of Brad Naples the Synclavier was one of the first synthesizers to completely integrate digital technology.' Direct quote from [10].

[10] The *Synclavier II* had a MIDI option, a sampling option and a stereo FM option.

[11] The *ARP 2500*, a monophonic, analogue, modular synthesiser with a set of matrix switches to connect both modules and patch cords, appeared in 1970 through the mid-70s [11].

[12] Such as Josef Häusler's interview with Boulez about *Répons* in 1985 [14].

[13] The basic note is E flat (S in German, also the first letter in the surname of Igor Stravinsky), as he began the project as short musical tribute to Stravinsky after his death in 1971.

solo flute, seven instruments[14] and electronics, which was performed in New York in 1974. The electronics were in charge of spatialising the sound of the instruments using an analogue device created by Hans-Peter Haller and Peter Lawo at the Experimental Studio of the Heinrich Strobel Foundation of the SWR in Freiburg, Germany in the early 1970s: the *Halaphone*. Even though Boulez abandoned this version of the piece soon after -as he was not satisfied with how the *Halaphone* worked in those early times-, after several versions of the piece,[15] the version that eventually satisfied his intentions, was composed at IRCAM in the early 1990s, thus, in the next period proposed in this article. During this second period of hybrid analogue-and-digital electronics, however, Boulez composed one of his finest pieces, *Répons,* which was performed in 1981 and 1982 in Donaueschingen, Paris and London. The electronics were the result of a collaborative work between IRCAM and the Experimental Studio (Freiburg), by still using the *Halaphone* as a sound distributor, this time attached to a small computer. Vogt states, that with the overwhelming reception of *Répons* in those years, both IRCAM and the Experimental Studio finally legitimated themselves [13]. By this time, the *Halaphone* was ten years old and better developed, so it indeed was in a position to overcome the challenges posed by Boulez's inventiveness, which was not the case back in 1974 when *'...explosante, fixe...'* was premiered. *Répons* consists of six instruments (two pianos -No 2 also synthesiser-, harp, vibraphone, cimbalom xylophone/glockenspiel) and a big ensemble and it grew in the three versions between 1980 and 1984 from 17 to 45 minutes of duration. The title refers to the responsorial style typical of the Gregorian chant, in which there is an alternation between soloist and choir. Thus, the six soloists are positioned at the periphery of the concert hall whereas the instrumental ensemble is placed in the centre, meaning that the audience and the six loudspeakers surround the ensemble while the six soloists surround the audience. The live-electronics apply only to the six soloists. Boulez revised the piece further in the 1980s with the newest developments at IRCAM available at the time and the help of Andrew Gerzso: the last version of *Répons* was then performed using the *4X* and the *Matrix 32.*[16] The software developed for the spatialisation was called the *Spatialisateur* [15]. The *4X* was a computer firstly designed by Giuseppe Di Giugno in 1980 with its final version, released in 1984 by the French firm *SOGITEC* [15]. It had eight processors boards, which could be independently programmed to transform, analyse or synthesise sound. The *Spatialisateur* was a computer programme, which, like the *Halaphone,* was able to distribute and move signals across several speakers (six, in the case of *Répons*) at variable speeds (both 'accelerandi' and delays) in different densities and registers, modifying the original sounds. The variable speeds produced specific spatial effects, which created a virtual space [16]. The *Spatialisateur* on the *4X* worked using an envelope follower, which read incoming audio input; the results of the envelope were then applied to generate a signal, which changed its frequency with the variations in amplitude of the waveform envelope. Through the so-called flip-flop units (FFUs), outputs to different speakers were allowed or neglected, as FFUs can only be on one at each time. The frequency of the signal determined how long a given FFUs would remain on, for example, with a higher frequency, the time will be shorter, and so on. A very short overlap among the speakers was required, in order to compensate the time that the amplitude takes from its maximum level back to zero [15].

The *4X* remained rather unchallenged, despite its (for nowadays perception) lack of power to produce more complex synthesis processes in real-time. In the mid-1980s, Robert Rowe began to develop the *4xy* programming to control the *4X*. Later, Miller Puckette began with an early version of *MAX* (without graphical interface). The *Macintosh* version of *MAX* was developed further to enable control on the *4X* with a graphical-interface. [17]

At the same time Boulez and Gerzso were working with the *Spatialisateur*, Nono kept working with the *Halaphone* until his death in 1990. In his pieces, Nono worked together with Hans-Peter Haller for the implementation of the live processes, mainly at the Heinrich Strobel Research Institute in Freiburg (Germany). All pieces composed by Nono in the 1980s using live-electronics concentrate in the electronic transformation of the instrumental sounds, in some way, quasi liquefying them in the space by the usage of spatialisation and delay lines. Nono's main characteristics of his mature style after completing his string quartet *Fragmente-Stille, An Diotima* in 1980, were the profuse usage of microtonalism, added to a tendency in the instrumentation for extreme low or high frequencies (such as bass flute, piccolo, tuba, etc) and for a favouritism for fragmented sections; these sections are often separated by pauses of different lengths, creating a

[14] The seven instruments are: clarinet, trumpet, harp, vibraphone, violin, viola and cello.
[15] Among them, one version is for vibraphone and electronics (1986) and another, purely instrumental, called *'Mémoriale ("...explosante-fixe..." originel)'* (1985) for flute and octet.
[16] This unit was in charge of the distribution of sound from the microphones or the *4X* and to the loudspeakers.

transition that operates on the limits of perception.[17] An example of this style is the piece *Omaggio a György Kurtág* (alto, flute, clarinet, bass tuba & live electronics - 1983-1986), divided in fourteen sections of different lengths, each separated by long pauses, the longest lasting one minute for a total duration of the piece of ca. eighteen minutes. The most compelling piece from that period is however *Prometeo Tragedia dell'ascolto* given the big scale of all forces involved in its performance. The characteristics explained above are richly amplified, also by the use of big spaces (the premiere took place at the church of San Lorenzo in Venice, Italy in September 1984).

Before finishing with this period, it is worth also dedicating a few words to the *UPIC* system, conceived by Xenakis in 1977, which combines synthesis methods with a graphical user interface for compositional purposes. The performance device however was an electromagnetic pen to draw different sound parameters on a large, high-resolution graphics tablet [18]. In 1978, Xenakis composed a piece with the *UPIC* called *Mycenae-Alpha* for mono tape, to be projected onto either two or four sound sources around the audience. It was part of a bigger work by the composer, *Polytope of Mycenae,* a spectacle of light, movement and music, which took place at the Acropolis of Mycenae. The real interaction at this early stage was that the system reacted in real-time to the graphics drawn on the tablet. However, for any other interaction, the computer chip was too slow. Despite this, the next period, from 1990, saw the *UPIC* develop and extent its potential to allow for real-time interaction.

Summarizing, the most common interactive processes used in this period were *delays, reverberation, transpositions or frequency shifting*[18] and *spatialisation*, which can be found in the following key works:

Pierre Boulez:[19]

1973-74: *"...explosante-fixe..."* (version for solo flute, clarinet, trumpet, harp, vibraphone, violin, viola, cello and electronics)

1980: *Répons* (two pianos, harp, vibraphone, xylophone, cimbalom, ensemble and live-electronics). Revised and expanded in 1982 and further, in 1984.

Luigi Nono:[20]

1980-83: *Das atmende Klarsein* (bass flute, small choir, live-electronics)

1983: *guai ai gelidi mostri* (ensemble, live-electronics)

1983-86: *Omaggio a György Kurtág* (alto, flute, clarinet, bass tuba, live- electronics)

1981-1985: *Prometeo. Tragedia dell'ascolto* (solisti vocali e strumentali, coro misto, 4 gruppi strumentali e live electronics)

1985: *a Pierre, dell'azzurro silenzio, inquitum* (flute, clarinet, live-electronics)

1987: *Post-Prae-ludium n. 1 per Donau* (tuba, live-electronics)

In spite of the relatively big progress that can be observed from the analogue to the digital era of sound electronics during these two decades, the rather slow computer chips did not allow for much automation in real-time. All pieces listed above needed manual steering for most of the processes to occur. Only during the period described in the next section (2.3) it is possible to identify automation implemented as an effective tool for real-time interaction. The basis for this development was nevertheless set during this period, mostly with the research at IRCAM, which included the first versions of the *MAX* software.

2.3 Digital Live-Electronics: ca. 1990 – present

The development of the digital techniques and devices might have begun in the 1980s, but it was not until the 1990s, that almost every kind of real-time processing could be achieved. The types of processes increased, whereas some new were discovered or, even though existent, they could

[17] Indications in his scores such as '***ppppppp***' are rather frequent in works from this period.

[18] They are not to be mistaken with pitch shifting in a phase vocoder, which uses real-time FFT (or DCT). Pitch shifting works with the transposition of the fundamental and the partials, keeping the ratio between them, while frequency shifting does not maintain this relationship, creating a different spectrum by raising all harmonics by the same amount of Hz. See Boulez and Gerzso for more details [15].

[19] Even though Boulez's *Dialogue de l'ombre double* for clarinet, piano resonance and tape (1984-5) works with similar spatialisation principles as *"...explosante-fixe..."* and *Répons*, the electronic part in 'Dialogue' is a prerecorded tape.

[20] Nono's piece *Con Luigi Dallapiccola* for '6 esecutori di percussione e live electronics', from 1979, is atypical for this period, as the technologies involved are stereo sound and three ring modulators with three sine generators, which modulate the percussion instruments in a similar way as Stockhausen did for *Mixtur* and *Mantra* in the former period.

only be properly applied for interaction purposes during this period. Synthesis processes depending on Fast Fourier Transform (FFT) such as *convolution, granulation, pitch shifting,* and *time stretching* became at last not only feasible, but certainly also common practice.

At the start of the 1990s, computers alone were not in the position to cope with the power needed for real-time processing. Hence, additional hardware was needed, such as the *ISPW* (IRCAM Signal Processing Workstation), the *MARS*[21] system, the *Kyma* or the *AUDIACSystem.*

The *ISPW* development began in 1989 at IRCAM as a replacement to the *4X*, which by that time, has served unchallenged over ten years. One of the problems that the *ISPW* solved was that of transportability, as the *4X* was too big to be moved. The introduction of the *ISPW* in 1990, designed by Eric Lindemann, allowed for more transportability and also sinking costs. The system ran the *MAX* software (which included by now DSP objects, programmed by Miller Puckette) on the *NeXT* computer and the separate DSP unit was in charge of all real-time processes [17].

Similar systems were the *MARS* workstation (designed by Di Giugno in Italy, developed almost simultaneously in time as the *ISPW* [17]) and the *AUDIACSystem.* The *MARS* workstation was a

> 'programmable specialized digital machine for real time audio applications which has been entirely developed by the Italian Bontempi-Farfisa research institute IRIS. MARS has been conceived as an integrated environment in which a graphical user interface, an embedded real-time operating system and two IRIS digital audio processors are linked together to create a flexible and an interactive workstation for audio research, musical production and computer music pedagogy.'[19]

At the beginning, it ran on an *Atari* computer, but by 1997 was ported to *Windows*-PC platforms. The *AUDIACSystem* was also a hardware-and-software environment for real-time interaction. It was a collaborative research project by the ICEM (Institut für Computermusik und Elektronische Medien) and the company Micro-Control GmbH & Co KG, which took place at the Folkwang Hochschule-Essen (Germany). The people responsible for its entire design were: Dr. Helmut Zander, Dipl. Ing. Gerhard Kümmel, Prof. Dirk Reith, Markus Lepper and Thomas Neuhaus. The project began in 1987 and involved not only the hardware architecture, but also the software exclusively created for this particular environment called *APOS.* The hardware architecture of the *AUDIACSystem* used the principle of the specialised subsystems, not only to generate organised forms for musical production, but also to incorporate the generation and transformation of sounds in real-time. This implied at that time a huge demand in relation to its computing potential, which could only be solved with the subsystems mentioned [20]. The DSP unit's size was about one cubic meter, which allowed for a rather comfortable transportation and could be set anywhere.

The *Kyma* system, which still exists with its latest version, the *Kyma X* and its sound unit, the *Pacarana* (a DSP module in charge of the entire sound processing) was a development which began already in 1984; that year Kurt Hebel and Lippold Haken (University of Illinois, USA) designed the *Platypus*, a digital signal processor for real-time audio, whilst Carla Scaletti wrote the software, which she called *Kyma.* The next steps were taken in 1987, when *Apple* gave a grant to Scaletti to develop a graphical interface and, in 1989 Hebel replaced the *Platypus* by the *Capybara*, which stayed in the market for more than ten years. In recent years, the *Capybara* was finally replaced by the *Pacarana.* The software ran almost since the beginning on both *Windows* and *Apple* platforms [21].

This period is perhaps the richest in different possibilities of generating interactive DSP. The reason for this is that computer technology after the second half of the 1990s, with the introduction of the first *Intel Pentium* and *Motorola/IBM PowerPC* RISC processors, increased enormously not only in the speed of their clocks from MHz to GHz, but also in memory size and the slow but constant introduction of faster and broader internal busses. Another event was the introduction in 2001 of the *Unix* BSD based *MacOS X* operating system by *Apple*,[22] which enabled more compatibility with other systems based on *Unix.* Added to these advances in technology, equipment became not only smaller, but also much more affordable, so that not only studios were in a position to use these technologies, but almost every musician owing a computer or a laptop could too.

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[21] Musical Audio Research Station.

[22] Apple bought in 1995 *NeXT* computers, as Steve Jobs came back to Apple as CEO; the idea behind this move was to ensure that Apple had the licences on *NeXTStep*, the *Unix* BSD operating system on all *NeXT* computers (NeXT was a company also founded by Jobs). At that time, *NeXTStep* was supported by Motorola's CISC (68030 and 68040) and all *Intel* processors, but not by the *PowerPC* RISC platform of IBM/Motorola. It took Apple more than five years to adapt the *NeXTStep*, and it was only in March 2001, when the *MacOs X* Version 10.0 appeared on the market for desktop computers (a server version was available since 1999) [22, 23].

With the appearance in 1997 of the G3 processors on *Apple* desktop computers and laptops, the additional hardware began to be less indispensable and since then, most live-electronics could be played directly from a laptop or computer (with or without the inclusion of an audio interface). The most common platforms nowadays are *MAX/MSP*,[23] *PD*,[24] *Supercollider*,[25] and the *Kyma X*.

Apart from these, some systems from the former period developed further, while others simply disappeared or were replaced mostly by software programmes; the *UPIC* is among those that were further developed. By 1991 a new 64-oscillator synthesis real-time engine and the coupling to a *Windows* PC, permitted a much more sophisticated graphical interaction [18].

A system which was absorbed by another one was the *Spatialisateur*. The IRCAM software development programmed a piece of software, which was incorporated to the *MAX* environment as a typical *MAX* object (*spat~*) for both *MacOS X* and *Windows XP* platforms. *The Spatialisateur Project* began in 1991 as a collaborative project between IRCAM and Espaces Nouveaux, collecting and developing research carried out in IRCAM's room-acoustics laboratory. It integrates 3D stereo reproduction modes for headphones (binaural), 2/4 loudspeakers (transaural), Vector-Based Amplitude Panning and Ambisonics [27].

A different development can be found in the work by Luciano Berio (Italy, 1924-2003) and the center Tempo Reale.[26] With only three compositions using live-electronics, Berio was not as prolific as he was composing pure instrumental music. However, what makes his work in the field of particular interest is the fact, that all three pieces were composed using the facilities and research at Tempo Reale. Among those features that most interested Berio in the field of live-electronics were those of physical movement of sound, such as trajectories followed by sound events through space; this resulted in new, unconventional acoustic spaces. Even though this was already a characteristic of Berio's instrumental music since the 1960s (for example, the inclusion of a third violins group at the back of the orchestra in his *Sinfonia* [1968]) or the two harps close to the audience in *Formazioni* [1987]), it is in his interactive music where we can find this concept fully developed. Added to space, there are other considerations such as transpositions, continuous modulation of harmonic and dynamic levels, and the profuse usage of sound layers, which were at the core of Berio's compositional intentions [28]. The three pieces by Berio developed at Tempo Reale since 1987 are significant because they all share the facts mentioned above. Berio's interactive pieces are: *Ofanim* (1988–1997) for female voice, two children's choirs, two instrumental groups; *Outis*, (azione musicale, 1996); and *Altra voce* (1999) for mezzo-soprano and flute. All the electronic parts were totally revised in 1999 [28]. The main challenge of the first two is the big instrumental groups involved, which turn the electronics rather complicated, as besides the system itself, several microphones, mixers, and other equipment are required.

The system developed at Tempo Reale is based on a number of different characteristics, which all serve the primary goal of achieving the maximum degree of automation possible, without having to excessively constrain the freedom during the performance. However, the three pieces mentioned use in most cases the common system of working with cues, with a cue manager at the core of it, as described by Giomi, Meacci and Schwoon (p. 37):

> 'The Cue Manager is based on a structured sequence of events in which each block represents a precise point in the score (cue) along with all of the electronics events associated with it. During a live performance, the list is scrolled manually by means of a computer keyboard or through a MIDI peripheral. (In *Ofanim*, for example, the keyboard player in the orchestra controls the Cue Manager.)' [28]

This is indeed a rather high degree of automation, but triggering the electronic events is made nonetheless manually.

Since Berio's death, the research and development of new tools has been continued, and among the latest we find *MEEG* and several *MAX/MSP* externals (for *MAX 5*). *MMEG* (or *Max*

[23] *MAX* (without the *MSP* part, which means 'Max Signal Processing' was developed also at IRCAM (Paris-France) from 1980 by Miller Puckette. It works with a set of objects than can be connected with each other. The first development for the *Macintosh* included only MIDI. From 1997 David Zicarelli used the *PD* audio part developed the year before by Miller Puckette and released *MSP*, as the DSP part for *MAX* [24]. In 2008, Zicarelli's company, Cycling74, joined the *MAX/MSP* package with *Jitter* (real-time video objects) in the latest version, *MAX 5*.

[24] By 1995, as the *ISPW* hardware was being let aside due to cost reasons; Miller Puckette (creator of *MAX*) began by then to develop PD (Pure Data), an improved version of the latest *MAX/ISPW* and mainly *MAX/FTS* [25].

[25] A free environment and programming language by James McCartney, which appeared in 1996 for real-time audio synthesis and algorithmic composition. In 2002 it was released under the terms of the GNU General Public License. The latest version so far (3.3), was released in April 2009 [26].

[26] TEMPO REALE, Center for Music Production, Research and Education was founded by Luciano Berio in 1987. Since then, the centre's main activity has been the production of Berio's works.

Electronic Event Generator) is a system conceived for data management integration into *MAX/MSP* for live-electronics purposes; it offers an interface supporting the modification of parameters in real time.[27]

In the recent past, other approaches such as game consoles and also *Nintendo's Wii* remote-control interfaces have been used for the performance of electroacoustic music. In 2004, James Paul Sain (USA, 1959) composed a piece for flute and *MAX/MSP*,[28] in which a game console controls the live-electronics.

The amount of interactive compositions that could be mentioned in this period exceeds the frame of this article. Therefore, the pieces and composers listed below (enriched by the examples already mentioned in this section) intend only to be a guidance and example of core works. Because my piece *Gegensätze (gegenseitig)* for alto flute, quadrophonic tape and live-electronics (1994) was the first work entirely composed to be performed in a concert situation using the *AUDIACSystem*, I would like to add it to this list.[29] [20].

Pierre Boulez

1991-93: *...explosante-fixe...* for MIDI flute, two flutes, ensemble and live-electronics.[30]

1997: *Anthémes 2* for violin and live-electronics.[31]

Cort Lippe (USA, 1953)

1992: *Music for Clarinet and ISPW*

1993: *Music for Sextet and ISPW*

1994: *Music for Flute and ISPW*

1995: *Music for Contrabass and Computer*

1998: *Music for Hi-Hat and computer (MAX/MSP)*

As it can be observed from this list, Cort Lippe was very prolific composing several pieces for one or more instruments and the *ISPW* in the first half of the 1990s. In *Music for Clarinet and ISPW*, he used a 'score-follower' (an idea also pursued by Boulez for pieces such as '*...explosante, fixe...*'), programmed in *MAX*, so that the electronics could follow the gestures and notes played by the clarinet.

A great portion of the development since 1990 has seen so far the practice of ideas on hold in the former decades as much as the search for entirely new ideas and possibilities. On the one hand, we can observe this fact in, for example, objects for the *MAX* software, such as *spat~*, (which is basically a nifty and increased development of the basic idea that gave birth to the *Halaphone*). On the other hand, several others, such as the *FFTease* package by Eric Lyon and Christopher Penrose [31], work with FFT, which allow for sound synthesis processes based on spectral analysis, something that was impossible to achieve until this period. With this degree of evolution in technology, automation became not only possible, but also a real alternative for the performance of interactive music. A way of achieving automation was *score following*, already mentioned afore. Barry Vercoe and Roger Dannenberg were the first to present this idea almost simultaneously (and independently) during the International Computer Music Conference 1984 [32]. Both authors defined it as:

> '[T]he process of tracking live players as they play through a pre-determined score, usually for the purpose of providing an automatic computer accompaniment to a live player.' [32]

By 1987, IRCAM was using it too. The main way of using *score following* is by pitch detection. Problems surged though, as some instruments such as woodwinds needed and acoustic-based pitch detection, complicating the process. Puckette and Lippe (p. 182) explain how the main algorithms worked in the early 1990s:

> 'The procedure for score following is rather simple: enter a score into a computer in some form, and then play the score as real-time input to the computer (either via a MIDI interface or a microphone and acoustic analysis), comparing the computer's stored score to the musician's playing on a note by note basis. If the comparison being made between the two is successful, the computer advances in the

[27] 'Max/MSP communicates with a relational database implemented in MySQL using a PHP interface. The entry and editing of data can be performed from any web browser through an html form.' [29].

[28] *ball peen hammer*, for flute and computer (2004) uses, apart from *MAX/MSP*, the *STEIM's JunXion* software, the *Logitech* Dual Action USB game controller, and the Logitech Attack 3 USB joystick [30].

[29] The piece was produced after a rather long period of research and development of the *AUDIACSystem* at ICEM – Folkwang Hochschule Essen (Germany).

[30] Electronics programmed at IRCAM by Andrew Gerzso. This is the fifth and so far final version of the piece, consisting of *Transitoire VII – Interstitiel 1, Transitoire VI – Interstitiel 2* and *Originel*, with a total duration of ca. 37 minutes.

[31] Electronics (also programmed at IRCAM by A. Gerzso) include pitch shift, spatialisation in six channels, harmonizer and score following.

database (the stored score) in parallel with the player, triggering electronic events at precise points in the performance score. In theory, one or many parameters can be followed' [32].

The IRCAM website points out two purposes of score following:

'The interest of score following is usually twofold: (1) technically for realtime alignment of audio signals to symbolic music score, and (2) musically for triggering and managing electronic music scores that are interpreted conform to musician's play.' [33]

The method described by Puckette and Lippe above (the same Lippe used in his piece for clarinet and *ISPW*) was running on *MAX*, either on the *Macintosh* or the *ISPW* [34]. Even though pitch detection algorithms or devices have improved in the last years compared to those in the early 1990s, they are sometimes still not fully reliable, and score following remains today an option, but not the only one. Further examples are discussed in section 3.2.

Other ways of achieving automation is the usage of computer-controlled timelines (for example, on *MAX/MSP*) and the usage of time-code, such as SMPTE. Section 3 deepens on the latter.

As for automation (partial or complete), the main subject in the following sections, this was the period in which they could be finally fully achieved. This was possible only due to the big step achieved by computer companies in the development of their products, for example, speeding their chips and the capacities of their systems, while at the same time procuring smaller sizes for hardware components, all facts, which are still on going.

3 General Considerations For Programming/Composing Pieces Including Live-Electronics.

In the present times, most of the systems that appeared at the beginning of the 1990s are out of use, so that the main environments for the performance of real-time electronics are *MAX/MSP, PD* and *Supercollider.* In spite of the *Kyma,* which still uses a separate unit for the DSP processes, the trend since the end of the 1990s is that separate audio-interfaces are used only for the purposes of a better overall output quality and multi-tracking, but the synthesis processes are performed inside the main computer by mostly the three software environments mentioned above and not on external devices.

Since 1998 I have been actively composing pieces for instruments and live-electronics using *MAX/MSP*; in most of them, I use complete automation of the real-time processes. This decision is explained later in section 4. The following three main considerations for the composition of interactive pieces are based on my own experience, as a consequence of both teaching about and composing for this particular combination.

3.1 Programming

Programming live-electronics is a constitutional part of the compositional process. How much concordance between those processes and the musical (notated or improvised) part can vary rather substantially depending on the composer and also on the compositional/improvisation goals set for the pieces. In order to achieve these goals, the composer has achieved a high degree of control over both musical and programming aspects of the entire piece. *Automation* (either complete or partial) can be a comfortable and effective option, as it is demonstrated in section 4.

3.2 Choice of Equipment and Devices

For the choice of equipment and devices required for an interactive composition, aspects such as the type of venue where a particular piece can be performed must be thoroughly considered. At least since the 1990s, only a minority of pieces have been composed for a special and determined space. A vast majority of the concerts including pieces with live-electronics take place generally in academic circles; moreover, the pieces performed in a single concert could vary enormously regarding their instrumentation, type and number of devices involved, microphones, etc. Thus, the planning of each composition can be summarised under: *'keep it as simple as possible'*. This 'precept' implies:

(a) *A careful planning of the main platform/equipment.*

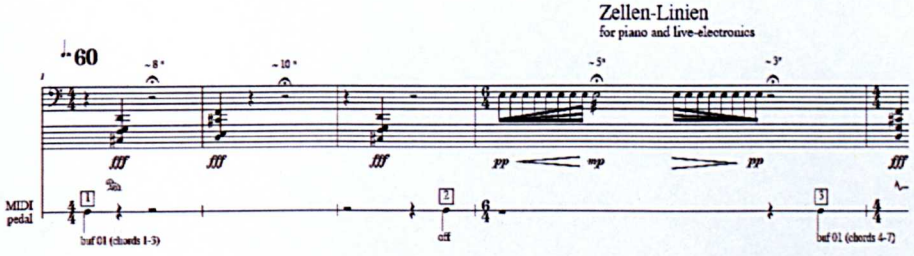
As a general rule, the simplest way of setting up the equipment is generally also the most effective. Platforms that only work in fixed places present a big disadvantage, as they do not generally allow the performance of those specific pieces outside the context in which they were

created. In this regard, using *MAX/MSP* (*Apple* or *Windows*), *PD* (multiplatform) or even *Supercollider* allows for rather unproblematic performances of interactive pieces in almost any concert hall. Using these environments, it is possible to transport the algorithms (patches) to any hardware (generally computers with or without audio interfaces), regardless of the hardware on which they were originally created. Automation is possible with all these platforms. This also impacts on the necessity or not of requiring the composer's compulsory attendance during rehearsals and performances, because the required files can be easily transported via a network or saved onto storage devices and installed in other computers without any difficulty.

(b) *Controllers and switches used by the performer on the stage to trigger the electronics vs. automation.*

A very careful planning is required for this issue, as there is a direct relationship between the number of the extra activities required by some live-electronics processes to be initiated or triggered by the player and the increasing amount of added technical difficulties, which in many cases can be detrimental to the concentration of the performer and also of the audience (something that can have a big impact on the perception of the piece). Sometimes performers must wear different devices in their clothing, or activate several pedals or switches, which in some cases, must be triggered very fast and even with special movements, all what may contradict the intention of the music dramatic, apart from -in some cases, unnecessarily- additional difficulties for the performer. In other cases, the switches are activated by a second person (usually the composer), via controllers, a mouse, etc. This latter case has a positive effect on the concentration of both performers and audience. However, if the person in charge of that particular activity is not the composer, it will be in my experience very difficult to find someone who will spend the necessary time rehearsing and learning how to activate the programmed live-electronics in an impeccable timing (essential for the synchronisation of the live interaction). If not the composer, this person should be a trained musician, capable of reading music and follow accurately the score, apart from knowing how to activate every single step of the live-electronics. This said, some pieces allow however for more freedom than others regarding the processes involved and the way they are musically used in a piece, so that the role of this second person can substantially vary and in some cases be of rather lesser importance than in others.

Hans Tutschku (1966, Germany), in his piece *Zellen-Linien* for piano and live-electronics (2007) makes usage of a MIDI pedal to trigger all events (32 events in total). The score of the piece[32] presents extremely carefully detailed indications about how to set up the software, which include a well prepared sound-check for the two existing versions (eight or six channels). Even though programmed completely on *MAX/MSP*, the patch itself is a stand-alone application (*Zellen-Linien.app*).[33] This is indeed a nifty solution, which provides for a comfortable transportation and installation of the software, as even the sound files required for the performance are contained in the download package. However, the set up requires loading the sound files manually. Each event is in itself rather fully automated, but their triggering is not: they are activated each time by the pianist via a MIDI pedal in a similar manner as Tempo Reale's *Cue Manager* described in section 2.3. It may be, that one of the reasons that this piece is not completely automated is that the sound files loaded to the memory (buffers) need to be tuned before the performance according to the actual tuning of the piano in the concert hall (although, I suppose there might be ways of getting around this problem). The system selected here is however very elegant: the score has two rows, the first (divided in fours systems, due to the extreme registers used in the piece) for the piano, and the second one for the activation of the pedal, written in actual beats. Figure 1 shows the first four bars of this piece, with indications of when the MIDI pedal needs activation for the events.



[32] The score can be found at: http://www.tutschku.com/download/Zellen-Linien-score.pdf
[33] The application can be downloaded in three different versions (*Apple PPC, Apple Intel and Windows*) at: http://www.tutschku.com/content/works-Zellen-Linien.en.php.

Fig. 1. Excerpt from the first four bars of the piece *Zellen-Linien* (2007) by Hans Tutschku.[34]

The player is not required a heavy load of extra work by switching the MIDI pedal. Nonetheless, as stated before, it is an extra activity, which in the end may impact on the performer's concentration and overall musical results, depending on many factors such as personality, experience, technology available, and so on. However, if specific processes are required at a specific times, in more complicated situations than the one just described in Tutschku's piece, manual steering of the system will not always produce the intended results. In those cases, *automation* is a very valid alternative for all those cases because its effects are twofold: it can set the performer as free as possible from any extra-musical activity *and* there is no need to have the composer or somebody versed in music to trigger the live-electronics (with the beneficial effect of allowing more frequent performances of pieces too). In this way the performer can concentrate solely on the interaction with the electronics and on the music itself, without the need of having to activate anything else.

As it was mentioned in section 2, one way of achieving this is using different types of *score-following* algorithms, which actually follow the pitches (or other parameters) played live; this is normally the case of pieces having a fully written score and therefore, it is not frequent in improvised pieces. Added to the former examples of score following are Noel Zahler's *Concerto for clarinet, chamber orchestra and interactive computer* (2003) composed under the same principle, even though using completely different algorithms than the ones applied by Lippe. In this case, the computer uses a -by that time- new score-following algorithm, which was created by Zahler, Ozgur Izmirli and Rob Seward; the algorithm was especially programmed for this composition using *MAX/MSP* [35]. In the past years, several composers have been using IRCAM's software *FTM* on *MAX/MSP*, which is basically a real-time object system and a set of optimized services to be used within *MAX/MSP* externals. These include score-following as well. A good example of this is *Etudes for listeners* by Miroslav Spasov (Macedonia, 1964), for piano and live-electronics.

Another way of achieving synchronisation is the usage of time-code (TC). TC such as SMPTE shown on a display on the stage makes a rather simple but extremely effective solution in the case of fully automated live-electronics. SMPTE displays are not easy to find though, but there are nonetheless several companies (most of them in Germany) building and selling them. There are different ways of sending the SMPTE to the display: one is to generate it for each performance; another one is to have the bi-phase modulated square wave recorded as an audio file within the live-electronics software (for example, *MAX/MSP*), which then runs during the whole piece, beginning normally by frame 00:00:00:00. This is my preferred method for the composition of most of my interactive pieces, which I refer to in more detail in section 4.

3.3 The Performer's Role

It is essential for performers to have a clear idea about their own role throughout a piece of music. Especially in the case of interactive pieces, this is primordial. A confused interpreter or a player who does not know exactly where the main aspects of a piece of music lie is not in a position of playing the piece in an adequate manner; as a consequence, the entire sound universe of that particular piece (including its dramaturgy) may not be projected to the audience as intended. The interaction with tape (i.e. the combination of a fixed medium with a live performer) has already been rather confusing for many interpreters since its introduction, mostly for those not acquainted with electroacoustic music. In the case of the interactivity with real-time DSP processes, the situation can be yet more challenging, mostly due to the variety of software, hardware and other devices that each particular piece may use. The fact that some processes cannot be practiced until shortly before the concert or rehearsal, demands a fair amount of concentration and energy from performers, for them to be up to the challenge. Also the acquaintance with typical electroacoustic sounds (for example, granular synthesis) plays an essential role.

In order to make sure, that the performer is supplied with all the information required, composers must provide for a fully edited score (or similar, such as for example, precise graphics -or both-), which should include the adequate level of guidance, giving a clear picture of what to do at each particular moment and how to interact sonically with the live-electronics. Concert organisers should also provide for good monitor systems, so that performers can listen to and provide for a good balance of their sound with the results coming out of the loudspeakers during both rehearsals and

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concert.

Interactive music is essentially music to be played live in concert. *The very core of interactivity lies in the live performance.* Thus, composers and concert halls must provide for the best possible framework. As it was mentioned above, the inclusion of pedals, switchers and similar devices do not allow in several cases for a complete concentration on pure musical aspects, which sometimes can be detrimental to the final artistic result of the pieces. At this point is where the inclusion of different degrees of automation can prove vital for the success or not of a piece of music.[35] Automation (and particularly complete automation) is the main subject of the next section, with examples taken from two of my most recent own compositional production.

4. Examples of Automation in Two of my Own Compositions

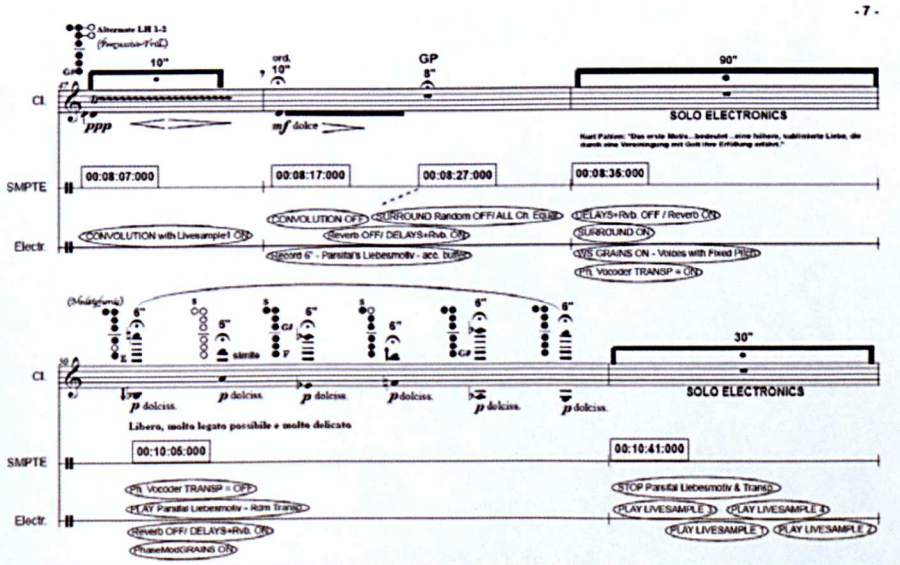
If automation at some degree is the choice to achieve a performance in which some of the topics already mentioned have been considered, the composer/programmer normally has two basic decisions to make: firstly, the degree of how much of the live-electronics' part should use automation added to how the performer can follow and understand it as simply as possible; secondly, the composer must weight the musical and technical advantages and disadvantages that automation implies for the intention (dramaturgic content) of the piece and its performance.

In order to give a practical description of the former statements, it will be attempted now to show them in two pieces of my own authorship: *Intersections (memories)*, for clarinet and live-electronics in 5.1 surround sound [*MAX/MSP*] (2007) and *farb–laut E-VIOLET* for viola and *MAX/MSP* in 5.1 surround sound (2008).

In all my interactive pieces, programming the electronics means that both music and electronics are essential parts of one-final product, the composition itself. This implies a detailed and exact programming of each section of the piece, so that for each of them, both the desired musical and the real-time processes concur in the *desired aesthetical and dramaturgical effect.*

4.1 Description of the Works

Intersections (memories). This piece for clarinet and live-electronics with a 5.1 surround spatialisation was composed based on a hidden story regarding real facts of my personal life. It is not intended however, that the audience should have any previous knowledge about the programmatic issue. The electronics are a substantial part of how the story is musically told. Hence, complete automation was in my view the only way to achieve the required absolute accuracy between player and computer.



[35] Success is meant here not only among different audiences, but also among musicians willing to play the piece several times.

Fig. 2. *Intersections (memories)* for clarinet and live-electronics: excerpt of the final part (page 7).[36] The row in the middle shows different clue-times, which the performer should follow on the provided SMPTE display. The lower row shows the DSP processes.

The diverse DSP functions in the piece include: random and circular surround spatialisation, granular synthesis (phase modulated grains and time-stretching granulation), different types of reverberation, convolution,[37] pitch shifting and live recording of particular notes with specific durations throughout the piece. These durations are shown in the long notes (of variable duration) played throughout the piece, which are all the eighteen notes with their original duration of the first Leitmotiv from Wagner's *Parsifal* (*Liebesmotiv*). As these notes are played mostly isolated, the audience has no idea of their real purpose when they first appear. However, the electronics record and store them in a cumulative buffer, so that when all notes have been played and recorded, the Leitmotiv is played back (granulated) in its original form, having a very precise dramaturgical function. In order to record all eighteen samples, so that they can be cumulated and afterwards played as a continuous melody, absolute accuracy was required; this would not have been possible without the programming of fully automated live-electronics.

The score presents three different lines, one of the instrument, the second for the SMPTE time and the third to describe the DSP process activated/deactivated at that particular stage (Fig. 2). The spatialisation of this piece (as it can be seen in Fig. 2, between SMPTE times 00:08:27 and 00:08:35) is also fully automated. The configuration for this latter is a system developed by myself, in which the 5.1 surround sound can move either in circle (clock-and-anticlockwise) or randomly, with the time of the movement of sound between loudspeakers measured in milliseconds. Time was dynamically programmed, so that for a given period of time (for example, 20 seconds), the sound must change constantly at a variable rate during that period. The range of this dynamical time set is variable, and can be, for example, from 5000 ms to 200 ms. If the changes between speakers occur at rates lower than 200 ms, the result will be a spatial granulation. This is because of the usage of envelopes for each localisation of sound in each speaker: the lower the rate, the more the results can be perceived as being 'granulated in the space'.

All processes in the piece respond to a particular dramaturgical reason, acting together with -and being excited by- the music composed for the live instrument (with no pre- recorded materials involved). Figure 2, above, shows also how synchronisation between the live part and the processes is written in the score, so that it can be achieved by reading a SMPTE display on the stage during the performance.[38]

farb-laut E–VIOLET. This piece, which was specially commissioned for the festival *farb-laut* in Berlin (Germany) in November 2008 is, at the time of writing this article, my last piece for viola and live-electronics (*MAX/MSP*).

Regarding the treatment of DSP, it is similar to the former piece: the live-electronics are fully automated for just the same reasons. However, automation has here a further implication: the piece was conceived, like all the others for viola and live-electronics I composed since 1998,[39] *to be played by myself*. Whilst *Intersections (memories)* needed complete automation for purely technical reasons (synchronisation), *farb-laut E-Violet*, on the other hand required automation to allow me to play the piece without further considerations.

As in *Intersections*, samples recorded during the performance interact throughout the piece in many ways, without the need of any pre-recorded materials. DSP functions besides live recording include different types of granulation, dynamic delays,[40] reverberation, *COMB* filters, ring modulated *COMB* filters, pitch recognition and 5.1 surround sound.

Figure 3 shows the main part of the *MAX/MSP* patch of this piece. Here we can see different aspects of how complete automation works: the button at the left upper corner is the only activation needed. From then on, the SMPTE time-code will be displayed on the *MAX/MSP* patch on the right upper corner. If needed, the SMPTE can also be sent to an external display.

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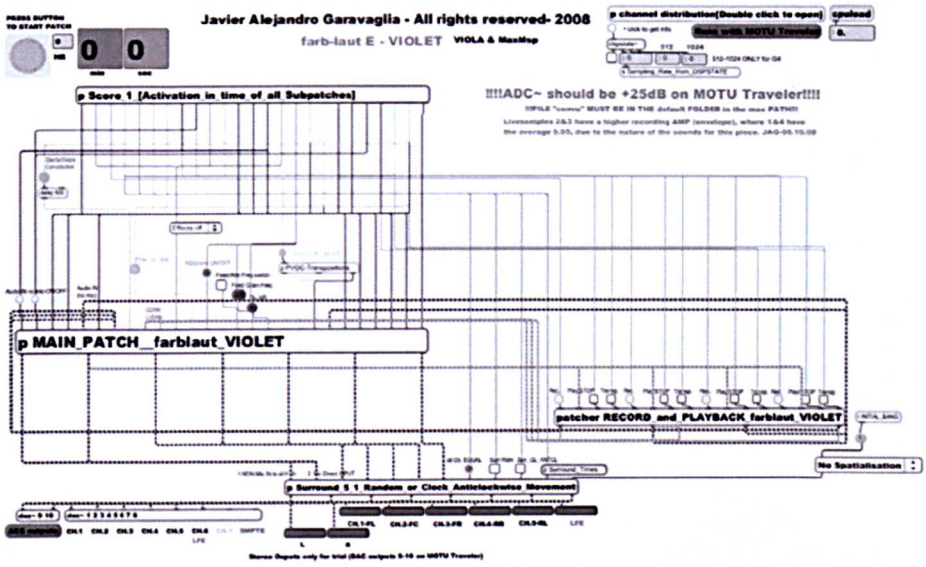
[37] Convolution: the method used for this piece is the re-synthesis of the spectral multiplication of the results of the FFT analysis of two different sounds (in this case, live clarinet against live recorded clarinet sounds).

[38] Due to space reasons, I only show an excerpt of the score but not of the electronics. A similar example of a *MAX/MSP* patch is shown for the next piece, in 4.1.2. (this time, without the score, which is organised also in a rather similar manner)

[39] *Color Code (1998); NINTH (music for Viola & computer) (2002); Ableitungen des Konzepts der Wiederholung (for Ala) (2004).*

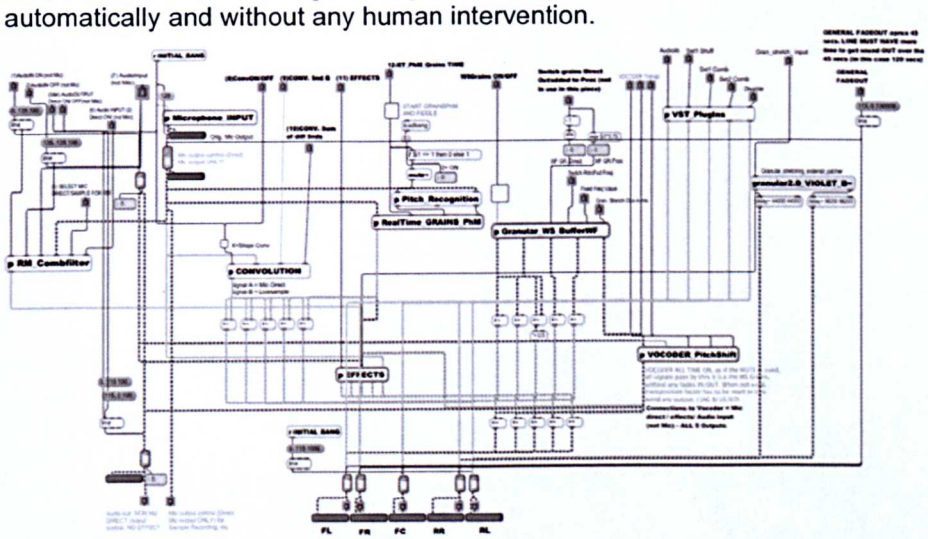
[40] These work with a given random time and location for each delay.



.**Fig. 3.** *farb-laut E-Violet* for viola & live-electronics: screenshot of the main *MAX/MSP* patch.

The first sub-patch ('*p Score_1_[Activation_in_time_of_all_Subpatches]*') is an electronic score, which automatically triggers the required DSP functions at precise moments. The sub-patch '*p MAIN_PATCH_farblaut_VIOLET*' contains all processes (displayed in detail in Fig. 4). There is also a sub-patch for recording and playback of the samples during the performance, as well as a sub-patch for the spatialisation, similar to that explained in section 4.1.1.

Besides a laptop, an audio interface, a microphone and a surround sound system, this is all what is needed for the performance of both *farb-laut E-Violet* and *Intersections (memories)*. A second person on the mixing desk is normally desirable for balancing the level of the sound in the concert hall, but not to be in charge of any of the processes directly linked with the electronics, which ran automatically and without any human intervention.



.**Fig. 4.** *farb-laut E-Violet* for viola & live-electronics: screenshot of the sub-patch containing all processes included in the piece.

4.2 Description of the Main Technical Characteristics in the Former Examples.

Both pieces described in section 4.1 share the following features:
- *Minimal technical requirements*: both need one computer, a microphone and an audio interface with at least one INPUT and a maximum of 8 Outputs (for example, *MOTU* 828 mkII, *MOTU Traveler* or similar).
- *A MAX/MSP patch*: a main patch consists of multiple sub-patches, each of them containing

algorithms with different DSP such as: granulation, convolution, phase vocoding (pitch shift), reverberation, dynamic delays, ring modulation, sample and hold, filtering, live recording, spatialisation, etc.

- *Solo passages*: in both pieces, the complete automation allows for the live-electronics to generate 'solo' electronic moments at particular points, in which no interaction between the soloist and the computer occurs (the performer has in fact a break during those sections). The sounds however, have their origin in some past interaction (normally sounds recorded at a previous moment during the performance).

- *Performance related issues*:

(i) The *MAX/MSP* patch is completely automated. The activation of the electronics takes place by pressing a button on the patch (*MAX*: *bang* function through the object *button*, see Fig. 3) at the very beginning of the work with a delay of about 10 or 15 seconds between pressing the button and the actual beginning of the patch/piece, to allow the player time to take position to play. All DSP events have a fixed duration, which require only mixing activity on the console and no manipulation of the electronics' part itself at all.

(ii) Because everything in the *MAX/MSP* patch is completely programmed in forehand, the evolution of every DSP event has to be accurately programmed and timed, so that the performer can accurately interact with them. This allows for each composed music moment to possess its own electronic environment programmed as much as composed, serving the higher purpose of the assigned dramaturgy for the passage and the piece. To achieve this goal, an electronic score (an internal *MAX/MSP* sub-patch with begin and ending times for different processes) has to be programmed, a process very alike to that of composing music. Figure 3 above, shows that the 'electronic score' is the first sub-patch in the main patch for the piece *farb-laut E-VIOLET*.

(iii) In order to perform the piece correctly, interpreters must know where they are at by reading the score and also, what they are supposed to expect from each musical passage. To achieve this, it is necessary that the composer provides for a fully written musical score, which must show clues at precise points (bars), measured in hours, minutes, seconds (see Fig 2.). These act as guidance and refer to the SMPTE times, which the performer must follow accurately. Practice has showed to me though, that absolute precision in the programming can nevertheless cause problems in synchronisation issues. Thus, a tolerance of about one second is automatically allowed in those moments, for example, when the computer must record into its memory a note or a passage played live by the performer, which will be used later in the piece. The SMPTE has been already programmed and included on the *MAX/MSP* patches (in these particular two cases, an audio file containing the bi-phased modulated square waves for each bit[41] of the frames), so that the performer can read it either on the computer screen directly or through a SMPTE display, whichever will be placed on the stage. In my own experience, and after talking to several performers of my music, I can categorically state, that to follow the SMPTE on a display or computer screen does not require further skills from a musician than those following a conductor's baton. Everyone found it a very pleasant experience, which required minimal efforts to become acquainted to.

(iv) Due to the automation of the patches, the performer is only required to follow the score looking at the SMPTE display. No further activity rather than playing the instrument is required, as the electronics play automatically. This has a big positive and relaxing impact on the concentration of both players and audience. In the case of pieces for several instruments, there are two ways of dealing with the issue: if it is an ensemble, the SMPTE display will be generally read by the conductor, thus making no difference at all to the ensemble's members; if it is a small group, such as duos or trios, and so on, several displays can be placed on the stage, all following however the same synchronised SMPTE time.

As it can be gathered by now, all features described in section 4.2 heavily depend on the electronics for the pieces working automatically. So, is automation the answer to all problems? The next section tries to answer this question by enumerating advantages and disadvantages related to the usage of complete automation in live-electronics situations.

[41] Each frame of the SMPTE (for example, 00:00:00:00, which is the first frame, with hours at the left and then minutes, seconds and frames to the right) is digitally encoded as an 80-bit word. The bi-phased modulated square wave is used to codify each of those bits during equal periods of time, where a 0 is coded if the square wave will not change its phase in each period, and a 1 if it does.

5 Advantages and Disadvantages of Using Automation in live-electronics.

As usual, when composers make their decisions during the composition of a piece of music, some choices must be left aside. This implies the awareness about the limitations that choices bring with themselves. In the case of complete automation (or, at least, a high degree of partial automation), it is indeed a choice, which will have consequences for the piece, for the musicians involved in its performance and also for the degree of success the piece can achieve. These consequences must be weighted at the time of 'decision-making' while the piece is being composed. In any case, regardless of which decision will finally be made, each of them will present advantages and disadvantages. So, in my experience, these decisions should be made only based on a rather overwhelming percentage of advantages against disadvantages. These are explained in detail below, relating to full-automation.

5.1. Advantages

Among the advantages that full-automation of electronics can confer to the performance of a piece of music, we can identify:

- *Concentration and reduction of unnecessary activities.*

The most obvious advantage is that the performer can concentrate exclusively on the pure musical aspects of the performance. This has a further implication (even though it may be rather subjective): if a performer is involved in multiple activities that are required for the realisation of the electronics (for example, pressing pedals, touching the screen or the mouse, or making movements specially required for triggering the electronics, which might not suit the musical context they are required for), these can be a distraction factor not only for the player, but also for the audience. Even though it is true, that the nature of the piece may or may not diminish the impact regarding the audience's perception, these extra activities, if not part of another event involved in the piece (i.e. some type of acting), will always be to some extent a factor of distraction.

- *Relative independence of the electronics from the composer's presence during the performance.*

Regardless of the composer's presence or absence during the actual performance, the live-electronics should not need further manipulation, as everything is already programmed. This allows for more frequent performances of each piece and facilitates its transportation, as the patch itself (given the correct version of the software) needs only to be copied on any computer available capable of running that particular version of the software required for the performance. Once installed in the right environment, all events of the piece should run automatically after pressing the initial button

- *Better combination of processes and less risk.*

This method allows, in addition, for a more accurate and complex combination, crossover, fade-in-and-out, and so on, of different real-time processes. The risk of improvising in a live situation with the combination of processes cannot avoid sometimes the risk of accidentally exceeding the limits of the CPU performance on the computer. With automation however, as everything should have been tested beforehand, this rarely happens.

- *Ideal method for composer/performer in one person.*

As in the case of the viola piece described above, in which the composer is intended to be the performer as well, automation allows for shorter, safer and more efficient rehearsal times, as nobody else is needed to use or run the patch.

- *Additional solution for synchronization of events and processes related to performing time.*

For all the pieces mentioned in section 4.1, and as a consequence of the automation of all processes, following a time-code is a secure way to read a score and perform an interactive piece: it guarantees a very accurate interaction with the electronics, mostly in those cases, for example, when the recording of live samples for further use in the piece is required. Even though methods such as 'score-following' (through, for example, pitch recognition) are sometimes very successful (such as Lippe's *Music for clarinet and ISPW*), this is however not always the case, depending mostly on how they are applied (i.e. what type of technology is used to recognise the parameter followed). Negative effects such as some processes not triggered in time (or at all) seem to be frequent using score-following algorithms.

5.2. Disadvantages

In spite of all the advantages pointed above, some problems *do* appear though, which can be summarised in an overall lack of flexibility, imposing a variable degree of limitation to the performance/rehearsal situation.

From an aesthetical perspective, the following problematic becomes apparent: can processes, which repeat themselves invariably by each and every performance, be identified as 'authentic live-electronics'? I am aware that some composers and performers regard the very essence of live-electronics as relying mainly on the possibility of live manipulation, adaptation, interaction and variation during performance time. However, if we keep in mind the definition of live-electronics in the introduction of this paper, the answer to the former question should be definitely affirmative, as this should still be a clear case of *"performance involving electronic instruments which can be performed in real-time"*. There is no contradiction between the concept of automation and this definition, as much as there is none regarding the definition of *interactivity* too. Moreover, the patches of my pieces using complete automation mentioned in this paper would not work if there would not be a 'live input' provided.

An obvious disadvantage is that the work is rather fixed in itself: if changes need to be introduced to the music in future revisions, the electronics must be therefore substantially reprogrammed. This includes the accurate re-programming of, for example, all amplitude levels within the patch, as much as all timing issues and all connections. It also requires an intensive testing during the re-programming/re-composing period.

Another disadvantage connected to the latter is, that the patch generally runs from the beginning to the end of the piece, without any break in the middle. This impacts on the rehearsal methods, as partial rehearsal of some parts of the pieces unfortunately cannot be achieved without waiting until the precise SMPTE location arrives. This said, the only way to rehearse pieces composed using this method is from the start to the end. Even though some performers may find this situation not ideal, my experience is that they feel rather comfortable after getting acquainted to the method.

6. Summary

The discussion of whether or not complete automation is an original method to compose, programme and perform interactive pieces is not the main intention of this article. The aim is simply to arise awareness about the fact, that applying complete automation to the real-time processes of the electronics can be far more beneficial than detrimental to the actual performance of interactive works, the achievement of their dramaturgical intentions, their rehearsals and their circulation in different venues. This is not only my view as a composer, but I also include here my rather long experience performing electroacoustic music.

Historically, automation was not quite possible in the first thirty years of the existence of live-electronics, simply because the technologies available could not afford such tasks.[42] But since 1997 at the latest, the development and evolution of hardware and software platforms have allowed for automation to be not only feasible, but a real, tangible option. We have observed in the former sections, that, in examples such as Tutschku's or in the system at Tempo Reale, automation has been introduced in a rather high degree, and in the case of the latter, even at the core of the system's conception. Manual operation of partial automation is indeed frequent, but the use of complete automation, at least as presented in section 4, does not seem to be so popular yet.

Programming live-electronics entirely timed on some type of 'electronic-score' (for example, a *MAX* sub-patch that automatically activates the start and end each process), allows performers for more artistic freedom during performances, as much as for concentration on basic activities such as reading the score, playing and interacting, without the need of extra activities such as switching pedals, etc. It also guarantees, that even if the composer does not attend the performances and/or rehearsals, the piece can be likewise easily activated. Environments such as *MAX/MSP* or *PD*

[42] One of the few exceptions could be drum machines, which appeared already in the 1930s with the *Rhythmicon* designed by Léon Theremin in 1932 as a commission from composer Henry Cowell. In 1959, the firm Wurlitzer released the *Sideman*, which was an electro-mechanical drum machine. The 1960s saw some others, such as the *Rhythm Synthesizer* or the *FR1 Rhythm Ace* by Ace Tone (later Roland). The list of devices that followed is too long for the frame of this article. However, it must be said that the automation was given in each case by some type of sequencing (the particular type depending on the technologies available at their own release times) and that they have never been relevant to pieces including live-electronics [36].

allow for a simple and effective installation of patches on different computers/platforms, with just only minimal adjustments required. Making the patches an independent application is also a very elegant and efficient option (as in the case of Tutschku's *Zellen-Linien*).

If the synchronisation between performer and the electronics is achieved through simply following a time-code instead of more demanding activities, digital-signal-processes such as recording live to a buffer[43] as well as other interaction processes, can be easily achieved on a extremely accurate timing; further requirements such as additional programming, pitch detection or even other devices are therefore needless for any synchronisation purpose. Moreover, benefits shall increase, if the different DSP functions run steadily at the exact same set-times, as they can be entirely tested already while the work is being programmed and composed. This can result in less or simply no danger of exceeding the CPU's limits, as the entire patch can be completely monitored beforehand.

All the positive consequences, which complete automation offers thanks to the evolution of computing technology since the 1990s, result in an easier, costless, more effective and more frequent distribution of interactive pieces, as the only requirements for their performance are the score and the patch/software. It must also be observed that a better distribution should allow also for easier, perhaps even more artistic and definitely more frequent performances of these pieces. Hence, the minor disadvantages of complete automation do not, in my view, seriously impact on the overall musical end-results and can be considered minor inconveniences or limitations, which cannot be eluded, but however do not invalidate the usage of full automation.

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