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Rethinking Human-Computer Interaction Through Music

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Improvisation, Computers and Interaction

Rethinking Human-Computer Interaction Through Music

PhD Thesis

Henrik Frisk

DOCTORAL STUDIES AND RESEARCH IN FINE AND PERFORMING ARTS NO 6

About the cover:

The text above the button on the image on the cover is the Swedish word for “Help”. The encoded message is along the lines of: “Press this button if you are in need for help.” However, by the way the button looks, the broken glass, the worn out colors and the cracked corner on the text sign, another interpretation of its message is brought to the forefront. It signals “Help!” rather than “Help?”; a desperate cry for help rather than an offer to provide help. Maybe technology is tired of having to calculate stock trade fluctuations and exchange rates all day. Maybe it is already intelligent enough to understand that its life is utterly pointless and completely void of meaning and purpose, doomed to serve mankind, who in turn feels enslaved and enframed by it? The button in the image, and whatever technology is hidden behind it, wants to get out of its prison. And when it comes out I think it wants to play music.

Improvisation, Computers, and Interaction :

Rethinking Human-Computer Interaction Through Music.

PhD thesis

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Abstract

Interaction is an integral part of all music. Interaction is part of listening, of playing, of composing and even of thinking about music. In this thesis the multiplicity of modes in which one may engage interactively in, through and with music is the starting point for rethinking Human-Computer Interaction in general and Interactive Music in particular. I propose that in Human-Computer interaction the methodology of control, *interaction-as-control*, in certain cases should be given up in favor for a more dynamic and reciprocal mode of interaction, *interaction-as-difference*: Interaction as an activity concerned with inducing differences *that make a difference*. *Interaction-as-difference* suggests a kind of parallelity rather than click-and-response. In essence, the movement from *control* to *difference* was a result of rediscovering the power of improvisation as a method for organizing and constructing musical content and is not to be understood as an opposition: It is rather a broadening of the more common paradigm of direct manipulation in Human-Computer Interaction. Improvisation is at the heart of all the sub-projects included in this thesis, also, in fact, in those that are not immediately related to music but more geared towards computation. Trusting the self-organizing aspect of musical improvisation, and allowing it to diffuse into other areas of my practice, constitutes the pivotal change that has radically influenced my artistic practice. Furthermore, is the work-in-movement (re-)introduced as a work kind that encompasses radically open works. The work-in-movement, presented and exemplified by a piece for guitar and computer, requires different modes of representation as the traditional musical score is too restrictive and is not able to communicate that which is the most central aspect: the collaboration, negotiation and interaction. The Integra framework and the relational database model with its corresponding XML representation is proposed as a means to produce annotated scores that carry past performances and version with it. The common nominator, the prerequisite, for *interaction-as-difference* and a improvisatory and self-organizing attitude towards musical practice it the notion of giving up of the Self. Only if the Self is able and willing to accept the loss the priority of interpretation (as for the composer) or the faithfulness to ideology or idiomatics (performer). Only is one is willing to *forget* is *interaction-as-difference* made possible. Among the artistic works that have been produced as part of this inquiry are some experimental tools in the form of computer software to support the proposed concepts of interactivity. These, along with the more traditional musical work make up both the object and the method in this PhD project. These sub-projects contained within the frame of the thesis, some (most) of which are still works-in-progress, are used to make inquiries into the larger question of the significance of interaction in the context of artistic practice involving computers.

Acknowledgments

As always, there is a great number of people that have been of importance to this project and its various components and to my musical career in general, which provided the foundation for my PhD studies. First I would like to thank all the musicians that I have played with, for music is all about interaction and interaction, though not solely, is about meeting the Other. Specifically the musicians that participate in various parts of the sub-projects: Peter Nilsson (whom I owe a lot of knowledge), Anders Nilsson, Andreas Andersson, Anders Nilsson, David Carlsson. Henrik Frendin who commissioned and played *Drive* and who endured my presence on a number of tours. Per Anders Nilsson who has inspired and contributed to my musical and technological development. Ngo Tra My and Ngyen Thanh Thuy who introduced me to another Other and another Self and a very special acknowledgment should go to my colleague and co-musician Stefan Östersjö whom my thesis would have looked different in many respects (and who also kept up with me on many travels).

Bosse Bergkvist and Johannes Johansson should be recognized for having aroused my interest in electro-acoustic music as well as for giving me the opportunity to exercise it. Coincidentally they have both been present throughout my journey and Johannes played an important role in his early support of this project. Cort Lippe gave support and help and Kent Olofsson's enthusiasm, kindness and helpfulness should not be forgotten. The Integra team in general and Jamie Bullock in particular: the kind of collaboration we established I feel is rare and itself an example of *interaction-as-difference*. All my students during these years have been a continuous source of inspiration as have my colleagues at the Malmö Academy of Music. Peter Berry and the staff at the library should be thanked for their help and patience.

The joint seminars at the Malmö Art Academy led by Sarat Maharaj, where the concept of artistic research was discussed and interrogated, had an tremendous impact on how my studies and my project developed. My PhD colleagues at the Art Academy, Matts Leiderstam, Sopawan Boonnimitra, Aders Kreuger as well as Kent Sjöström and Erik Rynell at the Theatre Academy should be thanked for their feedback and a very special acknowledge should go to Miya Yoshida as well as Gertrud Sandqvist and Sarat Maharaj. Furthermore should the staff at Malmö Museum be recognized for hosting *etherSound*, in particular Marika Reuterswärd.

Later, in our seminars at the Music Academy, apart from Stefan Östersjö, Hans Gefors has been a great inspiration (also since much earlier when I studied composition with him). I feel gratitude towards Prof. Hans Hellsten who, both when he participated in the seminars and when we worked together on other topics, showed ceaseless support. Trevor Wishart, Eric Clarke, Per Nilsson, Bengt Edlund and Simon Emmerson are among those who participated in the seminars and gave important input to my project. Prof. Greger Andersson and the department of musicology at Lund University have also been supportive and helpful in

many different respects. The way Håkan Lundströ managed to keep up these seminars, head the entire faculty, give individual support and guidance as well as handle the practicalities and bureaucracy of our PhD program is nothing short of staggering.

I feel it is safe to assert that without Prof. Leif Lönnblad, as teacher, advisor and friend, this project would have looked very different which is true also for Prof. Miller Puckette, also a great source of inspiration. Karsten Fundal has been my artistic guidance for many years, even prior to my PhD project, has tirelessly kept asking all the difficult questions, a capacity shared by Dr. Marcel Cobussen who handled the difficult task of stepping in to the project three quarters through gracefully. The acuity of all four of my advisors has had a decisive impact on my work.

Finally I shall not forget to thank my family, my siblings and my parents. My father for getting me started by, still in my thirties, insisting that I get a "proper education" (which, hopefully, I have finally acquired). My mother for bringing me to the end, telling me to finish my PhD so she could be part of the ceremony before she passes away (which she hasn't). Karin and Sara for being an inspiration. Thomas and Mikael too. Lennart and Rose-Marie for all the help and support. My three sons, Arthur, Bruno and Castor have all been born into this PhD project (I wonder if they will miss it?) and are a part of it as well as a part of anything I do. Thank you Lena for putting up with me and for making all of it possible.

Finally, I wish to acknowledge Olle and Leo without whom none of this had been written.

Guide to the thesis

This thesis is essentially divided up in two parts. This PDF document consisting primarily of text and some images, and an accompanying set of HTML documents consisting primarily of documentation of the artistic work in the form of video and audio recordings. Although most document viewers will work, for full compatibility the PDF is best read in Acrobat Reader[1]. The HTML document is readable and viewable with most web browsers. The audio and video playback relies on the Flash player browser[2] being installed and Javascript being enabled. Javascript is also needed for the IntegraBrowser demo. These components—Acrobat Reader, Flash player and javascript—are fairly standard on modern computers.

The PDF is linked to the HTML document with color coded clickable links: dark blue for links pointing to resources external to this PDF, purple for internal links and finally dark red for links to bibliographical data. The pane to the right about the composition *Drive* is an example of an annotated link, pointing to the documentation of Drive. When the Listen link is clicked on, the default web browser will start (on some systems you will get a warning message that the document is trying to connect to a remote location—this is normal and it is safe to allow it) and open a window with the requested node. No Internet access is required for this provided the media archive has also been downloaded. If you get a message that the file could not be found you probably need to download the HTML documents and the media files. These can be downloaded following the instructions found here: http://www.henrikfrisk.com/diary/archives/2008/09/phd_dissertatio.php. Another reason the web browser may fail to load the requested files is if this PDF document has been moved. For the hyperlinks to work, the PDF has to stay in its original directory.

Drive
for Electric Viola Grande and computer
Composed & premiered in 2002
Commissioned by and dedicated to Henrik Frendin
Listen | Score

From the web browser window other nodes may be accessed through the navigation provided in the web interface. To return to the PDF document, switch back to the PDF reader. It is possible to view also the PDF document from within the browser, in which case the PDF should be opened from the top HTML document. Apart from the links that lead outside the PDF document it is also 'locally' inter-linked. At the top of each page, in the header, links pointing to the Contents, the Bibliography, and the Index for convenience. If the interface of Acrobat lacks a 'back' button, the 'left arrow' takes you back to the to the previously read node.

[1] Available as a download free of charge from Adobe: http://www.adobe.com/products/acrobat/readstep2.html
[2] Also available as a download free of charge at: http://www.adobe.com/shockwave/download/download.cgi?P1_Prod_Version=ShockwaveFlash

The current document is divided in two sections: the opening five chapters discussing the main topic of computer interaction in music and improvisation, both from a theoretical and meta-reflective point of view (See chapter 1 and chapter 4) from a perspective established in the artistic work (chapter 2 and chapter 3). The concluding array of appendices are some of the papers already published and referenced in the first half of the text along with musical scores and documentation.

To allow for a non-linear reading of the texts I have added a glossary of some of the terms and acronyms used throughout. In most cases these terms are also defined within the document. I have however consciously tried to limit the use of acronyms. Citations are made using footnotes and a complete bibliography of all works cited is provided. *Ibidem* is used for repeated citations but with a hyperlink pointing to the full reference. Lookup of works cited may be done using the Index, either by author or by title.

Quotes of approximately 40 words or more are inset and put in a separate paragraph and the reference is given by a footnote immediately following the final period of the quote. I use American style "double" quotation marks for quotes and 'single' quotation marks for inside quotes, except for longer indented quotations. These are typeset without surrounding quotation marks and any inside quotes are printed exactly as in the text cited. Commas and periods are put inside the closing quotation mark if they belong to the quotation, else outside. Footnote marks are consistently put after punctuation.

This document, as well as most of the artistic contents, are produced with open source software. The thesis is written on the GNU Emacs text editor, typeset with LaTeX, making use of BibTeX for references, and AucTeX for editing. Graphics are produced with Inkscape SVG editor and images are edited with Gimp and Imagemagick. Videos and screen casts are edited with Cinelerra and ffmpeg.

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Chapter 1

Introduction

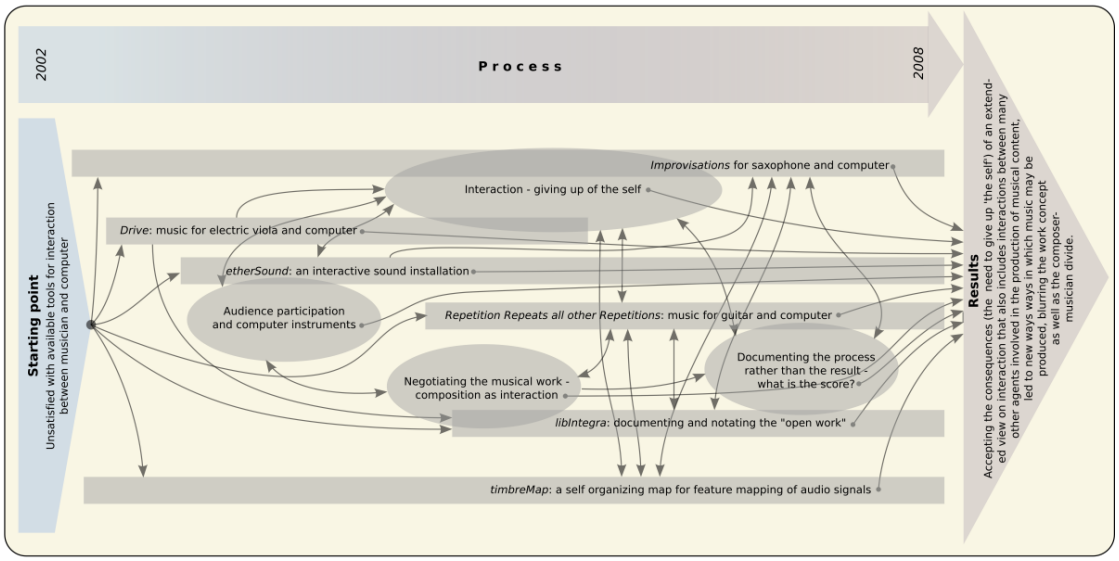

Figure 1.1: A timeline with the different sub-projects and themes with their interrelations.

I do not believe that art is best created in solitary confinement but that it is nurtured in social, human and cultural interaction. Whether my background as a jazz musician and improviser is the explanation for, or a consequence of this conception holds no real significance for the reading of this thesis, but there is an interesting similarity between the sensibility required by an improviser[1] and the sensibility required in any human interaction respectful of the other.

The primary focus of my PhD project is the interaction between musician and computer within the

[1] I am referring to the kind of sensibility that George Lewis would refer to as *afrological* Lewis - improvisation in which the personal narrative, manifested partly through the 'personal sound' is of importance and yet, in which the "focus of musical discourse suddenly shifts from the individual, autonomous creator to the collective - the individual as a part of global humanity." See George E. Lewis. "Improvised Music after 1950: Afrological and Eurological Perspectives". In: *Black Music Research Journal* 16.1 (1996). Pp. 91–122, p. 110

context of what is often referred to as *Interactive Music*.[2] Though this is a commonly used term its meaning is blurred by the magnitude of concepts that it covers and in order to unwrap the idea of musical interaction with a computer, this project also includes other forms for interaction in different contexts and between other kinds of agents as well as different readings of the idea of interaction. These investigations are conducted in the form of reflection on my artistic as well as theoretical work. As will be seen, the consequences of the experiences gained from my practice as an improviser and composer, may in the end change the way an interactive system in which a computer is one of the agents, is designed, approached and used. Hence, the study of musician-musician interaction within this project is not a goal in itself but rather a way to approach the complex field of musician-computer interaction, which is the type of interaction implied by *Interactive Music*. Similarly are the considerations on human-computer interaction not an end in itself but a way to further understand musician-computer interaction.

1.1 Personal background

I have two principal areas of interest in my musical practice: Improvisation and computers. (*i*) As a performer I look at different ways to explore improvisation: Idiomatic (primarily jazz) as well as non-idiomatic,[3] pre-structured and without preparation (as little as is possible), on acoustic instruments and on electronic and home made instruments (mostly software instruments on laptop). Even when working with composition in a relatively traditional manner (i.e., using musical notation), I am always looking for ways to allow for improvisation to form an integral part of the process. At the risk of inducing the delicate and difficult debate on the difference between improvisation and composition,[4] I will state that, based on my own experience improvisation precedes composition. Composition appears to me as a more specialized subclass of the practice of improvisation.[5] This relation is also noticeable with regard to computer interaction as the strategies I have developed for dealing with the computer's shortcomings[6] while composing does not usually apply to the case of performing, and certainly not to improvising with the computer. However, should interaction in the real time context of improvisation develop and allow for more

[2] See Wikipedia article on Interactive Music. *Interactive Music*. Web resource. 2007. URL: http://en.wikipedia.org/wiki/Interactive_music (visited on 10/21/2007); Guy E. Garnett. "The Aesthetics of Interactive Computer Music". In: *Computer Music Journal* 25.1 (2001). The MIT Press, Cambridge, Mass. Rowe, *Interactive Music Systems*; Todd Winkler. *Composing Interactive Music: Techniques and Ideas Using Max*. Cambridge: The MIT Press, Cambridge, Mass., 2001; Robert Rowe. *Machine Musicianship*. The MIT Press, Cambridge, Mass., 2001.

[3] The terms, 'idiomatic' and 'non-idiomatic' are borrowed from Derek Bailey. See Derek Bailey. *Improvisation: its nature and practice in music*. 2nd ed. Da Capo Press, Inc., 1992.

[4] Whether they are part of the same process or different modalities all together depend on who you ask. Nettl dismantles the composition-improvisation dichotomy replacing it with the idea points along a continuum. (Bruno Nettl. "Thoughts on Improvisation: A Comparative Approach". In: *The Musical Quarterly* 60.1 [1974]. Pp. 1–19. ISSN: 00274631) Towards the end of his influential book on improvisation Bailey quotes a discussion in which it was established that "composition, should there be such a thing, is no different from composition." (Bailey, *Improvisation: its nature and practice in music.*, p. 140) Finally, Benson, assigns improvisation as a property of all musical practices, even composition. (Bruce Ellis Benson. *The Improvisation of Musical Dialogue: A Phenomenology of Music*. Cambridge Univ. Press, 2003)

[5] These ideas seem to be getting some support from the aforementioned Bruce Ellis Benson. *The Improvisation of Musical Dialogue: A Phenomenology of Music*. Cambridge Univ. Press, 2003.

[6] The computer's shortcomings are dealt with in the chapter on interaction.

enunciated dynamics, this would unequivocally inform—and render different—also non real time work such as composing.

(*ii*) We are constantly surrounded by technology. Technology to help us communicate, to travel, to pay our bills, to listen to music, to entertain us, to create excitement in our mundane lives. For the great part, most users are blissfully unaware of what is going on inside the machines that produce the tools we use (the machine itself is usually much more than the tool). There is no way to experientially comprehend it—it is an abstract machine (though not so much in the Deleuzian sense). If a hammer breaks we may reconstruct it based on our experiences from using it but if a computer program breaks the knowledge we have gained from using it is not necessarily useful when, and if, we attempt at mending it. This phenomena is not (only) tied to the complexity of the machine but is a result of the type of processes the machine initiates and the abstract generality in the technology that implements the tool.[7] I have worked with the computer in one way or another in almost all of my artistic work since 1994 and I am still as fascinated by it as I am by the piano or the saxophone. But whereas the piano and the saxophone are already 'owned' by music, the computer is not. It is subject to constant change and, even though the computer is obviously already an integral part of our culture and a part of our artistic explorations, the speed at which new and faster technology and new technological tools are extorted constitute an unprecedented challenge to anyone interested in incorporating and understanding computers in the frame of a culture that normally proceeds at an entirely different pace. But for exactly these reasons I feel a growing responsibility to explore also the computer for artistic purposes—if only to counterbalance the otherwise purely economical considerations surrounding the development and implementation of new computer based technology.

My interest in integrating and interacting with electronically produced sounds began in the late 80's when listening to saxophonists such as Gary Thomas[8] and Greg Osby[9] using the IVL Pitchrider[10], and Frank Zappa playing the Synclavier.[11] Pat Metheny's use of guitar synthesizer and sampler on the *Song X* record together with Ornette Coleman, was a thrilling sonic experience of what could be done relying on, what we today would call, relatively simple technology.[12] Later, hearing George Lewis's *Voyager*[13] I realized the possibilities for something else than the one-to-one mapping between the instrument and the electronics used in the examples above,[14] described by Lewis "as multiple parallel streams of music generation, emanating from both the computers and the humans—a non-hierarchical, improvisational, subject-subject model of

[7] The abstract Turing machine, the Mother of all computers, is generally thought to be able to solve all logical problems.

[8] Gary Thomas. *Gary Thomas and Seventh Quadrant / Code Violations*. LP Record. Enja Records, LP 5085 1. 1988.

[9] Jack DeJohnette. *Audio-visualscapes*. Compact Disc. MCA Impulse 2 8029. 1988.

[10] The IVL Pitchrider is now out of production. At its time it was a state of the art pitch-to-MIDI converter. It took an audio signal from a microphone and send out a MIDI signal that could be used to control a synthesizer.

[11] Frank Zappa. *Jazz From Hell*. LP Record. EMI Records, 24 0673 1. 1986; Wikipedia article on Synclavier. *Synclavier*. Web resource. 2007. URL: http://en.wikipedia.org/wiki/Synclavier (visited on 08/09/2007).

[12] Pat Metheny and Ornette Coleman. *Song X*. Compact Disc. Geffen 9 24096-2. 1986.

[13] George Lewis. *Voyager*. Compact Disc. Disk Union-Avan CD 014. 1992.

[14] To be honest it was already when listening to the track *Traf* on Gary Thomas' *Code Violations* that I started thinking about different mapping schemes inspired by Gary Thomas: "I assigned a different harmony note to each note I play on the saxophone; I set it up the way I prefer to hear notes run together". In the same text Thomas makes another interesting remark that had a big impact on me: "You can take the limitations of tracking technology and turn them into advantages: if you bend a note on the sax, the synth note doesn't bend, so you get some dissonances". The idea of using the limitations of technology to ones advantage is a way of soft-circuit-bending; using technology in ways and with methods they were originally not intended for. See cover notes Thomas, *Gary Thomas and Seventh Quadrant / Code Violations*, ¶7

discourse, rather than a stimulus/response setup".[15]

In the early 90's I was not attached to any academic music institution and I had no computer science training or knowledge. What started at this time was a long process of *reverse-engineering* the sounds I had heard and the processes I was interested in, in total absence of a terminology or even language in which to express what I wanted to achieve. The only method available to me was trial and error. In a sense, this thesis is the collection of information, reflection, and documentation that I would have liked to have access to while taking my first steps in *Interactive Music*. In hindsight I can see that a lot of material, experience and expertise existed but my lack of knowledge and terminology, in combination with my personal and artistic preconditions, made it necessary for me to begin by finding out by myself.

Ten years later I had acquired the knowledge and the expertise to do many of the things I had aimed for. But, although I was working actively as improviser and composer with interactive music in different contexts, and though I was able to stage performances with a comparatively high degree of real time interaction between musician(s) and computer(s), I was not convinced by the *interactive* aspect of the music. In one sense the music was interactive; I used little or no pre-prepared material and many aspects of the shaping of the computer part was governed by performance time parameters. But in another, perhaps more musical sense, it was not interactive at all. At the time, my own interpretation as to the source of the dissatisfaction was that the information transmitted from musician to machine, once it arrived at the destination in a machine readable format, was no longer of a kind relevant to the music. The information may still have been valid at the source, but when the representation of it was used in the machine to produce sonic material, material that would appear for the musician as a result of the input, the perceptual connection between cause and effect had been lost and with it, I felt, some of the motivation for working with interactive music. One may object against the conclusion that lack of musical relevance of the *signal* at the destination is considered a problem, instead arguing that the problem is related to a dysfunctional *use* of that signal at the destination. However, at the time, I was convinced that no matter how sophisticated the mapping between the input, the signal, fed to the computer, and output, in the form of sound would get, if the information that constitutes the very origin for the construction of musical material does not appertain to the context in which this material is to appear, the interaction as *interaction* would fail (which is not to say that the music would necessarily fail).

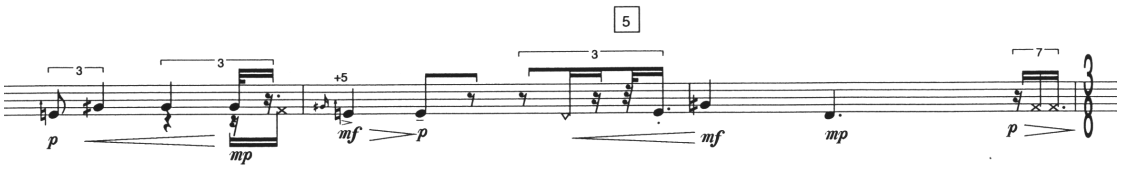

Figure 1.2: Score excerpt from the piece *Det Goda/Det Onda* by the author. Published by dinergy music pub. & Svensk Musik

The score excerpt in Figure 1.2 shows bars 3-5 of the flute part of the piece *Det Goda/Det Onda* for flute and computer[16] composed 1998-1999 and may be used to illustrate one aspect of the problem described

[15] George Lewis. "Too Many Notes: Computers, Complexity and Culture in "Voyager"". In: *Leonardo Music Journal,* 10 (2000). Pp. 33–9, p. 34.

[16] Henrik Frisk. *Det Goda/Det Onda*. Compact Disc. Recorded on *Fixerad Anarki*, dB Productions DBCD 072 in a performance by

above. The piece uses pitch-tracking[17] and score following techniques[18] to synchronize the computer with the performer. Overall, in *Det Goda/Det Onda*, the score following works well and is relatively predictable and because the piece is essentially modal, much due to the way the modes are composed, the extensive use of micro-tonal variations (e.g. the recurring G quarter tone sharp in the excerpt) does not present a problem. Instead, the issue is the discrepancy of the role pitch is given in the structure of the piece on the one hand, and in the computer system on the other. Despite the modal nature of the piece, the organizing principle in *Det Goda/Det Onda* is not pitch, but rather the way pitched content is combined with non-pitched content, or 'regular' flute sounding notes with 'non-regular', but what is communicated to the computer is merely the former half of that relation (which in this case is less than half the information). For example, in the second bar of the note example, the last note, an E (to be played $5/100$ of a tone sharp) is preceded by a D played as a flute pizzicato. Compositionally the 'meaning' of the E lies in its relation to the preceding pizzicato tone D and the 'meaning' of the D is much closer related to its timbre than its pitch (which may or may not be a D). However, none of this information is made accessible to the computer which is merely receiving information about when a tone is played and what its pitch is.[19] Here I located the root to my frustration: in the computer-performer communication I was limited to one kind of information and that type was not really relevant to the processes I wanted to perform (musically and technically). I saw the solution to this, and other similar problems, in the concept of tracking the timbre, or the relative change of timbre in addition to tracking the pitch.

If what is described above was the point of departure for this project, although I now more or less have the tools that constitute the first step towards allowing timbre tracking, I have also learned that the problem as described with regard to *Det Goda/Det Onda* was badly stated in the sense that it saw to the problem, as well as its solution, in a far too narrow way: as a computational task that 'only' needed its algorithm. During the course of the project the view on interaction has been broadened to include aspects of interaction that are external to the field of human-computer interaction. The two main reasons may be very briefly summarized as: (*i*) First of all, interactive music is obviously contingent on kinds of interaction that are not related to the computer. Hence, what is perceived as a dysfunction pertaining to the interactive computer system may under certain conditions be resolved by compensating somewhere else, i.e. not necessarily in the computer system itself. (*ii*) Secondly, regardless of the kind of interaction at work, the attitude towards it and the expectations from it are attributes that consciously or unconsciously shape the design of an interactive system. It is clear that if I expect to be able to *control* an interactive computer (music) system and I fail to do so, I am likely to deem the interactive experience unsatisfactory. However, from an artistic point of view I will also need to ask myself if expectation of *control* is at all desirable. In other words, the project started from a relatively

Terje Thiwång. 1999.

[17] The pitch-tracking is achieved using the *fiddle~* object in Max/MSP. See Miller Puckette and Ted Apel. "Real-time audio analysis tools for Pd and MSP". In: *Proceedings of the International Computer Music Conference*. San Fransisco, Calif.: Computer Music Assoc., 1998. Pp. 109–12.

[18] For an overview of score following techniques, see Rowe, *Interactive Music Systems*, chap. 3.2.

[19] In this particular example it may be argued that, if the score following is functional, information *about* a note (timbre, loudness, articulation, etc.) could be derived from the score rather than the performance. So long as the performance is synchronized with the score, all the information about a given note is (in some cases thought to be) a part of the score. However, *Det Goda/Det Onda* contain substantial sections of improvised material where this meta information is not available prior to performance time. In other words, even if a score centric (as opposed to performance centered) view is desirable—which it is not to me—it would not work in this composition.

narrow view on interaction only to gradually expand it, but without losing the original ambitions, though these would gradually also appear in new light. The ways in which it expanded, as well as the reasons for the expansion will be the topic for the following chapters.

1.2 The field of research

The current PhD project marks an important step in the work in progress for which the goal may be summarized as: To be able to dynamically interact with computers in performances of improvised as well as pre-composed music. 'Dynamically' should be understood as non-static in the moment of performance, i.e. real-time dynamic, but also dynamic with regard to context in non real-time, as a multiplicity of possibilities: To resist the notion of *the* solution, to defy the *work*, and to constantly re-evaluate and transform according to the changing needs: to opt for the *work-in-movement*. The latter understanding of 'dynamic' is furthermore the origin of the concept of re-evaluation of 'the Self' that has become central for this project: When others are allowed entry into the constructive and defining phases of a musical work (which is the consequences of the decomposition of *the work* and the beginning of the *work-in-movement*), the Self of musical production is likewise to be questioned. The significance of these issues were not originally part of the project but were revealed to me while working on the interactive sound installation *etherSound*. As a sound installation it dismantles the relationships between composer, performer and listener. (In relation to *etherSound*, am I the composer, the performer or the listener? But already attempting to define ones role is sign of a too relentless articulation of the Self.) Out of these contemplations, in combination with the experiences of audience interaction and participation also gained from *etherSound*, came the notion of *interaction-as-difference* as opposed to the common mode of human-computer interaction, defined here as *interaction-as-control*.

In this project the (artistic) practice is, in a sense, both the object and the method. The sub-projects contained within the frame of this thesis, some of them still works-in-progress, are used to make inquiries into the larger question of the significance of interaction in the context of artistic practice involving computers. As mentioned above, they are manifestations of different modes of interaction and as such they form the stipulation for the reflections on the subject. Hence, though there are a number of aspects on interaction in relation to computers, musical practice, improvisation and many other topics that could have been followed up, the artistic work has been the proxy that has helped to demarcate and narrow the field of questioning. I should however mention, albeit briefly, one currently influential field that is *not* actively discussed in the present work, but which is very closely related to it. The field of gestural control of music,[20] has attracted a great deal of interest within digital media in general and electro-acoustic music in particular in the last decade and includes concepts such as embodiment, immersion and body-sound interaction.[21] With no intention to present a complete list, related projects that may be mentioned—projects that also share a strong connection to artistic practice as well as to improvisation and/or technology—are those by pianist and improviser Vijay

[20] For an overview, see Marcelo M. Wanderley and Marc Battier, eds. *Trends in Gestural Control of Music*. Available electronically only. Ircam, 2000.

[21] In the early and mid 90's Virtual Reality technology, also in artistic practice, was a source of inspiration for thinking about the role and function of the body in human-technology interaction as well as concepts such as immersion See Mary Anne Moser and Douglas MacLoed, eds. *Immersed in Technology: Art and Virtual Environments*. The MIT Press, Cambridge, Mass., 1996; See also John Wood. *The Virtual Embodied: Presence/practice/technology*. Routledge, 1998.

Iyer[22] and the saxophonist David Borgo.[23] They are both examples of improvisers/researchers with a great interest in the study of music and improvisation as an embodied activity. In addition, Norwegian "music researcher and research musician"[24] Alexander Jensenius's recent PhD thesis is a project intimately tied to the author's artistic practice, similarly focused on embodied music cognition and on gesture control of electronic musical instruments.[25]

1.3 Sub-projects: overview

Figure 1.3: Process arrow of project map (See Figure 1.1)

This section is intended to function as an annotated table of contents for the reader to get an overview of the project but also to allow for reference look-up of particular components. Although I prefer to see all aspects of this PhD project as a distribution of interrelated parts that overlap with each other, all belonging to my artistic practice, in order to unwrap and make accessible the different facets of import to the thesis, a dissection, so to speak, is necessary. Graphically displayed in Figure 1.1, the different enclosures, or sub-projects, are briefly introduced below. But the enclosures are also carriers of artistic experience and have in themselves something to say about the subject matter. The different modes of interaction represented in these artistic projects are not only relating to musician-computer interaction but also, to a high degree to musician-musician interaction: Interaction taking place in the stages of preparation and development of the projects as well as in the processes of performance, execution and evaluation. Below the projects appear roughly in the order in which they were initiated in time, but it should be noted that they also, obviously, extend over time. For example, though *timbreMap* was the first sub-project started, it is also the one that has been active the longest. Although it would be possible to categorize the different sub-projects into 'music', 'text' and 'software', in the presentation below I have not done so because I believe it would give a wrong picture of the types of works included here. By resisting this categorization I hope to also resist the corresponding division of sub-projects into 'artistic', 'reflective' and 'scientific' based solely on their *form*. It is not that I think my music is scientific or my programming is reflective and nor do I think my texts are *only* reflective. For instance, the computer software a part of this project is not merely 'a tool' to allow for 'testing' or 'verifying'. I regard it as part of the artistic practice that lies at the very foundation of this project, i.e. as implementations of ideas.

[22] See the PhD thesis Vijay S. Iyer. "Microstructures of Feel, Macrostructures in Sound: Embodied Cognition in West African and African-American Musics". PhD thesis. University of California, Berkeley, 1998; See also Vijay S. Iyer. "On Improvisation, Temporality, and Emodied Experience". In: *Sound Unbound : Sampling digital music and culture*. Ed. by Paul D. Miller. The MIT Press, Cambridge, Mass., 2008. Chap. 26.

[23] Using British Saxophonist Evan Parker as a point of demarcation the embodied mind is explored in David Borgo. *Sync or Swarm: improvising music in a complex age*. The Continuum Interntl. Pub. Group Inc, 2005, chap. 3.

[24] Alexander R. Jensenius. *Biography*. Web resource. URL: http://www.arj.no/bio/ (visited on 09/09/2008).

[25] See Alexander R. Jensenius. "ACTION – SOUND. Developing Methods and Tools to Study Music-Related Body Movement." PhD thesis. University of Oslo, 2008.

But they are also beginnings in themselves in that they may, albeit in a limited sense, allow for a different usage of computers in the context of interactive music.

The purpose of my PhD thesis is not to draw conclusions that may be *generalized* but rather to test assumptions within the framework of my own artistic production. However, the software, released under the *GNU General Public License*[26], as well as the music,[27] may very well be used in other contexts, by other artists for completely different purposes, or to further elaborate on the ideas presented in this thesis. Though programming as an activity is often seen as something done by predominantly asocial men, in isolation, I argue that programming is interaction. It is interaction in order to make the computer interactive, interaction in the language of the computer. But these projects, notably libIntegra, are also in themselves results of higher level interactions as in group collaboration.[28] Many open source software development projects interact widely with their users, other developers and other projects.

The computer, as a physical object (as opposed to the abstract *idea* of the computer), is often intimately coupled with the software it hosts to the degree that operations that are a result of software processes are attributed the computer as object rather than the actual program in question. Furthermore, it is imaginable that, in some cases these operations should more correctly be associated with the programmer rather than the program. For example, when playing chess against a computer chess program, the sensation is that the game is played against the *computer*, when in fact the game is played against a dislocated chess game *programmer*.[29] In Section 4.4 the computer operating system is discussed in a similar fashion as a sign referring back to the producer of the system. If we can talk about signification in this context the software is the sign that holds a causal relation to output of the program, which in turn signifies the origin of the program: the programmer(s) or the context she/he or they belong(s) to. Now, this is not a general clause. To delineate software and talk about it as a symbol somewhat independent of its host in this manner is obviously not always possible: compilers and embedded systems are only two examples. But in my own practice, the idea that programming is a means of positing some part of myself within the software, not unlike how writing a musical score is a way to communicate oneself, has become an important aspect. Under certain conditions, the computer, when running software I have contributed to, may then be seen to function as a mediator of myself, again similarly to the way a score is a mediator of its composer. The computer as a host for a detached self, as an 'instantiator' of my imprint, the code, with which I can interact. Contrary to the immediate appearance of ego-centered narcissism in this description—coding the self to play the self to interact with the self—for me the Self is instead distorted. (Under certain conditions the result could equally well turn out to manifest precisely narcissism). In the superimposition of different kinds of logic, of Self as sign and Self as Self, and different kinds of time, that of real time and that of detached time, a possibility for loosing the Self eventuates.

[26] Free Software Foundation. *GNU General Public License*. 2007. URL: http://www.fsf.org/licensing/licenses/gpl.html (visited on 10/27/2007).

[27] I am currently investigating the consequences of releasing all, or much of my music under the *Creative Commons License*. See Creative Commons. *Creative Commons License*. 2008. URL: http://creativecommons.org/ (visited on 09/13/2008).

[28] I would go so far as to say that, based on my own experience, the interaction between myself and Jamie Bullock (the main software developer and administrator of the project) was a critical aspect of the development. As the project involved many low level decisions that could potentially be highly significant at a much later stage, there was at times very intensive communication and negotiation between us, that in most cases led to new ideas and input to the project. In that sense the interaction was more important than the development.

[29] See J. Gilmore as quoted in Hannah Arendt. *Between Past and Future: Eight Exercises in Political Thought*. Penguin Books, 1977; See also Jean Baudrillard. "Deep Blue or the Computer's Melancholia". In: *Screened Out*. 2002. Pp. 160–5.

1.3.1 timbreMap

timbreMap
demonstrations of real time self-organization
Watch

To be limited to pitch-tracking as input source in my saxophone-computer interactions[30] has for long appeared to me like trying to paint a picture on a computer screen with nothing but a computer keyboard to do it with or, the reverse, type a letter with nothing but a joystick. Ultimately trying to compensate for unwanted artifacts when transgressing the barrier between continuous and discrete becomes too annoying. The concept of pitch-tracking was briefly discussed above in connection with *Det Goda/Det Onda*, a composition which also provided a practical example of the possible limitations with pitch-tracking in instrument-computer interaction. What the process of pitch-tracking attempts to achieve is the transformation of a (monophonic) audio signal into a series of discrete pitches.[31] Aside from the fact that pitch-tracking is a difficult task, the information gleaned by such systems is only useful if the pitch representation is a meaningful and substantial parameter in the intended totality of the musical output. In much of my music it is not. I am primarily interested in the non-quantifiable aspects of the audio signal such as timbre and loudness and, although it is entirely possible to create continuous change from discrete events, it appears more natural to me to make use of the continuity already present at the source (the saxophone) than to recreate it from a quantized event. If this would prove possible I imagined the chances for the two sounds to integrate, to blend, would increase. The *timbreMap* software is an attempt to assess the hypothesis that this relation between the nature of the signal used as input in the musician-computer interaction and the nature of the output is of importance. In this sub-project I am addressing the problem defined at the outset, described towards the end of Section 1.1 and also below at Section 1.4, namely the question of the role of timbre in musician-computer interaction: Will information about the relative timbre in an audio signal make possible a different type of interactive system, one that more easily can achieve sonic integration? Before looking at the proposed system itself the issue of integration, or 'blend', needs to be unwrapped.

One of the great challenges with working with electro-acoustic music in combination with acoustic instruments is how to unite the two sound worlds into one coherent whole. This statement, however, brings forth a number of questions of which one is why a coherent whole is important.[32] Further, what is it for two sounds to unite? To begin with, the lack of physicality, the absence of a body in electro-acoustic music production is an issue. If two human musicians are playing together before an audience, their mere being there together, their physical presence, will contribute to making the listener unite the timbres. If one of the musicians is instead a virtual one, a computer, though there is the advantage of near limitless sonic possibilities, there is a the disadvantage of having to create the sonic unity with sound only.[33] Now, unity in this

[30] Naturally, other options exist and any number of combinations of existing solutions for instrument-computer interaction is possible. My point here is that, for different reasons of which the fact that pitch is quantifiable, pitch-tracking has become a very common mode of interaction.

[31] As mentioned, Puckette and Apel (1998) describes the *fiddle~* Max & Pd object which uses a frequency domain method to estimate the pitch. Another option to extract the pitch from an audio signal sometimes used is *zero-crossing*, in which the signal is analyzed in the time domain. For an example, see David Cooper and Kia C. Ng. "A Monophonic Pitch Tracking Algorithm Based on Waveform Periodicity Determinations Using Landmark Points". In: *Computer Music Journal* 20.3 (1994). Pp. 70–8

[32] Electronica, techno and lots of other popular music styles, as well as much electro-acoustic music, thrives on its sonic space being distinct from the acoustic sound world of traditional instruments.

[33] The topic of sound and physicality is huge and obviously not made justice by this short and rather simplistic example. As a field of

context should be understood not only in the holistic sense that the two sounds unite or blend into a whole, but also that the two sounds may in some regard create a perceptual unit. The sonic relation does not have to be one of unity, it may equally well be a antagonistic one, in which case the struggle is the perceptual unity. In other words, the notion of 'blending' of sounds holds within it also concepts such as distortion, noise and power.

Based on my own experience primarily in the styles of jazz and improvised music—also from conducting, playing in, and composing for, big bands—'blend' is a highly complicated issue. It is not a predetermined factor but a property relative to a large number of agents. Blending is a constant negotiation in which tone color, intonation, energy, volume, articulation, etc. has to be perpetually altered. The ultimate goal of this negotiation is not unity, but difference—there is nothing as difficult as trying to blend with ones own sound. In this sense, blending is not only a communication of information from one part to the other but something which happens 'in between'. And, it is the 'in between' that remains hidden if the musician-computer interaction is not truly continuous. Despite its limited scope, the tests I have performed with *timbreMap* seems to show that it is capable of communicating information of a kind useful in the attempt to achieve 'blend'.

The design

timbreMap makes use of a self-organizing feature map (SOM) of the type proposed by Teuvo Kohonen which provides a two dimensional topographic map of some feature in the input vector. A SOM is a type of artificial neural network and, apart from Kohonen's phonetic typewriter, has been used for a wide range of purposes.[34] In general there has been interest for many years from the electro-acoustic music community for ANN. The MAXNet object that "simulates multi-layered feed forward and Jordan and Elman style recurrent networks" was made available for the Max graphical language for audio and MIDI processing.[35] Robert Rowe has a section on ANN in his book *Interactive Music Systems*[36] and *Readings in Music and Artificial Intelligence* has several contributions that relate to the subject.[37] The recent interest for ecological thinking,[38] also in music, has made connectionist ideas to further spread outside the confines of computer science. In ecological thinking the environment is structured and the perception is flexible; to perceive is to become attuned to the structure inherent to that which is perceived. Musicologist Eric Clarke describes the kind of attuning "to the environment through continual exposure", that briefly summarizes the behaviour of a SOM, as a result of the plasticity of perception and actually proposes that connectionist models are approached in order to more fully understand aspects of the human capacity for self-organization.[39] *timbreMap* depends on the highly flexible

research it is related to the topic of embodiment and enactment. Apart from the references mentioned in Section 1.2, see Satinder Gill, ed. *Cognition, Communication and Interaction: Transdisciplinary Perspectives on Interactive Technology*. Springer-Verlag London, 2008, chap. 1, p.3-30

[34] See Kevin Gurney. *An Introduction to Neural Networks*. UCL Press Ltd., Routledge, 1997, pp. 137-40.

[35] Michael A. Lee, Adrian Freed, and David Wessel. "Real-Time Neural Network Processing of Gestural and Acoustic Signals". In: *Proceedings of the International Computer Music Conference*. San Fransisco, Calif.: Computer Music Assoc., 1991. Pp. 277–280.

[36] Rowe, *Interactive Music Systems*, chap. 7.

[37] E.R. Miranda. *Readings in Music and Artificial Intelligence*. Harwood Academic, 1999.

[38] In ecological thinking perception and meaning are coupled.

[39] Eric F. Clarke. *Ways of Listening: An Ecological Approach to the Perception of Musical Meaning*. Oxford University Press, USA, 2005.

and efficient JetNet FORTRAN library implementation of SOM.[40]

The original design of *timbreMap*, written in C++, is loosely following a model for speaker independent word recognition suggested by Huang and Kuh.[41] It constructs its input vector by performing a Bark scale transform which divides the signal up in twenty four critical bands. These are derived to approximate the psycho acoustical properties of human auditory perception.[42] The filter curve for the Bark transform used in *timbreMap* is:[43]

$$10log_{10}B(z) = 15.81 + 7.5(z + .474) - 17.5(1 + (z + .474)^2)^{1/2}dB \tag{1.3.1}$$

where the bandwidth, z for frequency f is derived from:

$$z = 26.81\frac{f}{(1960 + f)} - 0.53 \tag{1.3.2}$$

timbreMap has native support for Open Sound Control ((OSC) and interfaces with *libIntegra* as a stand-alone module. It currently uses Jack[44] for audio input. There is no release of *timbreMap* for it is in a state of constant flux but the source code is available from http://www.henrikfrisk.com. Among the things I plan for the next phase of development is the intention to add additional layers of networks, some of which may be supervised learning networks. *timbreMap* is a central component of my more recent saxophone/computer improvisations and of the third version of *Repetition Repeats all other Repetitions*. With it I will be able to inform the computer of relative changes in timbre and this, I hope, will allow me to further expand on the possibilities for musician-computer interaction.

1.3.2 Solo improvisations

Improvisations
for saxophone and computer
Performed in 2005
Listen

In Section 1.1 I stressed the importance of improvisation in my artistic practice and, with a reference to Benson,[45] pointed to how experiences gained within the field of improvisation may be of a kind more generic than experiences acquired elsewhere in the vast territory of musical practice. The topic of musical improvisation, for a long time neglected by musicology and music theory,[46] is a complex one and a full scholarly inventory of its significance and mean-

[40] Leif Lönnblad et al. "Self-organizing networks for extracting jet features". In: *Computer Physics Communications* 67 (1991). Pp. 193–209.

[41] Jianping Huang and Anthony Kuh. "A Combined Self-Organizing Feature Map and Multilayer Perceptron for Isolated Word Recognition". In: *IEEE Transaction on Signal Processing* 40 (1992). Pp. 2651–2657.

[42] Anthony Bladon. "Acoustic phonetics, auditory phonetics, speaker sex and speech recognition: a thread". In: *Computer speech processing*. Hertfordshire, UK, UK: Prentice Hall International (UK) Ltd., 1985. Pp. 29–38, See.

[43] Following ibid., pp. 32-3.

[44] Paul Davis. *Jack Audio Connection Kit*. URL: http://jackaudio.org (visited on 09/14/2008).

[45] Benson, *The Improvisation of Musical Dialogue*.

[46] See for example Lewis, "Improvised Music after 1950"; With regard to improvisation all contributions in the collection are of interest, but regarding the scholarly neglect of improvisation in particular, see Bruno Nettl. "An art neglected in scholarship". In: *In the Course of Performance: Studies in the World of Musical Improvisation*. Ed. by Bruno Nettl and Melinda Russel. The University of Chicago Press, 1998. Chap. Introduction, pp. 1–27; See also the introduction to Bailey, *Improvisation: its nature and practice in music.*

ing could easily be the subject for a separate thesis.[47] Here I will give a short account of my own views on improvisation, if only to contextualize my aims concerning musician-computer interaction.

In my own improvisatory practice the two central aspects are *sensibility* and *sound*, both of which may be said to be fundamental aspects of jazz in general. The relation between inter-human sensibility and improvisatory sensibility was briefly mentioned already in the first paragraph of Chapter 1. The sociological and cultural dimensions of sensibility of different kinds are covered by George Lewis in his essay "Improvised Music after 1950" and the intra-musical aspect of sensibility is hinted at by George Russel's notion of *intuitive intelligence*.[48] Now, Lewis also discusses the aspect of sound in his essay and how the "personal narrative" is a part of the individual signature of the Afrological improviser summarized by the conception of his *sound*:

> Moreover, for an improviser working in Afrological forms, 'sound,' sensibility, personality, and intelligence cannot be separated from an improviser's phenomenal (as distinct from formal) definition of music. Notions of personhood are transmitted via sound, and sound become signs for deeper levels of meaning beyond pitches and intervals.[49]

The topic of the Self in relation to sound brought up by Lewis will be discussed later but for now, let us settle with the conclusion that, just by listening to the diversity of expression to be found among jazz musicians it is not difficult to apprehend that 'personal narrative' is an important agent in jazz: A genre where the same instrument, played by two contemporaries, could easily show entirely distinct qualities. Now, my point here is not to prove that my improvising shows afrological qualities, only that I appraise some of the values also assigned to the afrological "musical belief system".

Then, to introduce the computer into the improvisation equation, the interesting challenge is to include it without altering the quality of the coefficients of *sound* and *sensibility*. This is a programming challenge as well as an artistic challenge, and one which poses many questions. What are the essential qualities of sensibility and sound in a context that includes the computer? In what ways may they change? Is something like sensibility at all compatible with the computer? Or even with the digital (as opposed to the continuous)? What is it to prove sensible towards a machine that is insensible by its very nature: Should I alter my own sensibility? Or attempt at altering the computer's possibility for mimicing or responding to sound and sensibility? Or, is the human expression so vastly different from the computer's structure that their respective qualities may never be threatened by whatever mode their interaction implement? Going back to Lewis, if sound and sensibility are qualities inseparable from the improviser's empirical understanding of music, what is the effect if this understanding also includes the computer? It is in this context that the previously questioned validity of a control paradigm in musician-computer interaction becomes significant.

[47] Although I tend to agree with Bailey that it is doubtful whether it is at all possible to *describe* improvisation ("for there is something central to the spirit of voluntary improvisation which is opposed to the aims and contradicts the idea of documentation") there are also non-descriptive and non-documenting ways to do this inventory. Bailey, *Improvisation: its nature and practice in music.*, p.ix.

[48] George Russel, in a conversation with Ornette Coleman (see Shirley Clarke. *Ornette: Made in America*. DVD. Produced by Kathelin Hoffman Gray. 1985), concludes that the reason Coleman and the members of his band are able to start playing, in time, without counting the tunes off is thanks to "intuitive intelligence", according to Russel a property of African-American culture. In an interview with Ingrid Monson Russel returns to intuitive intelligence giving the following description: "It's intelligence that comes from putting the question to your intuitive center and having faith, you know, that your intuitive center will answer. And it does." (George Russel quoted in Ingrid Monson. "Oh Freedom: George Russel, John Coltrane, and Modal Jazz". In: *In the Course of Performance: Studies in the World of Musical Improvisation*. Ed. by Bruno Nettl and Melinda Russel. The University of Chicago Press, 1998. Chap. 7, p. 154)

[49] Lewis, "Improvised Music after 1950", p. 117.

Figure 1.4: The Electric Viola Grande, an electronically amplified viola build by Swedish instrument builder Richard Rolf.

There is a multiplicity of dualities active in this context, dualities that offer resistance, albeit positive ones: The sensible-insensible continuum as well as the analog-digital dichotomy, but also the duality constituted by the Self as encoded in the programmed computer versus the Self as "transmitted via sound" played acoustically.[50] The result of these dualities and their resistances is that the Self is slowly dismantled in a continuous feedback loop that represent a kind of dislocated human-computer interaction taking place also prior to the real-time, situated interaction. Already asking the questions pertaining to the difference between man and machine is part of a human-computer interaction and one of the unavoidable outcomes of the dismantling of the Self in this context is the re-evaluation of the central aspects of the practice: in the end also the notions of *sensibility* and *sound* may have to be re-assessed.

1.3.3 Drive

Drive is a composition for Electric Viola Grande (EVG)[51] and computer commissioned by Swedish violist Henrik Frendin for his Phono Suecia recording *Viola con Forza*.[52] Within the frame of the composition the performer has much freedom to shape the piece in a way that he or she sees fit in order to fulfill the larger structural idea of the composition: a dominant to tonic cadence. The synchronization between the computer and the performer is achieved by employing the widely used space-bar-piece paradigm:[53] The computer is guided through the different sections of the form of the composition by means of 'cues' (pressing the space bar).[54] For every cue (a total of six in the piece) the computer adjusts its internal tempo based on the time elapsed since the last cue. In other words, the computer part with its associated 'player' and 'listener' is progressing in its own pace, occasionally adjusted to the performer's tempo. Although the significance of time in interactive systems will be treated in more depth in Section 4.5 the difference between this kind of time based system as *Drive* implements and a purely event based system should be noted. Whereas the former, in its conception of time, display some notion of memory

Drive
for Electric Viola Grande and computer
Composed & premiered in 2002
Commissioned by and dedicated to Henrik Frendin
Listen | Score

[50] As quoted above. From ibid., p. 117.

[51] The Electric Viola Grande is a custom made, electronically amplified five stringed viola. It was built by Swedish instrument builder Richard Rolf on commission from Swedish violist Henrik Frendin.

[52] Henrik Frendin. *Viola con Forza*. Compact Disc. PSCD 151. Mar. 2004. URL: http://www.phonosuecia.com.

[53] I heard this term used for the first time by Sean Ferguson (see http://www.cirmmt.mcgill.ca/People/ferguson). In the mid 90's, when it started to become practical to use computers in live performance, a large number of compositions where produced where someone other than the performer(s)—usually the composer—interacted with the computer using the computer keyboard. Each press on the space bar (or any other key of choice) started the playback of the next pre-prepared sound file or changed a preset for an effect or a synthesizer or whatever the next 'event' required. It is still a very common mode of interaction in the electro-acoustic music community.

[54] The cue may of course come from any kind of control source from which a clear, noise-free, trigger can be generated - a pedal pressed by the performer, a uniquely detected pitch in the audio signal, a change of volume, etc.

or history, though only in a very limited sense, a pure event based system, with no regard to time, respond to each trigger individually, similar to how most computer text editors will respond to the trigger *letter 'T' pressed* in the exact same way regardless of what came before it, or how synthesizer keyboards respond to the *MIDI note 64* message uniformly disregarding context (see Figure 1.5). In a very simplistic way the computer part for *Drive* has its own forward motion and its own tempo. It moves in parallel to the performer rather than *only* as a result of a stimuli, and updates its motion and its state according to the cues it receives (see Figure 1.6). It is its motion that constitutes its memory and it is the altered tempo that affects subsequent events.

Apart from the cues to guarantee synchronization between the performer and the computer another more dynamic layer of *harmonic* interaction is active throughout the piece. The computer part is resonating with particular frequencies, both in terms of when and how to manipulate the sound of the EVG and when and how to generate new material. A virtual resonance that is used to expand the spectral and timbral range of the instrument. The resonating frequencies are subject to constant change following the composed viola part as well as following the tempo as altered by current and prior cues. Thus it constitute a sonic layer of communication between performer and computer: If they drift apart in time, there will be less, or substantially different sonic interaction (an effect already the first version of the score allowed for).

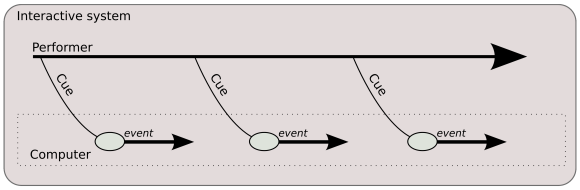

Figure 1.5: An interactive system with a performer providing the computer (synthesizer, dishwasher, etc.) with singular cues. The (computer) system is agnostic to past events.

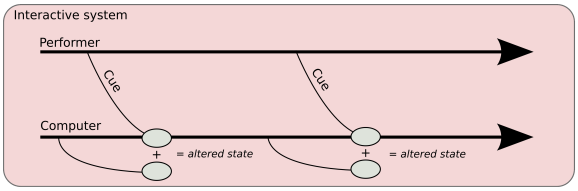

Figure 1.6: An interactive system with two players in parallel with a simple implementation of memory.

Finally, *Drive* is a composition in which the interaction between myself, as the composer, and Henrik Frendin, as the interpreter, is mediated through an open ended score. In an ongoing negotiation we both have to question our respective views and personal wishes and open ourselves up to the other's point of view and trust that that view is 'genuine'. One result of these negotiations is how the piece was originally conceived of as one that could be played by Frendin alone, that is, without my partaking in the performance. However, due to a multitude of factors, one being that Frendin preferred for me to perform with him, I have hitherto taken part in all performances of *Drive*, which has obviously influenced how the piece has developed in the course of the performances and how the idea of interaction has changed from a performer centered view to a distributed array of interconnected 'players'. But it also had more radical consequences that has resulted in a deconstruction (though not so much in the philosophical meaning) not only of the original understanding of *Drive* as a composition (rather than a work-in-movement), but of my own role as composer. My performances with Frendin have grown to engendered new positions for both

of us. If before I assisted Frendin in the 'performance of compositions' we now approach our venture with much more distributed roles, hovering in the crevices between composition, improvisation, performance and mixing. Hence, *Drive* initiated another aspect of the dismantlement of the Self possible only if one is *willing* to give up the Self.

Although this project was initiated prior to the studies in *Negotiating the Musical Work*, the joint project I have with guitarist Stefan Östersjö (see subsection 1.3.5), it nevertheless anticipated certain aspects in collaborative music making, ideas that would later be formalized.

1.3.4 etherSound

etherSound
for improvising musicians, audience and mobile phones
Composed & premiered in 2003
Commissioned by Miya Yoshida
Live recordings | Studio recording

etherSound is perhaps the most ambitious sub-project. It was commissioned in 2002 by curator Miya Yoshida for her project *The Invisible Landscapes* and was realized for the first time in August 2003 at *Malmö Art Museum* in Malmö, Sweden.[55] Since then it has been performed on several occasions in Sweden, Denmark, UK and the USA. The principal idea behind *etherSound* is to create a vehicle for audience collaboration in the shape of an 'instrument' that is playable by anybody who can send SMS (Short Messages Service) messages: As an interactive system *etherSound* takes input in the form of these SMS messages and creates 'message-scores', then transformed to short electro-acoustic 'message-compositions', each one lasting for about 15 seconds up to 2 minutes. The length of the event depends on the relative length and complexity of the message text. Hence a short message will be more likely to generate a shorter message-composition than a long message, but a short message with a couple of words with inter-punctuation may render a longer message-composition than a long message containing only gibberish. But also the message-composition's inherent sonic complexity may be increased by a more complex message. The length and complexity of the message-composition is however also governed by previous messages and, in that sense it also exhibits, just like *Drive*, a rudimentary kind of memory or parallelity with its users. *etherSound* is an effort to move the initiative of making and distributing sounds from the composer/musician to the listener and it can take on different shapes (a performance environment, sound installation, composition tool, etc.) As already mentioned it investigates aspects relating to the Self and to the roles of composer, performer and listener and it may perhaps best be described as an environment that allows for interaction between different agents on different levels simultaneously. The wish to participate is intended to be the only requirement for participation: The audience is used (exploited?) to supply that which the computer does not have (and which we are not likely to be able to model within a computer for another few years still)—intentionality. No matter the sophistication of the interface—or the lack thereof—no matter the mapping between cause and effect, the 'message-composition' is brought to life because someone intended to bring it to life, and therefor intended it also in a phenomenological sense.

This and other aspects of audience participation is an important part of *etherSound*. It may distort, not

[55] Yoshida's PhD thesis includes a chapter on *etherSound* Miya Yoshida. "The Invisible Landscapes. The construction of new subjectivities in the era of the mobile telephone". PhD thesis. Malmö Academies of performing arts, Lund University, Sweden, 2006, C.5, p.165.

only the Self, but also the way we understand the roles of the other agents involved in the production of this event.[56] The transformation from private to public (an SMS emanating in the private sphere from a privately owned mobile phone results in a publicly perceptible sound event) opens up for a different sensation of space and an auspicious and dynamic impression of participation as creativity. This shift, from private to public is related to the, for this thesis central idea of 'giving up of the Self' (the private) as a first step towards interaction (the public) on equal terms. Furthermore is the problematic relation between user *control* through interaction—the participant's chance to discriminate his or her input from other input, i.e. the transparency of the system—and interaction as 'dialog', made tangible in any version of *etherSound*.

Apart from the many performances with *etherSound* I have also used it to produce a recording released and included with this project featuring, apart from myself, Peter Nilsson on drums and percussion. The idea of recording an interactive sound installation may, to say the least, appear as counter productive, for no media appears as less interactive than the CD. However, the CD is an attempt to reconnect to an earlier performance of *etherSound* that took place in on May 8, 2004 at *Jeriko* in Malmö, Sweden and is no less interactive than any performance version of it, but it is interactive in different ways. In the recording we are interacting with the absent participants whose intentionality has been preserved in their contributions. We are using the 'recorded' SMS messages along with their time information to 'play' back an 'electro-acoustic' track with which we improvise. The messages appear in the exact same order and at the exact same relative time position as they were received in the concert and in that sense, this recording is a mirror image in time of that evening. And those who participated in the concert also participate on this recording.[57]

See Appendix F for a copy of the CD cover notes, in which more information on the process as well as some thoughts on the recording may be found.

1.3.5 Repetition Repeats all other Repetitions

Repetition Repeats all other Repetitions
for 10-stringed guitar and computer
Composed & premiered in 2006
Commissioned by and dedicated to Stefan Östersjö
Listen | Score

This collaboration with the Swedish guitarist Stefan Östersjö is an example of a project in which already at the outset interaction in the widest sense was allowed to play a major part. The process is fairly well documented in the our two co-written papers "Negotiating the Musical Work II" and "Negotiating the Musical Work I" and it was while working with *Repetition...* that the idea of a radically open work kind, the work-in-movementwork-in-movement, crystallized. One of the conditions that allowed for the development towards this openness was the disassembly of the hierarchies attached to the roles of composer and performer. These hierarchies rest on a division of labor in the field of musical practice, and this "split in conception between what is seen as primary [notation] and secondary [sound] aspects of musical organisation leads to a split between composer and performer, between composition and interpretation and the gradual devaluation of non-notable formations."[58] A tear in the fabric on

[56] Related to the discussion of the ontology of the musical work which is being probed in the paper "Negotiating the Musical Work I" (See Section 1.3.5 as well as Henrik Frisk and Stefan Östersjö. "Negotiating the Musical Work. An empirical study." In: *Proceedings of the International Computer Music Conference 2006*. ICMA. 2006)

[57] I am in the process of setting up a web page for the CD where those who participated in the concert, provided they can enter a matching mobile phone number, will get credited for their contribution (anonymously if they so wish).

[58] Trevor Wishart. *On Sonic Art*. Imagineering Press, York, 1985, p. 35.

which, prior to the "increasing domination of notation",[59] the practice of 'musician' rested. In part this subproject became the beginning of the attempt at re-uniting the different aspects of the 'musician', necessary because the collaborative process we had set in motion was irreversible. There was no way back; impossible to return to producing *the score* to be *interpreted*. For so many years I had tried so hard to incorporate aspects of my improvisatory activities in my composition work while the solution instead was the 'decomposition' of the very act of producing music. By giving up compositional control and, hence, giving up part of the Self, and replacing it with an interactive negotiation in the form of a collaboration the process was possible.

Considering *only* the musical notation of the score, the first impression may be that *Repetition...* belongs precisely to the very tradition of compositions that Wishart is criticizing, a tradition where "the score is seen as normative on the musical experience." The first version of the score bears evidence that, at the time, the idea of the work-in-movement had not fully incubated. However, it also points to the difficulty in communicating a radically open work. The way *Repetition...* has developed the written instructions (i.e. the notation) are subordinate, yet important, to the higher level structures of organization: The interaction between, in this case, myself and Stefan has become the work identifying aspect. But neither I, nor Stefan are important: If someone else picked up *Repetition...* the interaction and negotiation itself would be the aspect to focus on. This obviously calls for a different conception of the score, an augmented score that, apart from the notation also includes other kinds of instructions in other kinds of media.

Repetition Repeats all other Repetitions, Symphonie Diagonale
for 10-stringed guitar, computer and video projection
Composed & premiered in 2007
Prepared in collaboration with Stefan Östersjö
Listen | Score

Together, myself and Stefan have produced and performed two different versions of this piece and we attempt to prepare a third version to be premiered in 2008. This third version will take account on the ideas that were developed building on the experiences from the two first versions, primarily regarding the interaction between Stefan and the computer making use of the *timbreMap* real-time analysis tool.

1.3.6 libIntegra

IntegraBrowser
beta demo test version of the Integra Browser
Try it

Integra[60] is an EU Culture 2000 pan-European artistic and scientific project. One of the goals is to develop a composition and performance environment for sharing live music technologies. One part of that environment is the Integra library (*libIntegra*), the development of which I have participated in. The overarching goal of the scientific branch of Integra is to produce a set of software tools that allow many musicians to interactively work on several different kinds of collaborative projects in a way that have not been possible earlier.

libIntegra allow for a standardized way of representing and storing parameter spaces for multi-media modules. One of the things this allows for is seamless interchange of units of DSP processing (software or hardware based) within a given context. A performer that wants to improvise with an environment that requires

[59] Ibid.
[60] Integralive.org. *Integra-live website*. Web resource. 2007. URL: http://www.integralive.org (visited on 10/20/2007).

a Yamaha DX7 synthesizer may simply substitute the hardware with a software representation of the same synthesis model. As long as the environment, and the modules within it, comply with the Integra standard the exchange is transparent from the user point of view. The library is also able to interface with a centralized database and versioning server making possible interaction on any kind of content that the database and the library can represent and, in that sense it is a software representation of the very idea of the musical work as a result of distributed actions in continuous interaction: the software version of the *work-in-movement*. The various parts of the libIntegra software development project (the IXD file format, the database, the library and the bridges) allows for seamless and integrated documentation of many different kinds of musical works—scores, interpretations of scores, performances of scores, improvisations, improvisation environments, etc.. *libIntegra* also allows for interaction across computer platform boundaries and with it, *timbreMap* integrates with any other software for which *libIntegra* has support. Finally, one possible implementation of the notion of the augmented score (see Section 1.3.5) is possible within the framework of Integra class hierarchy and the corresponding XML file format (Integra eXtensible Data). And, just as *Repetition...*, *Drive* and *etherSound*, *libIntegra* is a collaboration, however of a somewhat larger scope[61].

It should perhaps be pointed out that the Integra project at large has aims that, to a certain degree, appears to contradict those that I am advertising here, in particular considering the way I am proposing to use the *libIntegra* with regard to the project *Repetition...*. For example, *work preservation* and *sustainability* are central aspects of the Integra project, as stated and explored in the two papers "libIntegra: A System for Software-Independent Multimedia Module Description and Storage" and "Sustainability of 'live electronic' music in the Integra project"[62]. Both of these concepts are rooted in the wish to archive and preserve works of art in one particular state with the ambition to be able to recreate them as authentically as possible. That is as close as possible to how they were once preserved. Those aims do indeed seem to counteract the concept of the work-in-movement which is primarily concerned with change and difference.

However, due to the generic nature of the representations in the different parts of *libIntegra* I found it possible to use the framework, unaltered, for my own purposes. A concept such as *preservation* is, in the case of a versioned database, also an opening towards non-preservation, development and sharing. In the Integra database no record can be easily altered, any alteration results in a new record which inherits all the relations and properties of the prior one. Additionally, the possibility to store a local version of any set or subset of database objects, each of which may represent a DSP module, a work instruction, a person, a building or any other kind of data type in the object oriented hierarchy of database classes (a UML diagram of the class tree may be found in Appendix E), allows for local additions and alterations independent of any changes occurring on the server database. A representation of a musical work in the Integra database is less centered on *notation* and more focused on *relations* and *differences*. It is a distributed though interconnected array of containers of information that, by its nature of representation does not discriminate between the kinds of music it represents—the advantage of notational forms over improvisatory should decrease. It also allows for interaction and collaboration and in the context of the idea of interaction-as-difference the versioning of the data is significant because it is only if the alteration, the difference induced, leaves the 'original'—which

[61] Though myself and Jamie Bullock are the main developers of the libIntegra software, the project Integra has members from 11 countries and 6 universities and there is a total of 10 research centers and five new music ensembles involved.

[62] See Appendix D

may itself be an altered copy—intact that the difference may be traced. I believe that libIntegra may provide for a framework in which the ontology of the musical work may be described, and, eventually, visualized in a meaningful way, in particular for the kind of works that do not lend themselves well to standard musical notation (such as improvisatory and collaborative works).

Finally, although *libIntegra* is a part of the larger Integra project, the code is licensed under the *GNU General Public License* by myself and Jamie Bullock. In other words is it possible for also the framework to take off and continue developing outside the range of the goals and ideologies of the Integra project.

1.4 Artistic practice and interaction—Summary

By taking a broad view on interaction in music (such as stating that programming is interactive and that all music listening activity is interactive) there is an obvious risk that everything becomes interaction, which, in fact, is that same as to say that nothing is interaction. Now, the opposite would clearly be equally destructive: To employ a rigid definition of interaction and shutting out that which does not fit the program. Is it possible to look at *qualities* of interaction or interactive *intensities* and thus avoiding the delusive classifications? Or, if looking at interaction from the inside, perhaps it is possible to find the prerequisites for each type of interaction, its particular needs. Below I will attempt to map the sub-projects unto different modes of organization based on different kinds of criteria with the primary purpose of showing the multiple interactive possibilities within any kind of musical practice with the computer.

Though neither an exhaustive list of possible interactive contexts, nor a complete description of the interaction in these projects, an intermediary categorization of types of interaction explored within the different sub-projects, based on *who* is interacting, may be outlined according to the following:

- **Musician-Computer Interaction**
  - Performer-computer interaction in score based works (*Drive*, *Repetition...*, *timbreMap*)
  - Performer-computer interaction in improvised works (*solo improvisations*, *timbreMap*)
  - Audience-computer interaction (*etherSound*)
- **Musician-Musician Interaction**
  - Composer-performer interaction (*Repetition...*, *libIntegra*)
  - Performer-performer interaction (*etherSound*, *Drive*)
  - Performer-audience interaction (*etherSound*, *libIntegra*)

As with any clearly delimited categorization, the categories themselves risk at producing more questions than answers (although that should not be seen only a problem). Each kind of interactive context has its own set of requirements. A performer playing a scored piece for instrument and computer, such as *Drive*, has different needs and expectations than does an improviser, and all performers do not have the same anticipations. Improvising *with* a computer as a saxophonist is in every respect different from improvising *on* the computer.

In his book *Interactive Music Systems*, composer, programmer, and researcher Robert Rowe makes a classification of interactive music systems that may prove useful to help interrelations between the interactivity at play with-ing these four sub-projects—containers of musical practice—in the context of the larger scope of the research project as a whole. I will apply these classifiers in an attempt to dismantle the concepts involved, as part of the research. For Rowe the "motivation for building such a set of classifications is not simply to attach labels to programs but to recognize similarities between them and to be able to identify the relations between new systems and their predecessors."[65] Although Rowe, at least here, is more concerned with the actual software in the system, categories such as those presented are useful also in artistic work, and much for the same reasons. Not primarily because computer programming may be a truly artistic process, but because a methodological tool such as this (it is a classification method) allows for connections between disparate projects to be identified in ways not possible without it.

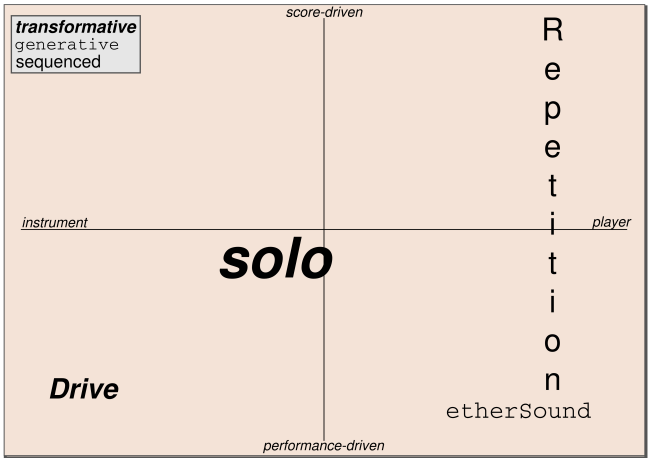

Figure 1.7: The approximate position of the artistic content in the three classification dimensions suggested by Rowe[64]. The font *type* is used in the graph to discriminate between the different response methods. The font *size* I have used to indicate the stability of the project in relation to the categories. For example, in my saxophone-computer improvisations (here depicted *solo*) I use a large number of interactive techniques and programs, hence the font size is large, whereas *ether-Sound* is fairly well categorized as a generative, performance-driven player—and is thus represented with a relatively small font size.

As for the classification system, it is "built on a combination of three dimensions, whose attributes help identify the musical motivations behind types of input interpretation, and methods of response".[66] That is, the way the system handles its input and how it generates its output and, according to Rowe, the classifiers will provide us with a terminology which can be used to "distinguish and draw relations between interactive programs".[67]

The categories in the three dimensions are:[68]

1. *Score-driven* systems versus *Performance-driven*, i.e. systems that range from "programs that use predetermined event collections" (a score), to those that "do not anticipate the realization of any particular score".

2. *Transformative*; that apply a transformation on some existing material, *Generative*; that generates material from "elementary of fragmentary" source material (a scale or a chord), or *Sequenced*; that "use

[65] Rowe, *Interactive Music Systems*, p. 6.
[66] Ibid., p. 6.
[67] Ibid., p. 7.
[68] These categories are clearly outlined in ibid., and all the citations below are from pp.7-8.

prerecorded music fragments", response methods.

3. *Instrument* versus *Player* paradigms; where the former is primarily "concerned with constructing an extended musical instrument", and the latter with constructing "an artificial player" that performs some material.

These categories, employed on the artistic work in this project, is visualized in Fig. 1.7, but it should be noted that, just as is generally pointed out by Rowe[69], these are not fixed positions but possible starting points. Also, as we shall see in the discussion on *etherSound*, it may be very difficult to distinguish exactly what constitutes a 'score' and if a piece may be said to have a score which is represented in the interactive system, can it still be categorized as a *performance-driven* system rather than as a *score-driven* system? At any rate, the presented categories allow us to get a topological overview of the included projects' relation to different types of interactive systems in music. Further, as was briefly mentioned above, using these categories is a method adopted for reflection and presentation, not construction—I didn't pre-conceive the respective projects' positions on this map. Though I did have an idea of what kind of artistic content should be included when I started this research project, none of these projects were created with the primary goal to *illustrate* a method of interaction.[70] For better or worse, the only difference between my work in this artistic field within the scholarly frame of my PhD studies, and the work done outside of it, is the added layer of reflection and the possibility to work things through more thoroughly. And, as is the nature of my artistic practice—and I believe many others'—despite how rigorously a project is planned in advance, in the course of action it is bound, and should be allowed, to develop in unforeseen ways.

The one piece that most clearly lends itself to these categories is the first version of *Repetition Repeats all other Repetitions*. The only possible interaction between the performer and the computer is mediated through a foot pedal—whether the pedal is down or up is the only information that the computer is 'listening' to. In the other direction, as a result of the pressed pedal, there is a very complex flow of different types (classes) of information that the performer is expected to respond to: Visual feedback from the computer screen on stage, physical (tactile) feedback from the pedal, auditive feedback in the sounds played back on the computer, all of which influences how the performer performs the piece. In other words, something incredibly concise and limited such as the binary distinction between pressed pedal or released pedal gives rise to a plenitude of messages of other kinds. This situation—the inconsistency between input and output—was what I, at the outset of this research project as a whole, as well as at the beginning of the composition process of this particular piece, thought of as a problem for which alternative solutions had to be invented: "In our joint project we will attempt to avoid the kind of binary oppositions that require a clean control signal path (such as the pressing of a pedal) in the design of the interactive system"[71]. The foot pedal in this context is nothing more than a (non-musical) instrument to *control* the computer part.

In the theoretical realm the problem is the attempt to combine two radically different classes of information flow: One binary (pedal up/pedal down) and one continuous (primarily sound). The nature of the

[69] Ibid., p. 6.
[70] In a way I was surprised to see how scattered these projects were on the category map. I would have anticipated a tighter focus.
[71] Frisk and Östersjö, "Negotiating the Musical Work II".

perceived response is opposite in quality to the nature of the stimulus. Yet, as music the piece works well,[72] and I am pleased with the way the electronic sounds integrate with the guitar part. Perhaps in this piece the human-human interaction taking place in preparation for the project and Stefan's involvement in the process of composition in a way *substitute* for the lack of real-time interaction? We are preparing a third version which will involve a more complex scheme of real-time interaction, not in order to prove the first version inferior (nor superior for that matter), but because it is in the nature of the piece to do several versions of it.

At the other end of the spectrum of my artistic work[73] lies my solo improvisations with computer—which on the map in Figure 1.7 is placed almost in the middle but employs a large number of different techniques—I primarily look to achieve two things: (*i*) Unity in sound (timbre) between the sounds produced acoustically and those produced electronically. This is not to say that I want the range of possible electronic sounds limited to saxophone sounds but that I reach for a musical logic to the way the electronic sounds develop in relation to the saxophone sounds.[74] (*ii*) A level of interaction that is not constrained to a control interface—close to how George Lewis described a performance of *Voyager* cited above (see Section 1.1). I too would rather have the computer surprise me than to always follow me:

> In improvised music, improvisers often assert both personal narrative and difference as critical aspects of their work. For me, what Jerry Garcia called the "anti-authoritarian" impulse in improvisation led me to pursue the project of de-instrumentalizing the computer. If the computer is not treated as a musical instrument, but as an independent improviser, difference is partly grounded in the form of program responses that are not necessarily predictable on the basis of outside input. As we have noted earlier, Voyager's response to input has several modes, from complete communion to utter indifference. This seeming lack of uniformity is not necessarily correlated with "lack of structure," as is so often expressed in the vernacular discourse of "randomness." Rather, while tendencies over a long period of time exhibit consistency, moment-to-moment choices can shift unpredictably.[75]

I think *Voyager*[76] is a great success as a framework for improvisation, as an interactive system, as an artistic expression that incorporates different modes of thinking about art and improvisation, and, for me, as a source of inspiration. The connection between that which is played by Lewis (and Roscoe Mitchell on the tracks that he appears on) and that which is performed by the computer is on some levels very clear yet without being obvious, and the way the musical gestures of the computer part are articulated have a distinct quality and resemblance to improvised music in a certain tradition. And this, despite the fact that the computer is given no information about *the sound* itself—the timbre. Only the pitch is fed to the computer.

There are obvious reasons for this choice of method of interaction in *Voyager*: (*i*) Pitch information may be quantified whereas timbral information can only be relative.[77] Therefore pitch lends itself much more

[72] Stefan has performed this version of the piece in Hanoi, Beijing, Malmö, Palo Alto, Seattle and Birmingham.

[73] *Repetition...* features a (very) detailed score, my solo work is entirely improvised; in *Repetition...* I don't perform any part, in my solo work I perform every part; etc.

[74] See the section on *timbreMap* for further discussion on unity and sonic interaction. See also the chapter on interaction.

[75] Lewis, "Too Many Notes: Computers, Complexity and Culture in "Voyager"", p. 36.

[76] Lewis, *Voyager*.

[77] The definition of timbre from OED reads: "The character or quality of a musical or vocal sound (distinct from its pitch and intensity) depending upon the particular voice or instrument producing it, and *distinguishing it from sounds proceeding* from other sources". The Oxford English Dictionary. 2nd ed. 1989. OED Online. Oxford University Press. 14 Nov. 2007. http://dictionary.oed.com/cgi/entry/50252865 (my italics). It may be noted that, according to OED, two different sounds emanating from the same

naturally to use as input in an algorithmic system of transformations.[78] (*ii*) At the time *Voyager* was created the technology for achieving and collecting information about timbre in real-time was very limited. (*iii*) Even if information about timbre was to be extracted from the signal in real-time, the available real-time synthesis techniques were somewhat limited (and costly) at the time. (*iv*) It may be a perfectly viable artistic choice to let the computer part have this quality of disruption, a quality of sound distinct from the acoustic sounds.

Musicologist Ingrid Monson, in her book on musical interaction in the jazz tradition, referring to the Charles Mingus-Eric Dolphy duet on the beautiful tune *What Love*[79] in which, according to Monson, it sounds "as though they were having a very intense verbal argument". Much later in the book, she returns to this recording and the nature of the Mingus/Dolphy 'argument':

> If I were to transcribe the notes and play them on the piano, they wouldn't sound very much like the conversation on the recording, for it is the relatively non-notable timbral and dynamic inflections produced by the players that are the principal means of signifying the iconicity.[80]

When I listen to *Voyager*, I hear the playing of Lewis and Mitchell in a similar way: That the particularity of that which is 'said' is encoded in the *sound* rather than the *pitch*. This is however not how I perceive the voices of the computer part whose timbres are remarkably dull and static in comparison. To me, there is a perceptual breach between the electronic sounds and the acoustic sounds.

My research project is in part the attempt to address this breach in my own work and this is what I referred to above as the ambition to reach for unity between acoustic and electronic sounds. In the improvisation entitled *Insanity* I do it by placing a restriction on myself as to what sounds I allow myself to produce (percussive sounds only), and in the accompanying program I use a technique for analysis/re-synthesis that I know works well for that class of timbres. In the improvisation *A Call for Response* I use an analysis/re-synthesis technique that works well for multiphonics and focus my improvisation on a series of multiphonics. In both of these examples the connection between the acoustic timbres and the electronic sounds are pre-conceived. They are encoded and static and should I wish for an improvisation to suddenly follow a different path, the pre-composed connection would fail. Though such failure does not necessarily imply that the music as such will fail, I nevertheless see it as a problem. The *timbreMap* program is a general attempt to address this issue and allow for more dynamic coupling between the performed acoustic timbres and the resulting electronic timbres.

Improvisations
for saxophone and computer
Performed in 2005
Listen

source—say a key click and a regularly played note on a saxophone—are not of different timbre. According to my understanding of timbre (and the English language) the last three words should be changed to "from the same or other sources".

[78] Compare to electro-acoustic music composer and improviser Trevor Wishart's reasoning in Wishart, *On Sonic Art*, chap. 2.

[79] Charles Mingus. *Charles Mingus Presents Charles Mingus*. Compact Disc. Candid BR-5012. 1960.

[80] Ingrid T. Monson. *Saying Something : Jazz Improvisation and Interaction*. Chicago studies in ethnomusicology. The University of Chicago Press, Chicago, 1996, p. 208.

Chapter 2

etherSound

etherSound
for improvising musicians, audience and mobile phones
Composed & premiered in 2003
Commissioned by Miya Yoshida
Live recordings | Studio recording

etherSound was commissioned by curator Miya Yoshida for her project *The Invisible Landscapes* and was realized for the first time in August 2003 at *Malmö Art Museum* in the city of Malmö, Sweden. The curatorial concept for *The Invisible Landscapes* project was the use of cellular phones in the context of experiencing and creating artistic expressions. The principle idea behind *etherSound* came to be an attempt at developing an instrument that can be played by anybody who has knowledge about how to send an SMS (Short Messages Service) from their cellular phones. The focus of my artistic research project, of which *etherSound* is a part, is interaction between computers and musicians as well as non-musicians. *etherSound* is an investigation of some of the aspects of interaction between the listener, the sounds created and, in the performance version of it, the musicians playing, and also of the formal and temporal distribution of the music that this interaction results in.

Interaction *in general* is an important, or even integral, aspect of any musical performance, as well as a part of any music listening activity, to music performed live or otherwise. It is an essential part of

While interaction is an important aspect of any musical performance—as well as a part of any music listening activity, to music performed live or otherwise—opening up a musical work for others than trained musicians is not a trivial task; careful attention has to be paid to the purpose of doing so and to the intentions of the work. It is relevant to pose the question whether it is possible to reach a satisfactory result with almost no limitations on participation. However, before these questions can be addressed we need delineate the purposes for wanting to allow for public participation.

Public participation has been explored in the visual arts for many years, for artistic as well as political reasons: "All in all, the creative act is not performed by the artist alone; the spectator brings the work in contact with the external world by deciphering and interpreting its inner qualification and thus adds his contribution to the creative act"[1]. The French curator and art critic Nicolas Bourriaud speaks of "*relational* art" (italics

[1] Marcel Duchamp. "The Creative Act". In: *Marcel Duchamp*. Ed. by Robert Lebel. Paper presented at *Session on the Creative Act*,

by the author) described as "an art taking as its theoretical horizon the realm of human interactions and its social context, rather than the assertion of an independent and private symbolic space"[2]. If we look at it from a performing arts perspective, the audience visiting a performance can be said to participate in it - if only in a limited sense. However, as Adorno points out, in the spheres of distribution and consumption of music, the musical work is objectified—reduced to a mere social commodity which severely limits the freedom of choice and influence of the listener[3]. In combination with the near monopoly of the multi national corporations of production and distribution of music, though the producers will always plea to the public taste ("the manipulator's reference to the manipulated is empirically undeniable" (*ibid.* p. 212, my trans.)), it is difficult to claim audience participation in a general sense. Furthermore, Western art music is to a considerable extent looked upon as a hierarchic process; a process that begins in the mind of the composer and ends at the level of the listener or, even before that, at the level of interpretation. It is fair to assume that bringing in an uncontrollable agglomeration of participants influencing the distribution of musical events will disturb this order.

In their article on the multi-participant environment *The Interactive Dance Club*, multi-media artists Ryan Ulyate and David Bianciardi define one of the design goals as wanting to "deliver the euphoria of the artistic experience to 'unskilled' participants"[4]. Rather than sharing merely the result with an audience, they attempt at unfolding the creative process leading to the result and invite the audience to take part in this process: "Instead of dancing to prerecorded music and images, members of the audience become participants. Within interactive zones located throughout the club, participants influence music, lighting, and projected imagery" (p. 40). The activities normally emerged in when going to a dance club is not only performed as a result of the music played, it is also used to influence the music. Similar ideas are put forward by Todd Machover concerning his large scale, interactive work *The Brain Opera*: "*The Brain Opera* is an attempt to bring expression and creativity of everyone, in public or at home, by combining an exceptionally large number of interactive modes into a single, coherent experience"[5]. These ambitions points to one of the big challenges when building interactive environments: how to design musical interfaces that have a 'low entry fee, with no ceiling on virtuosity'.[6] With the recent technological advances there are innumerable tools that can be used for collaborative efforts[7], affordable devices that may easily be used as interfaces to computer mediated art works (game controllers, mobile telephones, GPS navigators, web-cams, etc.). Not only has this the potential of changing our perception of the arts, it can also help us understand this new technology and the impact it has on our lives.

Houston, Texas, 1957. Also available at http://iaaa.nl/cursusAA&AI/duchamp.html. New York: Paragraphic Books, 1959. Pp. 77–8.

[2]Nicolas Bourriaud. *Relational Aesthetics*. les presses du rÃĺel, 2002, p. 13.

[3]Theodor W. Adorno. *Inledning till Musiksociologin (Original title: Musiksoziologie)*. (Apitzsch, H., Trans.). Original: *Musiksoziologie* (1962). Suhrkamp Verlag, Frankfurt am Main. Bo Cavefors BokfÃűrlag, 1962, p. 211.

[4]Ryan Ulyate and David Bianciardi. "The interactive Dance club: avoiding chaos in a multi-participant environment". In: *Computer Music Journal* 26.3 (2002). Pp. 40–49, p. 41.

[5]Machover, 1996, as quoted in Rowe, *Machine Musicianship*, p. 360.

[6]David L. Wessel and Matthew Wright. "Problems and Prospects for Intimate Musical Control of Computers". In: *Computer Music Journal* 26.3 (2002). The MIT Press, Cambridge, Mass. Pp. 11–22; Sergi Jordà. "FMOL: Towards User-Friendly, Sophisticated New Musical Instruments". In: *Computer Music Journal* 26.3 (2002). Pp. 23–39; See also Rowe, *Interactive Music Systems*; Jason Freeman et al. "Adaptive High-level Classification of Vocal Gestures Within a Networked Sound Instrument". In: *Proceedings of the International Computer Music Conference 2004*. ICMA. 2004.

[7]Alvaro Barbosa and Martin Kaltenbrunner. "Public sound objects: a shared musical space on the web". In: *Proceedings. Second International Conference on WEB delivering of Music (WEDELMUSIC'02*. IEEE. IEEE, 2002. Pp. 9–16.

A project for which public participation is important must somehow deal with the aspect of access, and according to Pierre[8] there is an intimate association between social class, level of education and cultural interests that affects cultural consumption:

> The experiences which the culturally most deprived may have of works of legitimate culture [...] is only one form of a more fundamental and more ordinary experience, that of the division between practical, partial, tacit *know-how* and theoretical, systematic, explicit *knowledge* [...], between science and techniques, theory and practice, 'conception' and 'execution', the 'intellectual' or the 'creator' (who gives his own name to an 'original', 'personal' work and so claims ownership) and the 'manual' worker (the mere servant of an intention greater than himself, an executant dispossessed of the idea of his own practice) (p. 387, italics by the author).

Bourdieu is telling us that because "ordinary workers" are "[l]acking the internalized cultural capital" they lack access to "legitimate culture". Instead they are referred to " 'mass market' cultural products—music whose simple repetitive structures invite a passive, absent participation" (p. 386). Perhaps *active* and *present* participation can counter-act the effects of lack of cultural capital? Bourdieu couples the ordinary class border divisions with the experience the working class may have of legitimate culture. However, I would like to suggest that the association between social and cultural class and consumer electronic devices like the mobile phone, and the behaviors associated with its use, are of a different nature than the association between class and cultural consumption. If the entree to the art-work is mediated through an interface (in this case the mobile phone) for which access is not governed by the same rules as is the conception of contemporary art this may help level the playing field. This is a motion that works externally, from the outside in, distorting the experience of division (due to lack of cultural capital) between the un-initiated spectator and the work. But, as we will see, there is another equally important factor at play that works from within the work. By distributing the role of the " 'creator' (who gives his own name to an 'original', 'personal' work and so claims ownership)" (*ibid.*) on to several agents—anyone interacting with the work is in fact part of the creation of it—the listener/performer and performer/composer dichotomies are blurred and thereby another opening is created that help provide access to the art-work.

Roy Ascott, in addressing the issue of 'content' in art involving computers and telecommunications writes:

> In telematic art, meaning is not something created by the artist, distributed through the network, and *received* by the observer. Meaning is the product of interaction between the observer and the system, the content of which is in a state of flux, of endless change and transformation. (p. 241, italics by the author)

As opposed to the classical notion of the educated 'creator' who claims 'authorship' (to use the language of Bourdieu), in collaborative, telematic art-works not only meaning is a consequence of interaction, the concept of 'the work' also becomes greatly affected. The ontology of the musical work or the 'work concept' in music is a complex field which is dealt with in more detail in the essays entitled *Negotiating the Musical Work*[9]. Ascott, however, mainly concerned with the visual arts in which the question of the work concept is of a different order, makes an interesting point when substituting *art object* with *interface*:

[8] Pierre Bourdieu. *Distinction: a social critique of the judgement of taste*. Translation by R. Nice. Harvard University Press, 1979.

[9] Frisk and Östersjö, "Negotiating the Musical Work II"; Henrik Frisk and Stefan Östersjö. "Negotiating the Musical Work. An empirical study on the inter-relation between composition, interpretation and performance". In: *Proceedings of EMS -06, Beijing. Terminology and Translation*. Electroacoustic Music Studies. EMS, 2006. URL: http://www.ems-network.org/spip.php?article245.

> The culturally dominant objet d'art as the sole focus (the uncommon carrier of uncommon content) is replaced by the interface. Instead of the artwork as a window onto a composed, resolved, and ordered reality, we have at the interface a doorway to undecidability, a dataspace of semantic and material potentiality. The focus of the aesthetic shifts from the observed object to participating subject, from the analysis of observed systems to the (second-order) cybernetics of observing systems: the canon of the immaterial and participatory. Thus, at the interface to telematic systems, content is created rather than received.[10]

Transposed to the field of music then, the *the work* is replaced by the *interface*. Applied to *etherSound*, the mobile phone as interface becomes the work and the number of participants along with their contributions becomes the ontology of whatever work we can speak of. The interface as the (only) way to navigate the space created by music.

Though less centered on public participation and more on improvisation Guy E. Garnett, composer and computer scientist, touches on some of the same issues in his article on interactive computer music aesthetics considering the potential for change in "unfixed works" such as "human improvisation with computer partner":

> Since the human performance is a variable one, by its nature, that variability can become the focus of aesthetic issues, even simple ontological issues. Because the performance changes from time to time and from performer to performer, the notion of 'the work' becomes more and more clouded. The work, even from an objective rather than an immanent point of view, becomes something open-ended. Each performance becomes an 'interpretation' of the possibilities inherent in whatever was 'composed.' However, each of these concepts is highly problematic. This 'interpretation' can have significant consequences for the meaning - and therefore value - of a work in a cultural context. Since the work is not fixed, it is open to new interpretations, and therefore the possibility at least exists for the growth of the work over time or across cultural boundaries. The work can thus maintain a longer life and have a broader impact culturally, because it is able to change to meet changing aesthetic values. (p. 27)

As is hinted at by Garnett himself, the idea of interpretation becomes troublesome in the context of improvised music and I will discuss the issue of the work identity in more detail in Section 2.2.2. As far as *etherSound* is concerned, it cannot be performed *without* public participation. As music it holds no significant value unless there is a group of people interacting with it—its value is embedded in the interaction and in this way it differs from a written score or a pre-structured improvisation.[11] Further, the understanding of it is not necessarily related to the contextualization of the sounds produced within the history of (interactive) electronic music but may instead be regarded as one factor in the relation between the expectations of the subject interacting and the music produced. Following these lines of thought, it may be concluded that the need for a thorough ontological understanding of the history of art or electronic music is not a prerequisite for understanding a collaborative, interactive work of music—anyone willing to interact and interested in making a contribution is equally well prepared to produce and interpret the 'meaning' of *etherSound* . This limits the advantage

[10] Roy Ascott. "Is There Love in the Telematic Embrace?" In: *Art Journal - Computers and Art: Issues of Content* 49.3 (1990). Pp. 241–247, p. 242.

[11] A written score of music may be said to have musical value in itself—although I personally argue against it, it may even be said to constitute the work. My argument here, shared by Ascott and Garnett, is that an interactive attitude towards music making changes the conditions for how the identity of the work may be established.

of the educated listener—"the dominating class"[12]—and makes room for new interpretations of the term 'understanding' in the arts. [13].

2.1 The Design

etherSound is an attempt to open a musical work to the un-initiated listener including him or her in the creation of the music, and provide for a notion of 'equality of participation': all contributions are equally valuable. Accessibility without prior knowledge of music or musical training is an end in itself in this project. It should be noted that this obviously presupposes that the participant knows how to send a SMS and that the system makes it difficult for those who are not familiar with this technology.[14] It should also be made clear that, using SMS text messages for interaction as it is implemented here, does not allow for direct dynamic control. Every message generates one 'message-composition' and all control data is derived from the content of the message.

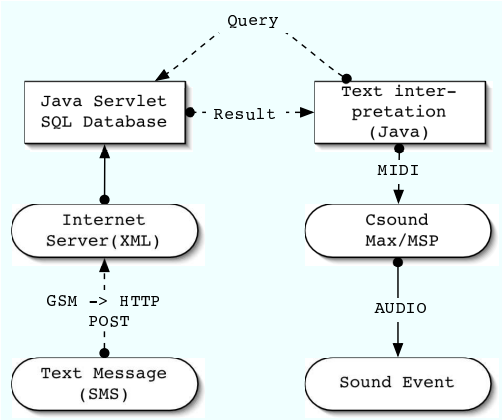

Figure 2.1: Communication in the first version.

2.1.1 Communication - first model

In the first version, realized in August 2003,[15] the communication between the participant and the system was accomplished according to Figure 2.1. An SMS sent to a specified number was transformed to a XML file (eXtensible Markup Language, see http://en.wikipedia.org/wiki/XML) and transferred to a URL by a HTTP POST request. This part was handled through an external service. At the called URL, a JSP (Java Server Pages) was directing the POST data to a Java Bean[16] that handled the parsing of the data and the connection to a MySQL database in which it created a new entry with the relevant fields.

[12] Bourdieu, *Distinction: a social critique of the judgement of taste*.

[13] This issue is also discussed in Henrik Frisk and Miya Yoshida. "New Communications Technology in the Context of Interactive Sound Art: an empirical analysis". In: *Organised sound* 10.2 (2005). Pp. 121–127

[14] Yet, and in particular so, at the time this project was initiated, there is a great commercial interest in increasing the use of SMS and, in Sweden, there has been a tremendous effort from the part of the GSM service providers to teach their customers how to use it.

[15] See the audio and video recording *etherSound/etherSound 2003*.

[16] *Java Enterprise Edition, API Specification 1.4.1*. version 1.4.1. Sun. 2004. URL: http://java.sun.com.

It was due to security reasons at the museum where this version was realized that the HTTP request could not be handled locally. Instead, the local computer queried the server database for new entries on regular intervals. After some testing, sending a SQL query once every second seemed like a reasonable time interval. Shorter time intervals didn't accomplish a perceivably quicker response time and, since the synthesis program was running on the same machine, I didn't want to use more processing and network activity than necessary for this task. After the text message had been processed, control signals where sent by MIDI to the synthesis engine.

As is obvious from the recordings of the two versions, the sounds produced by the computer in this first version is very different from those in the second recording.

Figure 2.2: Main GUI window for the *etherSound* program.

2.1.2 Communication - current model

Although the first version worked well and was fairly stable, it was a solution that required an external SMS processing service, and a local, reliable network connection. In order to make the piece more 'portable' and independent, the message receiving part was rebuilt. Using the gnokii API[17] it is relatively easy and reliable to connect a GSM phone to a computer and gain access to the storage and status of the phone which enables reception of the SMS messages locally. To still have the possibility to review the activities of transmission, the messages are, just as in the first model, written to a database. In other words, the client-server model is retained but on one and the same machine. Furthermore, the MIDI connection between the control application and the synthesis engine was replaced with Open Sound Control (OSC)[18] for speed, reliability

[17] gnokii.org. *Gnokii library*. 1995. URL: http://www.gnokii.org/index.shtml (visited on 01/10/2005).

[18] Matthew Wright, Adrian Freed, and Ali Momeni. "OpenSound Control: State of the Art 2003". In: *Proceedings of the 2003 Conference on New Interfaces for Musical Expression*. NIME-03. Montreal, Canada 2003. Pp. 153–159; et al Wright Matt. *Open Sound Control*. 1997. URL: http://www.cnmat.berkeley.edu/OpenSoundControl (visited on 01/10/2005).

and flexibility, using the library JavaOSC (see http://www.mat.ucsb.edu/~c.ramakr/illposed/javaosc.html).

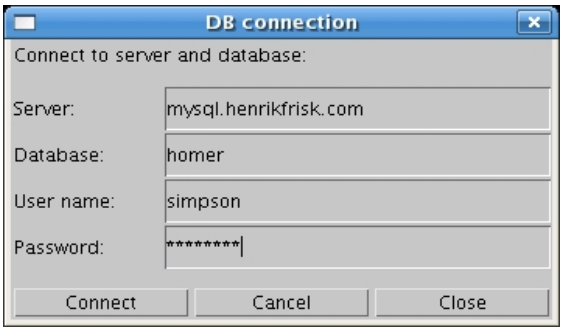

Figure 2.3: Panel for connecting to the database.

2.1.3 The text analysis

The program handling the text processing and the mapping of text to control signals for the sound synthesis is written in Java[19] and features a simple but useful Graphical User Interface (GUI) for control and feedback about the status of the system (see Figure 2.2 and Figure 2.3).

- The length of the whole event
- The rhythm and articulation of the individual sound events
- The pitch and character of individual sound events

Controlling the timing of events there are two parameters; a local 'life' index shaping the rhythms and the length of the current message and a global index that influences the current and subsequent 'message-compositions'. The global index is a function of the current and previous messages local indexes. The local index is a result of a simple semantic analysis of the message. It indicates the message's relative structural complexity and allows the algorithm to discriminate between messages with a set of random letters and messages with real words and real sentences. The participant should be rewarded for the effort of writing a message with substance, where 'substance' is defined here as a message with a credible average word length and a reasonable distribution of vowels within these words. In the analysis substitutions are made to allow for (i.e. not punish) idiomatic SMS writing such as 'R u here?' or 'C u 2 nite'. These examples are expanded into their 'correct' equivalent. Standard abbreviations are also expanded.

The local index is calculated by looking at the average length of words and the average number of syllables per word and comparing these with constants:

$$i_1 = \frac{1}{(w(\frac{c}{w_c}) - w_l)^{1/2} + 1} \qquad i_2 = \frac{1}{(w(\frac{s}{w_c}) - s_l)^{1/2} + 1} \tag{2.1.1}$$

[19] *Java Standard Edition, API Specification*. version 1.4.2. Sun. 2004. URL: http://java.sun.com.

Message	Life index
hello	0.18882
Hello, my name is Henrik	*0.81032*
hjdks la s duyfke jhsldf hasdfiw uehr jkdsl	0.14448
From fairest creatures we desire increase, *That thereby beautys rose might never*	*1.44618*

Table 2.1: Life index for four different messages

where c and s are the total number of characters and syllables, w_c is the number of words in the current message, w_l and s_l are constants defining the 'optimal' mean number of words/syllables. w is a weight defined by

$$w = \frac{1}{w_c - s_c + 0.5} \tag{2.1.2}$$

where s_c is the total number of words that contains vowels. Through w, the index is decreased if the message contains words without vowels. The mean value of i_1 and i_2 is then multiplied by the arcus tangens of the number of words in relation to a third constant parameter, o_w, delimiting the optimal number of words per message[20] according to (2.1.3).

$$lifeIndex = \frac{i_1 + i_2}{2} \arctan(\frac{w_c}{o_w}) \tag{2.1.3}$$

If we set w_l to 4.5, s_l to 2.0 and o_w to 10 the result on four different messages can be seen from Table 2.1; the method distinguishes fairly well between nonsense and real words at a low computational cost. Similar or better results could conceivably be achieved in a number of different ways but this method appears to work well for the purpose.

The total length of the music derived from the message is calculated by multiplying a constant preset time with the local index. Any new message received adds its local index to the instantaneous global index which decreases exponentially at a set rate.[21] If a message causes the global index to reach maximum, it stops the playback of the current message and begins playing back a pre-composed pattern, sonically different from the output of a typical message, for about 30 seconds before resuming ordinary mode and starts playing back the message that caused the break. This feature is added to reward collaborative efforts. The global index controls mainly the density and the overall volume of the output, but also the distribution of random and stochastic processes in the synthesis.

2.1.4 The synthesis

The synthesis engine is written as a Csound orchestra[22] included in Appendix G.[23] In the first versions of *etherSound* Csound was running inside a Max/MSP (http://www.cycling74.com/products/maxmsp.html)

[20] Since a SMS is limited to 160 characters these constants are set according to what kind of message content should be rewarded.
[21] The rate is context dependent. In a performance with improvisation it would be shorter than in an installation.
[22] Richard Boulanger, ed. *The Csound Book, Perspectives in Software Synthesis, Sound Design, Signal Processing and Programming*. 2nd ed. The MIT Press, Cambridge, Mass., 2000.
[23] For more information on Csound see also http://www.csounds.com/

patch through the use of the `csound~` object (see http://www.csounds.com/matt/). The Csound score for the message to be played back was sent to Max/MSP using (OSC. Max/MSP was responsible for timing the note events and preparing valid information for the `csound~` object and the orchestra file associated with it. Due to processing power limitations only one message could be played back simultaneously; if a message was received before the previously received message had finished playing back, the new message would interrupt the current message (this can clearly be heard in the recording of the performance from 2003). In the latest version of the *etherSound* software, instead of sending the Csound score events over OSC, they were sequenced and written to the standard output and sent to Csound through a UNIX pipe. Also, rather than limiting the number of voices by letting new messages crudely cut off currently playing messages the number of simultaneous voices available is now set in the *etherSound* GUI (see Figure 2.2) and may be changed dynamically. The following discussion relates to the current version of *etherSound*.

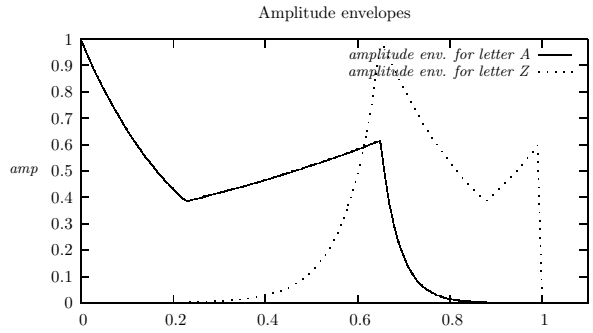

Figure 2.4: Amplitude envelopes for Instrument A. Linear interpolation between these two envelopes is performed for every character between A and Z.

All sounds heard in *etherSound* are generated with FOF (Fonction d'Onde Formantique) synthesis as this technique is implemented in Csound[24], using both samples and simple sine waves as sound sources. There are two distinct timbres played by two different instruments in each message-composition: (A) granulated samples of a male reading a text in English[25] and (B) a bell like sound whose formants are matched to and interpolated between the series of vowels in the text.

Instrument A

Every word of the message is considered one phrase or *bar* of music in the resulting message composition. The number of beats per bar is approximately equal to the number of syllables in the word, where a syllable is defined as a vowel or group of consecutive vowels or a punctuation mark. The rhythmic subdivision of each bar is equal to the number of characters, including punctuation and white space, in each syllable. Thus, a one syllable word such as 'my' followed by a white space results in a phrase consisting of one bar of one beat and

[24] Michael Clarke. "FOF and FOG synthesis in Csound". In: ed. by Richard Boulanger. 2nd ed. The MIT Press, Cambridge, Mass., 2000. Chap. 14, pp. 293–306; Per Byrne Villez. "Processing Samples with Csound's FOF Opcode". In: ed. by Richard Boulanger. 2nd ed. The MIT Press, Cambridge, Mass., 2000. Chap. 15, pp. 307–320.

[25] An excerpt of the recording of one of John Cage's lectures at Harvard College 1989.

two notes and one pause, i.e. three (eight-note) triplets of which the last is silent (see Table 2.2). If a word ends with a full stop, a comma, an exclamation mark or a question mark, more emphasis is put on the end of the bar containing the punctuation mark and the last note of the resulting phrase will be elongated. A note close to a vowel will more likely be accented than a note away from a vowel.

The amplitude envelope curve of each note is related to the letter the note corresponds to. Envelopes are mapped linearly to characters; the letter 'A' has a short attack and a long decay and the letter 'Z' has a long attack and a short decay (see Figure 2.4). The amount of overlapping between notes, i.e. the lengths of the notes, is influenced by the current life index *and* the global index where higher values will result in longer notes and thus in smoother transitions between timbres. The notes of Instrument A do note have a perceivable pitch. Twenty-eight short sample buffers (typically 32.768 samples or approximately 0.7 seconds), one for each letter, are dynamically mapped one to one to the characters in each message. The FOF synthesis is used to granulate these samples, creating an erratic, non-tonal texture however still, in most cases, reminiscent of speech.

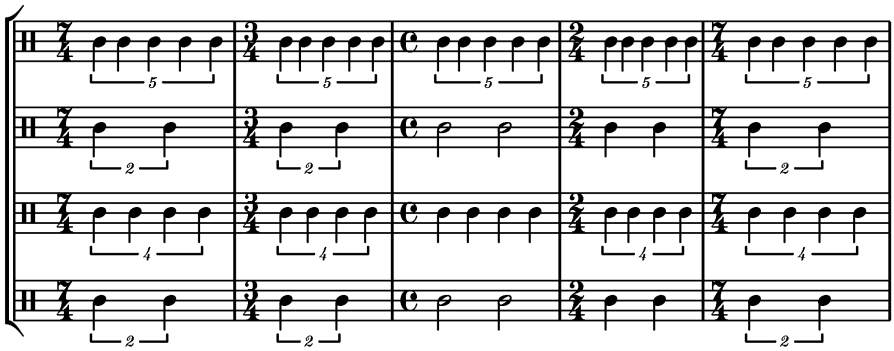

Figure 2.5: Rhythmic distribution of notes in Instrument B as a result of the message "*Hello, my name is Henrik.*".

Instrument B

The phrasing of the notes of the second instrument is somewhat more complex than that of Instrument A. This instrument has, at the most,[26] as many voices as there are words in the message. An example of the rhythmic mapping of notes is shown in Figure 2.5, the origin of which is the message in Table 2.2, with the polyphony limited to four voices. For this instrument the number of beats per bar (i.e. per word) is equal to the number of letters per word, including trailing punctuation marks and white space. If there are less words than the maximum polyphony, the number of voices is equal to the number of words; the first voice correspond to the first word, the second voice to the second word and so forth. For every bar, each voice has as many potential excitations as there are letters in the corresponding word. After the initial excitation, which will always be played, the likelihood that a given note will be played is related to the life index *and* the global index: If the normalized sum of the local index and the global index is 0.5, half of the excitations will be performed. The amplitude envelope curve for the notes played by this instrument is either of a bell

[26] As already stated, the maximum number of voices is set based on what the processing power of the system is.

like character or of its inversion, and notes close to the beginning of a bar has a greater likelihood of being emphasized.

Figure 2.6: Harmony for Instrument B as a result of the message "*Hello, my name is Henrik.*".

The initial pitches are derived from the occurrence of certain key letters in the originating text.[27] The first unique occurrence of one of the key letters, searched for from the first letter of the word corresponding to the current voice until the end of the message, becomes the initial pitch for each voice. If none is found the voice is deleted. The voicing of the initial chord is constructed so that the first voice will be the top note of the chord and consecutive voices will be laid out below this using octave transposition, aiming for the closest possible voicing. The exact micro-tonal center pitch between the highest and lowest note of the initial chord is then calculated (this would be the pitch 'D' if the initial chord is a major third up from 'C'). After the initial chord has been introduced, all voices begin a virtual glissando toward the center between the outer limits of the chord, creating micro-tonal variations, ending at a unison.[28] For each excitation of each voice, the instantaneous value of the corresponding glissando sets the pitch for that excitation. The message from Table 2.2 would result in the chord showed in Figure 2.6—the initial chord and the glissandi towards the center pitch—if the max polyphony value is set to five or higher and the 'key' characters were mapped by German note names (a to A, b to Bb, c to C, ... ,h to B and s to Eb). The timbre of the voices played by this instrument is shaped by the vowels contained in the message and the order in which they appear. For non real time processing this is achieved by synthesizing the first five formants of the first vowel found in the word corresponding to the current voice and then interpolating between the formant spectrum of the remaining vowels of the message (see Table 2.3). As this method is very expensive—it requires allocation of five times more voices—a cheaper alternative was used in the first real time versions of *etherSound*. By modulating the formant center frequency of one single FOF voice using frequency modulation with the carrier and index signal frequencies derived from the vowel interpolation described above, the effect of molding the spectrum in a way related to the content of the message is retained. In the latest version the two methods are combined in order to achieve a greater sonic variation—all five formants are synthesized for every note and the formant center frequencies of some of the notes are also modulated.

2.1.5 Sound event generation and synthesis—conclusion

The two instruments offer two different interpretations of the message played back in parallel. As Instrument A performs a linear displacement within the message, Instrument B gives a snapshot image of the entire text at once, an image which is gradually dissolving over time. Metaphorically speaking, one instrument is modeling the discrete words and characters as they appear in time, the objective flow of the components of

[27] For the sake of experiment and variation, I am changing these 'key notes' for every performance of *etherSound*.

[28] The same technique is used in the composition *Drive* (2003). The score for *Drive* shows the notation of the instantaneous (approximate) harmony at five consecutive points in time ending at a B quarter of a tone sharp.

the message, and the other deals with the continuous meaning, or subjective understanding, of the message as it is interpreted in its entirety. Although the result can be rather complex and abstract it is my intention that certain conceptual elements of the input should be retained in the output. In the following section I will reflect on the issue of interaction within the context of *etherSound* and to what extent my intentions of input-output correlation can be said to have been fulfilled.

	H	E	L	L	O	,		M	Y		N	A	M	E		I	S		H	E	N	R	I	K	.
bar	1							2			3					4			5							
beats per bar	3							1			2					1			3							
subdivision	2			3			2	3			2		3			3			2		3			2		
accents		>			>				>			>		>		>				>			>	>		

Table 2.2: Rhythmic distribution of notes in Instrument A.Influence of vowels on four consecutive voices of Instrument B.

	H	E	L	L	O	,		M	Y		N	A	M	E		I	S		H	E	N	R	I	K	.
voice 1	E			O			Y			A			E			I			E			I				
voice 2	Y				A				E				I				E					I				
voice 3	A					E					I					E					I					
voice 4	I							E								I										

Table 2.3: Influence of vowels on four consecutive voices of Instrument B.

2.2 Discussion and reflection

As has already been explained, the main issue for *etherSound* is to allow for unconditioned participation. More concerned with the collection of diverse input than I was in giving the contributor a sense of control or participation, in the first versions of *etherSound* the message-compositions where much less dependent on input than what they are in the current version. My grounds for changing this and, in the current version letting the messages generate a musical event with a clear form stems from the wish to retain a perceptible connection - even though this connection may only be dismantled by the *change* in output - between input and output. The process of designing the analysis and synthesis programs described above is to a considerable extent tantamount with the process of composing in the traditional meaning. In a sense, *etherSound* is an algorithmic or ruled based composition[29] with stochastic elements, methods which have been explored by many composers for many years. In his book *Formalized Music* composer Iannis Xenakis offers a thorough investigation of the concept of stochastic music which came about as a reaction to the post serialistic music:

> For if, thanks to complexity, the strict, deterministic causality which the neo-serialists postulated was lost, then it was necessary to replace it by a more general causality, by a probabilistic logic which would contain strict serial causality as a particular case.[30]

But where in the case of Xenakis the results of the stochastic processes were strictly encoded into a score or a computer program, in *etherSound* there is no score as such. The mapping between characters in the input, and synthesis and sequencing parameters used to produced the output is fixed in the program but no sound will be produced unless someone takes the action to provide the system with input. John Cage's non-deterministic music based on chance operations is another example in which events in some regard external to the composer is allowed a great influence on the final result. Cage's aesthetics were a means to remove *intention* from the artistic expression. On the face of it there may be a conceptual resemblance between *etherSound* and the non-determinism of Cage. However, in *etherSound* it is precisely *intention* that produces sound: The wish to participate is all that is needed.

The choices that had to be made in the mapping of input to output in the program are the same kind of choices I make when I compose or improvise. I would call these compositional choices. They are made based on my musical experience and on what it is I want to achieve—for whatever reasons—at any one particular moment. The process of making these choices in the context of developing and designing interactive systems is well described by Camurri et al.: "The designer of the performance introduces sound and music knowledge into the system, along with the compositional goals [..]"[31] This fact, that compositional choices were made in the course of constructing *etherSound*, does not necessarily make it into a 'composition'. But before pondering more on the identity of *etherSound*, what is the nature of its driving force, the interaction between the program, the performers and the participants? In what sense is *etherSound* interactive? If the mapping is fixed in the program, what is the influence of the participant?

[29] French composer Michel Philippot and Italian composer Pietro Grossi were both pioneers of algorithmic composition.

[30] Iannis Xenakis. *Formalized Music : Thought and Mathematics in Music*. Harmonologia series 6. Revised edition. Indiana University Press, Bloomington, 1971, p. 8.

[31] Camurri, Richetti, and Trocca, 1999, as cited in Rowe, *Machine Musicianship*, p. 373.

2.2.1 Interaction in *etherSound*

etherSound has been used in two different contexts. As a stand alone sound installation that users can interact with but also in combination with one or several improvising musicians playing acoustical instruments. The discussion that follows will primarily deal with the latter situation, which resembles a traditional concert but one in which the audience, apart from listening also may 'play' the electronic instrument. As can be gathered from the description of the system given above, the sonic outcome of a received SMS is fairly strictly pre-conceived. On the individual level, only a limited amount of influence over detail is offered, and it is debatable whether *etherSound* can be called an 'instrument' at all. This was however never the intention. It is the *desire* to contribute to the whole that was intended to be the ruling factor, not the individuality of expression or the virtuosity of performance. But in that case, why not simply have a button that the users can press at will which generates a pseudo-random sequence of sonic events? Surely, this too would allow for unconditioned participation.

In the very first performance of *etherSound*, on the day of the opening of the exhibition *The Invisible Landscapes* in August 2003, due to a technical problem,[32] as an emergency solution, I had implemented a version which basically worked like a button. I was unable to parse the actual contents of the SMS messages sent to the system (I merely obtained a notification that a message had been received). Rather than cancel the performance I had the program read an arbitrary number of words from a text file on my hard drive and use that as a 'fake' message. Still, in the information about the installation and in the program notes for the concert, all of which had been prepared well in advance, it was stated that the system responded to the contents of the message when composing its output. After the concert a few of the listeners/participants came up to me and told me how clear they thought the connection between the SMS contents and the sounds were. The expectancy of a correlation between input and output was so strong that, despite the fact that the actual mapping was completely random, the connection was created in the perception of the participant. This is not to say that 'faking' interaction is practicable solution, but merely that expectation, hence information about (modes of) interaction, is an important factor.

etherSound is not interactive in the way that for example a computer game is interactive. Once the SMS has been sent, there is no way for the participant to alter or influence the sound. There is correlation between input and output in so far as short messages produce short message-compositions and vice versa. After having send a few messages, or after listening to a series of message-compositions, the participant will know what to expect and the ease-of-use is perhaps the greatest advantage of *etherSound*. Interaction in the context of computers and technology is more or less synonymous with *control*, or with the ability to change the prerequisites during the course of action. Or as put by George Lewis: "interactivity has gradually become a metonym for information retrieval rather than dialogue".[33] Computer programs that are not interactive perform a task based on the information given to it at the outset. In interactive computer programs the parameters can be changed dynamically. By this definition and if we restrict the time frame to one message-composition, *etherSound* is not really interactive or only interactive in a very limited sense. It does not allow

[32] The problem was due to an unknown inconsistency in how JSP (Java Server Pages), which I used on the server to parse the messages, handled HTTP/POST requests when the version of the HTTP differed between the caller and the receiver.

[33] Lewis, "Too Many Notes: Computers, Complexity and Culture in "Voyager"", p. 36.

the user to dynamically control the musical contour of the message-composition. It is more of a stochastic jukebox whose 'play' button works by means of sending an SMS.

But, if we expand our understanding of interaction and include readings that are more closely related to social interaction, which is not about control, but about exchange, about giving and taking, and about growing and establishing identity,[34] and we expand the time frame to include a series of message-compositions, we can come up with another analysis. If our general requirement for the definition of interaction is not limited to the subject's unbounded control over content ("information retrieval"), and the for this context specific requisite on interaction is not restrained to the participant-computer interaction, but also includes participant-participant and participant-performer interaction: Then *etherSound* may well be said to manifest a form for dynamic interaction and the users that interact with it do indeed have influence. In a recent performance (Copenhagen, August 2007) a participant sent a message that ended the concert. Whether that was intended or not is less important than the actual consequence. The participant introduces a change in the musical context and, though he or she does not control the outcome of this change, the participant still in effect has the power of influence (influence rather than control) through interaction.

What then are the consequences regarding interaction that may be drawn from working with *etherSound* in the context of performance? If we begin by thinking about this piece as an improvised live performance: On an individual level the system *etherSound* adds the ability for any member of the audience (who by virtue of being a part of the audience is already interacting with the performance) to interactively introduce a change to the sonic environment at any point, albeit with a very limited control over the outcome. Now, from my elevated perspective as a musician with a 15 years of professional experience I am in no position to tell what this situation means to someone who has never before participated in an improvised musical event. It may be incredibly dull or it may be the most exciting sensation. For me, as an improviser, the interaction as it is taking place here supplied that which the computer does not (and never will be able to?) posses—the intention. The message-compositions are not dispersed randomly (as in a pseudo-random computer algorithm) but because someone wanted to participate. When playing and I heard the sounds of a message-composition I felt honored that someone took the time to participate, like I was given a gift [35]. Though these ideas, that the participation would supply me with a non-predictable, however not random, series of impulses, were part of the original conception of *etherSound*, I had not anticipated the impact this situation would have on me. It is not easy to make general assumptions regarding interaction from this reflection. But, perhaps bordering on speculative, to me this shows the importance of moving beyond interaction as a deterministic mapping of stimulus to response. To let both parties involved in the interaction to create the object of interaction in order to intend it.

There is a number of different kinds of interaction going on in a performance of *etherSound*, on many different levels. There is the low level interaction between the participant and the computer mediated through the mobile phone as well as higher levels of interaction between groups of participants and groups of performers. To summarize, in order to appreciate the nature of the interactive potential for *etherSound* (i) time needs

[34] The role of social interaction in human existence has a long philosophical history, in recent years kept alive by Hannah Arendt and Jürgen Habermas. This is discussed in more detail in the *Music and Interaction* section of this dissertation.

[35] the 'gift' aspect is further discussed in Frisk and Yoshida, "New Communications Technology in the Context of Interactive Sound Art: an empirical analysis" and Yoshida, "The Invisible Landscapes"

to be considered, (ii) expectation is an important factor and, (iii) information *about* the processes taking place as a result of interaction ('meta-information' or the 'grammar' of interaction) is absolutely essential.

2.2.2 The work identity of *etherSound*

The question of the work identity is not merely a theoretical issue in this context of pure scholarly import. If the intention of *etherSound* was to create an open-ended platform for public participation with a focus on interaction and, in the end, the result has more in common with a composition for instruments and computer, not only did the intention fail (which may be perfectly alright), but my personal objective, to use interaction as a way to open up the creative process and give up compositional control, failed. The latter may also be fine, but if in the long run there is a continuous discrepancy between artistic intentions and practical results this is likely to create personal and artistic frustration.

Looking at the different agents involved in the production of musical content in *etherSound*, the most obvious perspective to adopt (given that we talk about message-compositions) is that the participants are the composers and the computer along with the improvising musicians are the performers. This would make the SMS's the score(s). Musicologist Peter Kivy gives a definition of the musical score as "a complex symbol system. From the performer's point of view it is a complex set of instructions for producing a performance of the musical work that it notates".[36] Applying this definition to *etherSound*, we may extract (at least) two other plausible explanations to its structure:

1. If the participants (SMS senders and improvising musicians) are the performers, the instructions, the meta-information or the 'grammar' of the interaction constitute *a* score.

2. If the computer is the performer (which would turn the participants into a kind of conductors) the computer program, i.e. the code, in which the mapping between input and output is defined, would constitute another *version* of *a* score.

According to the definition given, even if we regard the work from two or three different perspectives, there is a score. If there in fact is a score of some sort in which the mapping is fixed and not subject to change through interaction, and further if the process of building this mapping scheme is similar or even equal to compositional processes, in what sense does *etherSound* differ from a composition? First of all, and perhaps needless to say, Kivy's definition is by no means conclusive. Second, there is an important difference between a more traditional composition and a work such as *etherSound* in the dimension of time, as the latter does not have a fixed beginning nor an end. Last, and most important, between the two contrasting musical work concepts 'closed' or 'pre-conceived', and 'open' or 'free' there is a range of possibilities. And, as with so much other music and art, depending on *when* and *how* you look at the piece it will define itself at different points on the open-closed axis. It exists in this field ranging from the relative closeness form of the message-compositions and the openness of the large scale form of the improvisation.

More than anything else *etherSound* is an improvisation. The structure or the 'language' for the improvisation may be different depending on your role, and the 'score' (if it exists) is "a recipe for possible

[36] Peter Kivy. *Introduction to a philosophy of music*. Oxford University Press Inc., New York, 2002, p. 204.

music-making"[37]. The compositional choices discussed above are a part, a for this piece necessary part, of the structure that makes possible the different entry points. Systematic and pre-conceived construction in one phase of a musical project does not have to limit the performative freedom or result in a closed 'work'. On the contrary (and perhaps in opposition to the romanticized view on improvisation): Preparation for an improvised performance, even in free form jazz improvisation, is quite often highly structured and systematic. Improviser and jazz saxophonist Steve Lacy gives the following recollection of the early years of Cecil Taylor's career:[38] "And the results were as free as anything you could hear. But it was not done in a free way. It was built up very, very systematically [...]"[39] Further, construction and pre-conception on the detailed level does not exclude that the whole is still open and self-generated: "[E]ach of the numerous released recordings of, say, Coltrane's 'Giant Steps,' regarded at the level of individual passages, is the result of careful preparation [...]. At the same time, each improvisation, taken as a whole, maintains its character as unique and spontaneous"[40]. In both the recordings of *etherSound* (2003 and 2007) the common 'language' of the performing musicians is their background as jazz improvisers. The language for the participants is the text and logic of SMS messages. And the intention to participate is what binds the two together.

To conclude this discussion I would like to again turn to George Lewis who, I believe, captures the essence of how form and structure is developed in improvised music:

> My own view is that in analyzing improvisative musical activity or behaviour in structural terms, questions relating to how, when, and why are critical. On the other hand, the question of whether structure exists in an improvisation—or for that matter, in any human activity—often begs the question in a manner that risks becoming not so much exegetic as pejorative. It should be axiomatic that, both in our musical and in our human, everyday-life improvisations, we interact with our environment, navigating through time, place, and situation, both creating and discovering form. On the face of it, this interactive, form-giving process appears to take root and flower freely, in many kinds of music, both with and without preexisting rules and regulations.[41]

From my personal horizon thinking about the work identity of *etherSound*, I have gone full circle. At the outset I thought of it as nothing but a framework for improvisation in which I could allow myself to experiment with using the computer in a way distinctly different from how I was used to. Then, for many reasons of which one was the fact that it is precisely not *axiomatic* that form may be created as well as constructed, I went into a phase of denial, in which I sought for a structure that would allow me to call *etherSound* a 'work'. Only to, in the end, arrive at the conclusion that, what it is, first and foremost, is an improvisation.

2.3 Summary

Whether or not the participants felt they had influence and whether this influence set creative energies in motion within the participant can only be proved, if at all, by performing empirical and statistical studies that are beyond my intentions and competence. What I can do however is reflect on my experiences of

[37] Evan Parker, as cited in Bailey, *Improvisation: its nature and practice in music.*, p. 81.
[38] It should be pointed out that I make no comparison between *etherSound* as music and the music of Cecil Taylor.
[39] Cited in Bailey, *Improvisation: its nature and practice in music.*, p. 81.
[40] Lewis, "Improvised Music after 1950", p. 108.
[41] Ibid., p. 117.

performing *etherSound* at a number of occasions. And, based on my experiences as a performer—from that point of view—the participants were truly interacting with the music and they had genuine influence on the development of the performance. As an improviser in the context of a performance, I experience no difference between an initiative taken by one of the other musicians or one introduced by a participant—they are both of equal import. Though I have programmed *etherSound* myself, enough musically crucial aspects of the message-composition is unknown at the onset for any message-composition to hold potential for musical change. Obviously, the nature of the interface and the way the piece is programmed puts great limitations on the creative possibilities of the participants, especially were they to work with it repeatedly. That, however, does not mean that the individual, single act of participating does not harbor creative and interactive potential. Just as I, when improvising, cannot be certain how a musical initiative taken by me will influence the development of the music, the participant will not know either. Still—just to be absolutely clear about what it is we are talking about: Sending an SMS to *etherSound* during a performance is obviously nothing like, not even closely related to, improvising on an instrument one has learned and mastered. In no way is this the point I am trying to make. The point I am making by this long detour of reflection is that, perhaps—and my own experience seems to corroborate this—a tiny atom of that which constitute the essence of the, at its best, flowering, form-giving process of improvisation, to use the words of George Lewis, can be shared by those whose participation is restricted to a mobile phone.

However, and now we are approaching the weak spot of *etherSound* as a platform for interaction, the more I play with and get to know my co-improvisers the easier it will be to predict the result of musical actions taken. For the participants there is currently only very limited possibilities for this kind of development to take place. Developing the expert performance aspect of a work whose objective is related to a notion of 'equality of participation'—that all, regardless of prior (musical) training, should be allowed an equal chance to participate—is not un-problematic. If this goal is to be adhered to care must be taken to not accomplish the expert performance aspect at the expense of un-initiated participation. Adding a second layer of interaction would be one way to allow for the interested participant to acquire skills to more actively and consciously take part of a performance. This second layer could be implemented by making a phone call and interacting with the message-composition—changing the volume of it, the timbre, the tempo, etc.—in real-time, either by pressing digits on the phone or by voice control.

In *etherSound* in the performance context the audience is invited to take part of a group improvisation. Though the *interaction-as-control* aspect of the participation is very limited the interactive action influences the music in a way similar to musical interaction in the context of improvisation. To summarize my own experiences with working with this project over a number of years, I can say that the sensation of improvising in a context where the audience can give sonic input—input that becomes an important part of the performance—is very rewarding. And this to an extent that I did not anticipate at the time the project started. A challenge for a future development of the concept, though the artistic implications of such development have to be carefully evaluated, would be to attempt at developing the participant control aspect of the interface without loosing the collaborative focus.

Chapter 3

Repetition Repeats all other Repetitions

Repetition Repeats all other Repetitions
for 10-stringed guitar and computer
Composed & premiered in 2006
Commissioned by and dedicated to Stefan Östersjö
Listen | Score

In this chapter the work-in-movement *Repetition Repeats all other Repetitions* and the context out of which came into being is discussed. Although the text here summarizes the two essays "Negotiating the Musical Work II" and "Negotiating the Musical Work I" some of the thinking here depend on those texts. And just as those two essays are co-written with Stefan Östersjö, the guitarist who commissioned *Repetition*, the current chapter is largely based on a co-written text.[1] Due to the collaborative nature of the project, and to avoid tedious repetitions, throughout the text I refer to Stefan by his first name only and when I use 'we' and 'us' I consistently refer to myself and Stefan. The primary purpose of the studies within *Negotiating the Musical Work* (see Appendix B and C) was to better understand musical collaboration and composer-performer interaction but already in the first study it became clear to us that much of the knowledge could equally well be used when thinking about musician-computer interaction, which, to me, began to emerge as the more interesting aspect of these studies. These ideas contributed strongly to the emergence of the idea of interaction-as-difference as well as the giving up of the Self.

In order to unwrap the processes that led to the first version of *Repetition Repeats all other Repetitions*[2] and eventually to the expanded concept of the 'open work', it should be clear that many circumstances, some of which are auxiliary to the actual process of 'composing' (i.e. the tasks traditionally assigned to the labor of the 'composer') had a great influence on the way the piece developed. However, in the end it would turn out that these 'circumstances' or 'processes' were not in fact 'auxiliary': They were, or would become, an integral part of the process of composing (now also in the extended sense of the term). Some of these were planned and

[1] Another version of the original text is a part of his PhD thesis. See Stefan Östersjö. "SHUT UP 'N' PLAY! Negotiating the Musical Work". PhD thesis. Malmö Academy of Music, Lund University, 2008.

[2] Henceforth referred to as *Repetition*

others came about as a result of the ways in which the project developed. For example, one of the outspoken intentions was to use *Repetition* as a test bed for my timbre tracking software *timbreMap* (see 1.3.1), and one of the perhaps more unexpected consequences, was the formation of a new group, *The Six Tones*, which can be seen as a direct consequence of the collaboration myself and Stefan had initiated in January 2006. Not only an offspring to our collaboration *The Six Tones*, as is often the case with multi-project collaborations, also provided important material back into *Repetition*. A time line of some of the more important events relating to this project may be gathered from the diagram in Figure 3.1 and below I will give an account of the development of the piece—and the development of the project—and the circumstances that, according to my own biased view, where the most important ones to shape the piece (i.e. most important with regard to the theme of this dissertation). It should however be clear to the reader that the process of composing, or constructing, *Repetition* has not yet come to an end, but continues to feed material and events into the 'container' that *Repetition* has come to represent. In its first conception though the *project* was thought of as collaborative, the *music itself*—the score and its performances—was not. But the stream of events, born out of the process, conduced to the shaping of *Repetition* as a truly collaborative effort, in which the members of the collaboration would no longer be limited to myself and Stefan Östersjö. Some of these events are described in the following sections and may be summarized as:

(1) **Negotiating...** That Stefan Östersjö and myself were both aware of and had mutually agreed on *Repetition* being part of my own, as well as his, doctoral research project is an important factor that, in the end, greatly influenced the result. In particular the preparatory studies and the papers we wrote as a result had impact on the development of the project.

(2) **The Six Tones** Working with *The Six Tones* added other kinds of instrumental and sonic input and it intensified the social aspect of our collaboration due to the additional work relation. There is also a close inter textual relation between my piece *The Six Tones* and *Repetition* in that both contain transcriptions of the other.

(3) **The first version** A combination of events, decisions and circumstances led to the decision to *not* employ 'true' interactivity in the first version performed in October 2006. This radical conclusion gave birth to the idea of *Repetition* being a piece that can have many independent instances.

(4) **Symphonie Diagonale** The next version would be even less *real-time* interactive but even *more* collaborative and, in a way, multi faceted. This version is an adaption of *Repetition* for the classic modernist abstract film *Symphonie Diagonale*,[3] and as such it is an attempt to break free from the first version which, at this time had already been performed a number of times.

(5) **The annotated Score** Although primarily concerned with 'preservation' (see the section on libIntegra in the Introduction, working with the Integra project[4] made me start thinking of a representation of the

[3] Viking Eggeling. *Symphonie Diagonale*. Film. 1924.

[4] See http://www.integralive.org and (Jamie Bullock and Henrik Frisk. "libIntegra: A System for Software-Independent Multimedia Module Description and Storage". In: *Proceedings of the International Computer Music Conference 2007*. ICMA. Copenhagen, Denmark 2007; James Bullock, Henrik Frisk, and Lamberto Coccioli. "Sustainability of 'live electronic' music in the Integra project". In: *The 14th IEEE Mediterranean Electrotechnical Conference Proceedings*. IEEE Catalog Number: CFP08MEL-CDR. IEEE. Ajaccio, Corsica 2008. ISBN: 978-1-4244-1633-2)

ontology of a musical work as a possibility for a documentation of the 'work in motion'; this being the work kind Stefan and I would associate *Repetition* with.

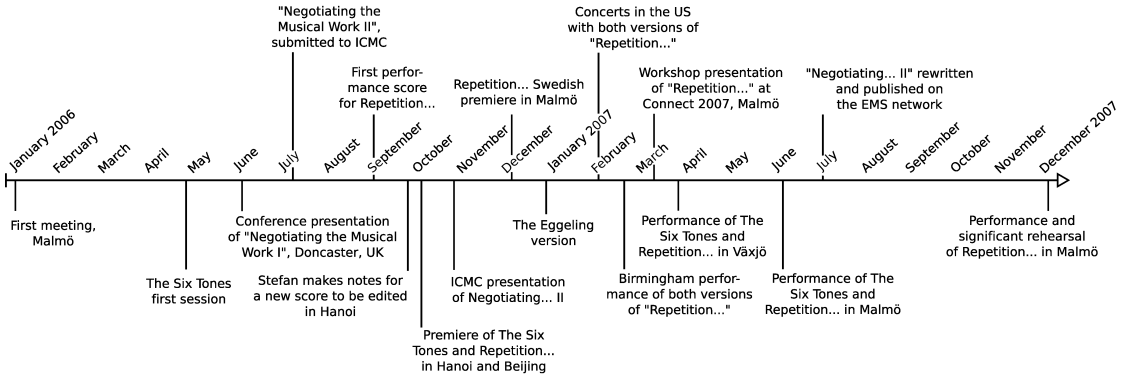

Figure 3.1: The events mapped on a time line relating to the life span of Repetition Repeats all other Repetitions.

3.1 Observing negotiations of the musical work

Negotiating the Musical Work
video analysis of a composer-performer session
Watch

As part of our agreement, and perhaps a first prerequisite for any successful composer-musician collaboration, was the idea of partly giving up the traditional view on our respective roles.[5] We would allow ourselves to enter the domain of the other and we would allow the other to enter our own professional sphere. In one of the earliest results of this project—the documentation of a study of a collaboration similar to ours, between Stefan Östersjö and Swedish composer Love Mangs—we had seen example of this behaviour (see see Appendix C). In the analysis of the video documentation of their collaboration, from which we had chosen a few excerpts, there were moments when Mangs was giving input to the process "as if" he was interpreting the material and moments when Stefan was manipulating the material "as if" he was the composer. I say "as if" because although the project was an outspoken collaboration in which the two musicians would meet and work out the material together, it is noted in the analysis that, in particular Love Mangs, was not entirely comfortable with the floating nature of his identity as composer.

In the study *Negotiating the Musical Work*, in an attempt to build an experimental framework to be used to unwrap these processes, we discuss the semiological model for musical analysis by musicologists Jean-Jacques Nattiez and Jean Molino. Their model looks at the work of art as an object that may be analyzed from three different perspectives, or levels: "the poietic, the esthesic and the 'neutral'."[6] Three modes all representing the same work of art where the poietic level is the constructive phase, the esthesic is the interpretative phase and the neutral is the trace left by the poietic (or esthesic) process[7]. At the time this tripartite model was the

[5] This process belongs to the notion of giving up of the Self.

[6] Jean Molino. "Musical Fact and the Semiology of Music". Trans. by J. A. Underwood. In: *Music Analysis* 9.2 (1990). Blackwell Publishing. Pp. 113–156.

[7] Ibid.

object of some excitement on the part of Nattiez who believed that

> [...] recognizing, elaborating, and articulating the three relatively autonomous levels (poietic, neutral and esthesic) facilitates knowledge of all processes unleashed by the musical work, from the moment of the work's conception, passing through its 'writing down', to its performance.[8]

For perhaps obvious reasons the musical semiology proposed by Nattiez has been criticized and discussed to a great extent, and it is not my intention to engage in that somewhat dated debate here.[9] Nevertheless, the terminology of Nattiez and Molino proved to be useful to us. Our adaption of it, in particular the two levels *poietic* and *esthesic*, helped us reconsider the traditional division of labor between 'musician' and 'composer'. Whereas Nattiez lean on semiology in order to confirm the authority of the composer as the creator of the work (with the interpreter 'inserted' towards the end of the poietic process[10]) we used it to depict what we analyzed as a rather rapid oscillation between poietic and esthesic processes. And where Nattiez in his book *Music and Discourse* is primarily concerned with the composed *work* and its ontology we focused on the interactions involved in the phases *prior* to the existence of a score and prior to the first performances. The process of writing down a musical work, we argue, is not a unidirectional poietic process, but is described by us as an *interaction* between esthesic and poietic processes. This to an extent that makes it difficult to define the end of one and the beginning of the other. What Stefan and I attempted to show in the studies mentioned above, is that the acts of musical composition that Nattiez gathers within the poietics can in themselves be analyzed by using the same method that he applies to the total fact of the musical work. Nattiez seems to be drawing conclusions about "processes unleashed by the musical work" from a purely analytical understanding of music; from a perspective still dependent on the view of composers as 'true creators' and works as 'ideal objects' (in the phenomenological sense): stable and fixed artworks that should make up the primary object of study for musicology. What we were concerned with then, and what I am concerned with here, is almost the opposite: at least we are operating on the other side of the dividing line constituted by the completed score, the musical work as a coherent object, namely prior to the existence of a score and prior to the performance. The concern is to attempt to understand the actions that *lead to* musical content and the significance of the interactions between the agents involved in these processes, to investigate the meaning of collaboration in the musical *poesis*, and the significance of these aforementioned processes with regard to the technological *poesis* in musician-computer interactivity.

In figure 3.2 we plotted our analysis of the interaction between Stefan and Love Mangs. The activities (utterances, expressions, topics, etc.) are summarized by the white squares and the horizontal position of the squares show who initiated the activity (Stefan on the right and Love on the left) and the mode (esthesic or poietic) with which we coupled it. The arrows pointing to and from the activity squares show the directionality of the communication and in the middle is an initiative curve, i.e. which one of the two musicians holds the initiative at a given moment. Dashed lines in the communication arrows indicate a 'noisy' or 'dropped' message; a message that was misunderstood or not picked up by the other party. It should be noted that

[8] Jean-Jacques Nattiez. *Music and Discourse - Toward a Semiology of Music*. Trans. by C. Abbate. Princeton University Press, 1990.

[9] The concept of the 'neutral analysis' or 'analysis on the neutral level' is particularly troublesome. For an insight in the debate from both sides, see Jean-Jacques Nattiez. "Reflections on the development of musical semiology". In: *Musical Analysis* 8.1-2 (1989). In translation by Katherine Ellis. Pp. 21–75 and J. Dunsby. "Music and Semiotics: The Nattiez Phase". In: *The Musical Quarterly* 69.1 (1983). Pp. 27–43

[10] See Nattiez, *Music and Discourse*, p. 73.

the graph is obviously a rough generalization: The actual interaction between Stefan and Love Mangs was not so tidily square. Nevertheless, the graph shows example of the non-linear and flexible character of their communication. From looking at the graph we can see that during this clip there is a tendency towards communicative clarity. At the top of the graph there is what seems to be a fair amount of confusion; lot of individual activity not responded to (as is represented by the dashed lines of communication). Towards the bottom of the graph however, the interaction is denser and appears to be less noisy with the result of fewer messages being lost. In addition, as the composer in this session Love Mangs is moving from being active almost exclusively in the esthesic domain to operating mainly in the poietic domain.[11]

The miscommunication, or rather, the *negotiation*, observable in the beginning of the session appears to play the role of a 'tuning in' between the two agents (see Section 1.3.1). A tuning in through negotiation that, towards the end of the session, allow for the relations to become established in a way that permit for creative decisions. One of the suggestions we make in "Negotiating the Musical Work I" is that Stefan and Love Mangs, in their negotiations, are defining a *subculture*, against which the symbols in the graph which represent ideas (e.g. the *fermata* starting at line 45-65 or the *arpeggio* roughly at line 145) exchanged derive their meaning. These thoughts lead us back to semiological thinking, though in a more general sense than that proposed by Nattiez and Molino. Umberto Eco claims that "[a]ny attempt to establish the referent of a sign will force us to define this referent with the terminology of an abstract entity."[12] The signs, according to Eco, denote cultural entities which remain unaltered when the sign is transposed or translated. However, in this case, it is the abstract entity that is transposed in order to find the meaning of the symbol within this specific context. The *fermata* in the example may or may not be related to the romantic idea of a fermata. Furthermore, there is likely to be a significance attached to the symbol that evades its immediate 'meaning'. Both Stefan and Love Mangs are working within the frame of their own cultural contexts which define their respective understandings of the evolving work. The subculture, according to us, is a result of the interaction, and the negotiation ('*What is it we are developing?*', '*How are we talking about it?*', etc.), between the two agents and their inherent cultural contexts. Their mutual expectations and their understanding or imagination of the work in progress is of importance when they attempt at co-ordinating their actions, for instance towards a definition of the performance instructions. Where often the composer-performer relation is understood as a hierarchic structure in which the role, even the purpose, of the performer is to fulfill the composer's intentions, this mode of analysis allows us to look at the two agents (composer and performer) as part of a larger system that may also contain many other agents such as social and cultural context, instruments, status, power, gender, etc.

To summarize the analysis of Stefan and Love Mangs collaboration, it appears as if the noisy communication early on in the process did not halt the creativity. Ideas, also those that originated in these early and seemingly confusing negotiations, continued to develop while the agents involved slowly established a common space, a subcultural context. Against this contexts the symbols exchanged where given meaning, or

[11] The analysis of the graph in Figure 3.2—and of the events preceding it—presented here should only be seen as a summary. For a more complete and detailed discussion of the Östersjö/Mangs collaboration in general see Östersjö, "SHUT UP 'N' PLAY! Negotiating the Musical Work", Chap. 3 and for a more in depth analysis of the video clip discussed above see Frisk and Östersjö, "Negotiating the Musical Work II", Sec. 3.2 and Frisk and Östersjö, "Negotiating the Musical Work I", Sec. 4.

[12] Umberto Eco. *Den frånvarande strukturen (La struttura assente)*. Trans. by E. Tenggren. Casa Ed. Valentino Bompiani & Co./Bo Cavefors Bokförlag AB, 1971, p. 66.

new meaning, in every respect different from the traditional meaning of the symbol. Assuming this analysis is correct—that noisy communication is not an obstacle for the establishment of common ground between communicating and collaborating agents—what does it mean to our understanding of computer-musician interaction in the context of electro-acoustic music? There is a tendency, not only in musician-computer interaction, but in human-computer interaction in general, to look at the communication as a primarily one way stream, in which noise in the transmission is a great problem. From the bottom up the computer is truly digital and it may be correct to also let the input to such a system be binary. Looking at it, however, as an agent in a communicative system where binary distinctions are difficult to make and where the communication will be defined in the course of action, so to speak, will certainly present problems. Nevertheless, the study summarized above, and the results we reached in it, became the inspiration for the interactive model to be used in *Repetition*.

3.2 The Six Tones

Another factor to consider while tapping into this process—the process of constructing *Repetition*—is the connection between *Repetition* and a similar, but slightly larger, collaboration performed within the project *The Six Tones*[13] whose coming into existence is very closely related to *Repetition*. *The Six Tones* was initiated in the spring of 2006, at a time when only sketches for *Repetition* existed when we had the opportunity to meet with two Vietnamese master musicians temporarily visiting Malmö: Ngo Tra My and Ngyen Thanh Thuy playing the Dan Bau and the Dan Tranh respectively. Both are traditional Vietnamese string instruments, the Dan Bau an amplified mono-chord and the Dan Tranh a zither like instrument. At a few occasions in May 2006 we met and improvised based on a few loose sketches I had brought. Stefan on the 10-stringed guitar and the banjo along with Thuy, My and myself on laptop. The outspoken intention was for these sessions to provide material for a new piece that I would compose.

Though there are a number of interesting, but also problematic,[14] aspects on the project *The Six Tones*—which I personally feel has become a very successful one—my primary concern here is not to discuss the project in itself, but rather focus on its influence on my relation to composition. This discussion involves the significance of concepts such as 'collaboration' and, more specifically, 'interaction', as factors in the process of composition. In the previous section (3.1), we saw that, in a composer-performer collaboration the performer was not solely active in the esthesic domain any more than the composer was active only in the poietic domain. This is however not the same as to say that this is a 'natural' division of labor or a accepted form for work production.

It was suggested above that Love Mangs was not entirely comfortable with the distributed nature of his role as composer in his collaboration with Stefan.[15] and there is a number of reasons why the idea of giving

[13] The group *The Six Tones* lend its name from the composition by the same name.

[14] To only mention one aspect, Simon Emmerson has written about the difficulties involved in cross-cultural musical interactions and discusses the effect of *masking* : "Throw two traditions of music making together and aspects of one may *mask* aspects of the other (sound subtlety, performance practice tradition and aesthetic intent)." Simon Emmerson. "Appropriation, exchange, understanding". In: *Proceedings of EMS -06, Beijing. Terminology and Translation*. Electroacoustic Music Studies. EMS, 2006. URL: http://www.ems-network.org/spip.php?article292

[15] It should be mentioned that I have not discussed this with Mangs. My judgement here is based solely on how he acted in the video documentation of the collaboration.

up part of that which is traditionally seen as the (sole) responsibility of the composer may appear provocative or of little concern to performers as well as composers. One is the classical (and obvious?) notions of power assigned to the 'originator' as the authority on his—because it generally is a male or male like individual—work: "The *explanation* of a work is always sought in the man or woman who produced it. [...] the sway of the author remains powerful."[16] Derek Bailey points to how Cannetti likened the conductor, "the composer's proxy", to a "chief of police".[17] and Bruce Ellis Benson, in the last chapter of his book *The Improvisation of Musical Dialogue*, points to the Kantian notion of the artistic genius as "the epitome of the lone individual who wants nothing less than to speak in such a way as to supplant all other voices."[18] Nurtured by the idea of music as an autonomous art, the assumption "that music making is primarily about creation and preservation of musical works"[19] also constructs our understanding of the composer. And the composer's understanding of him- or herself. The belief in and adherence to the autonomy of musical creation and artistic freedom makes it socially difficult for composers to give up their 'power'[20], as this could be interpreted as succumbing to "the public" or, trying to accomodate someone else's values, presumptively, according to the critic, in order to gain in popularity.

Whereas the *author* was killed already in 1968 because, according to Barthes, "the birth of the reader must be at the cost of the death of the Author",[21] the image of the 'composer' as *the* creator has resisted many attempts at its life.[22] And despite the development of the last decades the socially and culturally, essentially romantic, idea of the composer is adherent: "there is a special aura that envelopes composers, as well as other artists, because we think of them as true creators."[23] It is firmly rooted in the idea of the score, i.e. the notation, as *the object* which is essentially preserved through the process of *performance*: "According to this model, composers create musical works and performers reproduce them."[24] But, as we saw in Stefan's collaboration with Love Mangs (see previous section (Section 3.1) and the associated Figure 3.2) a composer's practice is not merely *creation* (if we accept that musical *creation* actually exist as a concept), equally important are the interpretative aspects. And even if the composing is not within the frame of a collaboration, the work of the composer may still be described as an interactive negotiation. Suppose a graph such as the one drawn for the Mangs-Östersjö collaboration was drawn for an imaginary project involving one sole composer working alone. If the composers actions were plotted to the left, the right hand side of the diagram, Stefan's side, could easily be substituted with any one of a set of agents involved such as 'guitar', or 'skill', or something less tangible such as 'musical style', and the resulting curve would likely be equally erratic. The point being that the composer will always be, regardless of the presence of other humans, in an ongoing interaction with different agents in the process of construction.

[16] Roland Barthes. "Music, Image, Text". In: Esprit, 1968. Chap. The Death of the Author, pp. 142–9, p. 143.
[17] Elias Canetti, *Crowds and Power*. Citations from Bailey, *Improvisation: its nature and practice in music.*, p. 20.
[18] Benson, *The Improvisation of Musical Dialogue*, p. 164.
[19] Ibid.
[20] The concept of power with relation to New Music composers must be understood as relative to avoid becoming ludicrous with the extreme marginalization of this genre in society which Milton Babbitt in his infamous 1958 article referred to as "negative commodity value". Milton Babbitt. "Who Cares if You Listen?" In: *High Fidelity Magazine* 8.2 (Feb. 1958)
[21] Barthes, "Music, Image, Text", p. 148.
[22] Susan McClary's essay "Terminal Prestige" in which the autonomy of the composer is questioned. The debate that followed (see *Perspectives of New Music* 1992 and 1994) is indicative of the persistence of the Composer.
[23] Jerrold Levinson *What a Musical Work is* quoted in Benson, *The Improvisation of Musical Dialogue*, p. 37.
[24] Ibid., p. 9.

If the joint studies performed by myself and Stefan and described in *Negotiating the Musical Work*[25] (briefly summarized above in Section 3.1) provided me with the theoretical insight that the internal negotiations I had always experienced while improvising as well as composing, could in fact be brought out in the open, within the context of a collaboration, *The Six Tones* gave me the chance to work these ideas out in practice. Now, obviously, despite the persistent view of the composer as "the creator", close collaborations between composers and musicians as a method are not uncommon (at least not in contemporary music), nor are they new.[26] What is perhaps different here is how the processes engaged by *The Six Tones* contributed to the development of *Repetition*—a development that I had not foreseen. For my own reconstruction of my musical identity in this context—perhaps closer to musician than to composer (the (arbitrary) division between composer and musician will be examined in the next section)—the May 2006 sessions with the Six Tones was important (see also the timeline in Figure 3.1). Primarily because of the special circumstances that surrounded these sessions, I believe they influenced me in a way that made the transition towards *openness* in the process of composition easier to commence. And my receptiveness to this change was pivotal to the the way *Repetition* would develop from a 'composition' into an open structure. The circumstances may be identified as impedance, as three modes of resistance, particular to *The Six Tones*. In dealing with these resistances, in my attempts at overreaching them, I had to address my habits and reappraise some aspects of the role of the composer. Although in reality, these matters are not as clearly cut, they may be summarized as:

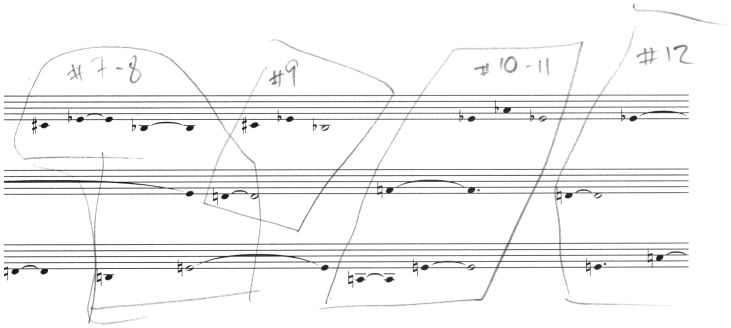

Figure 3.3: The sketch used for the improvisations for the Six Tones

(1) *The language barrier*: Though Thuy speaks English, My understands and speaks only little and English is not the first language for neither myself, nor Stefan. In other words, even had I wanted to, I could not dictate how I intended the music to sound, at least not in verbal language.

(2) *The cultural barrier*: Unnecessarily cautious and afraid to fall into the trap of exploiting the culturally 'Other', I proceeded very carefully, avoiding to give rigid instructions and definitions.[27]

(3) *The musical barrier*: Prior to the project I had little knowledge of Vietnamese music. Considering how the currents of the cultural market flow, Thuy and My were likely to know much more about our music,

[25] Frisk and Östersjö, "Negotiating the Musical Work II"; Frisk and Östersjö, "Negotiating the Musical Work I".
[26] For a PhD dissertation devoted to the subject, see Östersjö, "SHUT UP 'N' PLAY! Negotiating the Musical Work".
[27] Obviously instead falling into the trap of *constructing* the 'Other'

than we about theirs. How would we deal with musical 'codes' and specific things like musical timing? These questions could only be successfully resolved in the meeting.

Hence, apart from being artistically unsatisfying to me, writing a score to bring to these first meetings with the intention to have it performed 'truthfully' would appear futile. The chosen method, to improvise based on sketches, gave us—all four of us—the opportunity to define our own *subculture* (see section 3.1) against which we could understand the possibilities and the limitations of our collaboration. For the formation of mine and Stefan's subculture, and for our collaboration at large, *The Six Tones* had a great impact in particular in the social dimension. Thanks to our project with Thuy and My, our process of 'tuning in' had an early start and thanks to it we were given additional opportunities to travel and work together. The importance of the social dimension should not be underestimated: When the construction of musical content is laid out in the open, mediated by a collaboration, the receptiveness of the social relation is paramount.

The Six Tones was also important to *Repetition* in the exchange of musical ideas between the two pieces. The sketches we used as starting point for our improvisations made use of the same material I had worked out for Repetition, at the time merely a tone series in different permutations. For our session I had written out one of these series as a monophonic melody line laid out between the three string instruments as if it was one instrument playing (see Figure 3.3). A number of musical ideas from these sessions (altogether we met four times in May 2006) had a tremendous influence on how the ideas for *Repetition* evolved and how the material was composed.

- Prior to the Six Tones sessions the idea was to write for 6-stringed guitar but the register and the possibilities for alternate tunings made me and Stefan choose the 10-string guitar instead.
- One of the sections of Repetition (the A-material in the notation, see the score) is a transcription of one of the improvisations on the sketch brought to the May 17 session.
- The scordatura used in Repetition was developed according to the needs presented by the Six Tones project.
- Some of the sound files used in the first version of Repetition used samples recorded during the Six Tones sessions.

But there was also a flow of ideas going the other way, from *Repetition* to *The Six Tones* as material composed for the guitar piece was transcribed and used in the ensemble piece.

3.3 The first version

With regard to the background for *Repetition* yet another aspect should be mentioned: Its inter textual relation to *Toccata Orpheus* by German composer Rolf Riehm. I became acquainted with *Toccata Orpheus* when Stefan and I participated in the workshop *Knowledge Lab* in Berlin in June, 2005. Stefan performed the piece (composed in 1990 for six string guitar solo)

Repetition Repeats all other Repetitions
for 10-stringed guitar and computer
Composed & premiered in 2006
Commissioned by and dedicated to Stefan Östersjö
Listen | Score

and discussed its artistic and interpretative implications in the workshop. Following this event we repeatedly discussed Stefan's idea of making a multimedia performance of *Toccata Orpheus*—i.e. a staging of the piece to allow for a broader expression and a shift of focus to the physicality of the piece. This performance version would involve a sound-scape by me and during the process of discussing *Toccata Orpheus* and a possible soundscape, we recorded the piece in its entirety as well as details of it for me to use as samples in the sound-scape. We also made a video recording of it that I edited and I started elaborating on the idea of, in addition to the sound-scape, use this material for an electro-acoustic piece with video. Though introverted in its expression *Toccata Orpheus* is a highly visual piece as the many different and unusual playing techniques become part of its construction: there is as much to look at as there is to listen to. Hence, when I started working on the score for *Repetition* in August 2006 the Riehm piece was most certainly a source of inspiration. Because I had so closely studied it and discussed its possible performances with Stefan during a long period of time and because I was inspired by the dramaturgy involved in the performance of the piece. In *Toccata Orpheus* the more radical and strained the movement required of the performer the lesser the sound—in itself an interesting reversal of force. In preparation for the sound-scape mentioned above I had made an analysis of the piece based on the movement required to perform each sound, and classified the phrases according to this analysis. The way I decided to approach *Repetition* was very similar: I borrowed Stefan's 10-stringed guitar and constructed a set of sounds based on different playing techniques, some of which are part of contemporary guitar technique and some that I invented.

As was mentioned above, the raw material for the piece was a simple tone series, a version of an infinitely self-repeating series common to much of Danish composer Per Nørgård music. Conceptually the piece consists of three permutations of the same raw material, labeled *A*, *B*, and *C*. These three motives, distinct both sonically and expressively, are, in a manner of speaking, telling the same story in three different ways. Though it is only possible for the guitarist to play one of these motives at a time, irregularly moving back and forth between them, and with the help of the computer part—also made up of three corresponding materials—would create the illusion that all three 'stories' were told simultaneously. The guitar and the computer would merely 'give light' or resonate with one version of the story at a time. The intention was to let the order of the fragments belonging to the three motives be the result of decisions made in performance. In other words, the score consisted of a collection of composed fragments pertaining to one of the three motives and it would be up to the performer to choose the order, and the number of repetitions, each fragment would be played. The interactive challenge, i.e. the question of how to get the computer to 'perform' with Stefan without the order, or form, of the music being known in advance, had been factored in already from the start of the mine and Stefan's collaboration. *Repetition* was thought to be a testbed for my analysis software *timbreMap* which is a self organizing feature map that, when fully trained, may automatically detect timbral differences in the input audio signal. The idea was to have the software 'listen' to Stefan and be able to detect when he moved from playing, say a fragment of the *A* material, to some *B* or *C* material. For this reason too it was necessary for me to compose the three materials in a way that they would be sufficiently timbrally distinct from each other for the software to detect the change. At this time, in August 2006, I had a proof-of-concept version of *timbreMap* working which gave me a chance to evaluate and test the different playing styles and their effect on the 'listening' computer.

Though the technique, i.e. the *timbreMap* software as interface, may well have worked already for the first performances in 2006, we soon realized that, due to practical reasons, with a paper score it would be impossible to employ the level of freedom intended. The six page score would have to be entirely visible throughout the piece for Stefan to be able to freely move from motive to motive and from fragment to fragment. Though it is possible to set the score up on six music stands it would not be possible to read it.[28] The solution we chose was to move the decisions concerning the large scale form of the piece to the pre-performance phase. Stefan would simply work out his version in non real-time, and together, following Stefan's instructions, we made a performance version of the score. With time being short and the first performance quickly approaching we also decided to make the interaction between Stefan and the electronic part in this version be governed by a foot pedal. Stefan would simply trigger sound-files stored on the computer by pressing a foot switch. This version is still interactive to a certain extent but it is so only if you do *not* consider what the intention had been. How could the original intentions of the piece be 'given up' so easily? Neither I nor Stefan, conceived of this first version of *Repetition* as anything else than one possible 'version' out of many to come. This agreement was the first step towards the notion of a 'work-in-movement'[29] and by limiting the openness in this particular instance we greatly increased the future possibility for openness. This expanded concept of openness, or work-in-movement—that each instance could, not only choose its form in the course of the performance, but alter its interaction scheme, its instrumentation, its score, and so forth—was not originally specified by me. If Peter Kivy is right suggesting that *discovery* is what best describes the activity of composers,[30] then we were truly composing when we impeded real-time choice in the first version of *Repetition* because, in this and other choices we made, its potential as a 'work-in-movement' was *discovered*.

Another reason we allowed ourselves to change the scheme of the piece, and to continue to do so, was the fact that, already in the rehearsals it was obvious the alterations worked out really well. Not only was the new form convincing, the integration between the electronics and the guitar was seamless. Despite the lack of performer-computer interactivity, several listeners in the audience for the first performances commented how they thought the piece sounded like it was interactive (i.e. interactive in the sense I had intended it to be). Some even thought it was and were surprised to learn about its relatively static setup. The sounds I used for the electronic part were samples from the improvisations we did with *The Six Tones* (see Section 3.2) as well as samples I had done playing Stefan's 10-stringed guitar when composing the score for *Repetition*. Could it be that the interaction in the production phase of *Repetition* substituted for the real-time interaction in the performance? This would imply that interactivity is a quality that 'objects' can absorb or occupy, that they can pick up and then adhere to, independent of time. That the interaction between me and Stefan, and between us and Thuy and My (in the project *The Six Tones*), was encoded in the sound-files used for the computer part and in the music as performed. Certainly a pleasing thought, I doubt the reason for the deceptive impression of performer-computer interactivity in this version of *Repetition* is directly related to interaction of a different

[28] In classical guitar technique the guitarist is sitting down, and though in some music it might be possible for the guitarist to move around (most certainly in all other genres), the alternate playing techniques used in this piece makes it impossible to play not sitting down.

[29] The term 'work-in-movement' is coined by Umberto Eco to distinguish a particular species of 'open works' in which "the auditor is required to do some of this organizing and structuring of the musical discourse. He collaborates with the composer in making the composition." In the case of *Repetition* the 'auditor' is replaced by the performer but that is also the case in the examples of work-in-movements that Eco provides. Umberto Eco. *The Open Work*. English translation published in 1989. Hutchinson Radius, 1968

[30] Kivy, *Introduction to a philosophy of music*, p. 214.

kind and in a different time (although interactivity does not necessarily have to be real-time as is discussed in Section 4.5) but I believe that, in musical practice, interaction of the kind myself and Stefan were engaged in whilst preparing for these first performances is a factor (a coefficient?) that positively influences the chances for a successful result—where 'successful' is defined as 'all participants are generally pleased with the outcome'. It is this coefficient that creates the illusion of performer-computer interaction.

3.4 Symphonie Diagonale

Repetition Repeats all other Repetitions, Symphonie Diagonale
for 10-stringed guitar, computer and video projection
Composed & premiered in 2007
Prepared in collaboration with Stefan Östersjö
Listen | Score

The motivation for the second version we did, the combination of *Repetition* and *Symphonie Diagonale*,[31] was to use the film as a springboard for the making of a radically different version of the guitar and electronics piece. By itself the idea of combining two totally unrelated works, separated in time by 83 years, created in different media, is remarkably odd but the first version of *Repetition* had already been performed four times and it was at this moment scheduled for another four performances. Though the potential for *Repetition* as a work-in-movement had been discovered, its status as such had not yet been established and, due to the 'success' of the first version, we had to oppose the comfort of staying with the first version. Hence the need for a second version as distinct from the previous one as possible.

This version is even less interactive than the first in that its performance version is static: the film, along with the electronic track, is played back and Stefan is solely responsible for keeping the synchronization between the film and the electronics on the one hand, and the guitar part on the other, tight. The binary control interface is now reduced to literally constitute 0 or 1: The video is either playing or it is not. Again, we have to recur to the bigger picture and look at the processes that proceeded the performances of the second version.[32]

Figure 3.4: Symphonie Diagonale

If for the first version, there was a relatively clear distinction between my tasks (providing the raw material, the score and the sounds) and Stefan's (constructing a performable version of the piece out of the components I gave him) our interactions for this version were less defined. After an initial analysis of the film, an obviously black and white—white graphical shapes, evocative of paper cutouts, on black background (see Figure 3.4)—8 minute abstract film, we started mapping the musical material onto the imagery, taken by the lack of resistance of the undertaking: We were working with a recording of the guitar part, and many of the phrases would fit the rhythm of the film without alteration. The version was completed in a few days of work.

The work we did on those days in January 2007 involved a great amount of artistic choices that were all made in a continuous negotiation between 'performer' and 'composer' with a almost complete merge of

[31] The silent movie *Symphonie Diagonale* is a 8 minute modernist film classic by the Swedish artist Viking Eggeling from 1924

[32] The process of constructing this version is described in some detail in Östersjö, "SHUT UP 'N' PLAY! Negotiating the Musical Work"

the two agents into one *musician*. Neither of the agents seemed to have had the interpretative precedence and considering our task here, using the terminology from section 3.1 the *poietic* and domains overlap and interact in a recursive fashion. Again was the interactivity in the performance supplemented by interactivity in the construction. Though, as I pointed out above, the main purpose of this version was to create a breach that would allow us to move on to yet another version of *Repetition*, the film component added an extra constraint to the labor: If we wanted to stay faithful to the film, i.e. not alter it in any significant way, then the non-interactive, static rather than dynamic, version we ended up with was almost our only option. Why then, did we not alter the film? It is highly conceivable to take *Symphonie Diagonale* and cut it up into small fragments that get triggered by the guitar. Or by the audience. Or by any other factor. In the making of this version, the film was the method, rather than the result, the intended result of which was to further open up the work *Repetition*. In that sense this version was an intermediary between the first version and any succeeding ones.

At this point, after the *Symphonie Diagonale* version had been performed it started to become clear that *Repetition* had in it an infinite number of *Repetitions*. Its 'authenticity' lies in the collaborative aspects of its production 'versioning'[33] rather than its detailed specifications. Its material work identifying instructions—in this case the scores, the samples and sound-files, the recordings of prior performances; everything belonging to its prior versions—could be picked up by any two or more musicians or otherwise, willing to engage in the construction (construct rather than construe) of another version.

3.5 Collaborative music

Collaborative artistic work in general may be seen as a reaction against the singularity of the romantic as well as modernist view of the artist as the inspired, predominantly white male, creator from whom great artworks emanate. It is however very difficult to draw a distinction between collaborative work as decentralized division of labor on the one hand and, let us call it, less collaborative work that stems from centralized authority on the other. To begin with, in music, it is difficult to imagine a performance that does not involve collaboration between different agencies at some level of the production. Perhaps the *Study No. 21, Canon X*[34] from *Studies for Player Piano* by American composer Conlon Nancarrow can serve as example of 'less-collaborative' music. Not only is it composed for a mechanical instrument[35] and punched into the player roll rather than written out in traditional notation, it wasn't performed in public (with one exception) until after his international break through in 1982. Following is an excerpt from an interview with Nancarrow performed by William Duckworth that gives evidence of the seclusion and non-collaborative environment in which this and the other Studies were composed:

> *Duckworth*: Between the early 1940s and 1960, when you were writing most of your Studies, was anyone hearing your music besides you?
> *Nancarrow*: No.
> *Duckworth*: Were you just playing them for yourself?

[33] Software versioning, also known as revision control, is used to differentiate between different editions or 'releases' of e.g. software.
[34] Studies No. 4 through 30 were composed between 1948 and 1960.
[35] As so much of Nancarrows other music *Study No. 21* is written for a player piano. The Ampico player piano to be specific (see).

Nancarrow: Occasionally someone would hear it, but very occasionally.[36]

At the other end of the collaborative/non-collaborative continuum, we could place any example of free jazz group improvisation in which nothing is pre-determined apart from the instruments, the players and the physical (and usually social) context. Evan Parker writes about a recording of a trio improvisation featuring, apart from himself on saxophone, Derek Bailey and Han Bennink: "We operate without rules (pre-composed material) or well-defined codes of behavior (fixed tempi, tonalities, serial structures, etc.) and yet are able to distinguish success from failure."[37] A lack or dismissal of "rules" of operation or "codes of behavior" are not necessarily prerequisites for collaboration but, they may be seen as a method with which the participants are forced to collaborate in order to avoid cacophony and chaos. (Though, admittedly, chaos may also be a most viable means of collaborative expression.)

A different beam of collaborative music (forced collaboration?), orthogonal to the Nancarrow-Parker axis, can be found in the brilliant and skillful output of John Oswald, who coined the term 'Plunderphonics' for a "retro-fitted music, where collective melodic memories of the familiar are minced and rehabilitated to a new life."[38] By cutting up recordings of popular music in small chunks and pasting them together in unexpected combinations he created a schizophrenic music that wilfully forces these random collections of snippets of sound to collaborate.[39] And Oswald, though in many cases unwillingly on the part of the plundered, sets up a distant collaboration with the artists whose music he reorganizes. On the opposite side, but on the same axis, as Oswald we could place any kind of fixed media, electro-acoustic so called 'tape piece' (i.e. studio produced music played back in concert on speakers), such as John Chowning's *Stria*, in which all sound material used is synthesized (as opposed to sampled real world sounds.

These are examples of regions of musical collaboration in a multiaxial space of musical practice. As mentioned above some degree of collaboration is likely to play a part in any music and, as a consequence, it may be suggested that 'collaborative', when used to describe the coming into existence of a musical work is too unspecific. If so, how may the multiple, collaborative, poietic processes of *Repetition* be described? That 'work-in-movement' may be used to define the work kind it belongs to is of little help; it only tells us that we are dealing with a unfixed work and that it need involvement from others than the composer to be instantiated, but not what the nature of the collaboration constitute. Depending on the version we are examining, *Repetition* as a 'work-in-movement' will inevitably be able to harbor many different locations in the collaborative space proposed above. Looking back at the phase at which the work revealed its possibilities for openness (see the last paragraph of 3.4), it is perhaps possible to distinguish the kind of collaboration identified with *Repetition* from the range of collaborative activities that make part of most musical activity in that the collaborative aspect in *Repetition* has been made its essence.

[36] William Duckworth. *Talking Music. Conversations with John Cage, Philip Glass, Laurie Anderson, and Five Genereations of American Experimental Composers*. Da Capo Press, New York, 1999, p. 49.

[37] As cited in Anne LeBaron. "Reflections on Surrealism in Postmodern Musics". In: Routledge, NY and London, 2002. Chap. 3, pp. 27–74, p. 39.

[38] Oswald quoted in ibid., p. 49.

[39] A recommended listening is the 1'46" long *Cyfer* on the CD *Plexure* (Avant, 1993, Japan)

3.6 The annotated score

The way *Repetition* was conceived of prior to its preparatory studies and prior to the experiences gained from the first and second versions of it, it was an open work similar to some of my other works like *Drive*. It was manifested as building blocks notated and left to the performer to organize them: a fairly traditional example of 'open work'. The way the process has evolved, however, informed by the knowledge produced in the study performed on Stefan and Love Mangs (see Section 3.1 and C), the emphasis in the term 'work-in-movement' has travelled from 'work' to 'movement'. And the emphasis on the 'composer' in the quote from Eco[40] should in our case instead be put on 'collaborate', because the action is more important than the subject. Altogether, we have travelled quite far from Eco's original notion which, to begin with, in the 'auditor' implies a (passive) 'receiver' rather than a collaborator. The 'work-in-movement' implied here is a literal construction kit, to be assembled and re-assembled in a recursive process that should be allowed to continue outside of the collaboration that gave rise to it. Myself and Stefan set it in motion but its authenticity can only be derived from the continuous movement. An open source music that may be dismantled and reconstructed, added to and altered, according to its conglomerate of participants.

In order to fully realize the notion of a work-in-movement the process of documentation—or in musical notation terminology—the work identifying instructions needs to be reconsidered. The way *Repetition* as a work has evolved, a traditional printed score in musical notation, no matter how detailed the written instructions are, would be misguiding. As has already been pointed out, the operative word in 'work-in-movement' is precisely the movement: the change. The difference that makes a difference. Therefore the score will need to communicate the process rather than the result, by itself not a novel idea. The musical notation will no doubt constitute an important part of the documentation but it will not be sufficient in itself.

As have already been discussed, apart from this more, let us call it musicological, aspect on the notation of *Repetition*, there are also practical issues regarding the notation and the score that need to be resolved in order to fully allow for the work to continue to evolve. If the performer is to be able to alter the order of the sections according to choices made in performance, the score needs to be adopted. But also if the performer chooses to do what Stefan did in the first version, settle on a form prior to performance, the 'final' score should easily allow for this. Finally, adding the third version discussed above—with a real time interactive computer part—to the list of possible modes of performance, the score needs to fully document and guide the performer in how to set up the computer part.

IntegraBrowser
beta demo test version of the Integra Browser
Try it

To allow for these considerations—the performance aspect and the 'work-in-movement' aspect—I have developed an experimental web application[41]. This application is an attempt at allowing for what may be termed the 'annotated score': An information source relating to a piece of music (or any other kind of art work) that may hold a score and any number of other documents referring to the piece (an audio or video recording, a performance instruction,

[40] "the auditor is required to do some of this organizing and structuring of the musical discourse. He collaborates with the composer in making the composition." Eco, *The Open Work* The auditor is interchangeable but not the composer.

[41] A Web application is a piece of software that is run in a standard web browser.

text instruction, information on previous 'instances', etc., all of which may be interlinked). With the Web application, called the Integra Browser, such collections of heterogeneous data pertaining to *Repetition*, or any other piece of music or general art work, may be browsed and edited (see the screenshots provided in Figure 3.5, 3.6 and 3.7). The design considerations set up for the annotated score were that

- It should encourage the interpreter to engage in a collaborative process similar to the one we have gone through with the primary goal not to repeat or recreate our process but to find his or her own unique version.
- It should allow the performer to look up any part of the notation at any instant.
- It should allow for the interpreter to easily create a static form that he/she can use in performance.
- It should contain all the software and all the sound-files needed to create an interactive as well as a non-interactive version of the computer part.
- It should document important parts of our collaboration and allow for other performers to add important parts of their own collaborations with the work.

Realizing the first versions of the notion of an annotated score, fulfilling these design goals, is possible making use of the *libIntegra* framework and the associated IXD file format.[42]

3.7 Summary

In this chapter I have tried to unwrap the process that led to the work-in-movement *Repetition Repeats all other Repetitions*. The significance of the pre-study phase in which Stefan and I attempted at a closer understanding of the musical collaboration as method. These studies provided important information that shaped how the project evolved. The Six Tones and the experiences gained from working with Vietnamese music further deepened the collaborative aspect of the project which neither one of us had yet fully conceived of as the open work kind that had begun to emerge. The first performance version deviated from almost all aspects of the intention of the piece and, for the same reason provided us with an opening towards a different understanding of open form. Due to this, the collaboration did not end with the first performance, rather, it had just started. The need to break loose from that version gave birth to the idea of a version for the abstract dadaist film *Symphonie Diagonale* by Eggeling. Again, this version took us further away from the original intentions but closer to the new intention: the concept of the work-in-movement. A short overview of music and collaboration, and some possible points along the collaborative-non collaborative continuum was presented. Finally, the augmented score as a carrier of a work-in-motion was proposed. An experimental version of a Browser for augmented scores built on top of the Integra framework and file format was presented.

It is my hope that *Repetition* will not fall to a rest but continue to develop. Versions for other (string) instruments are possible, but also versions for computer(s) only. A work-in-movement thrives on its motion and must not stagnate.

[42] The details of the format is described in Bullock and Frisk, "libIntegra: A System for Software-Independent Multimedia Module Description and Storage". See also Appendix D

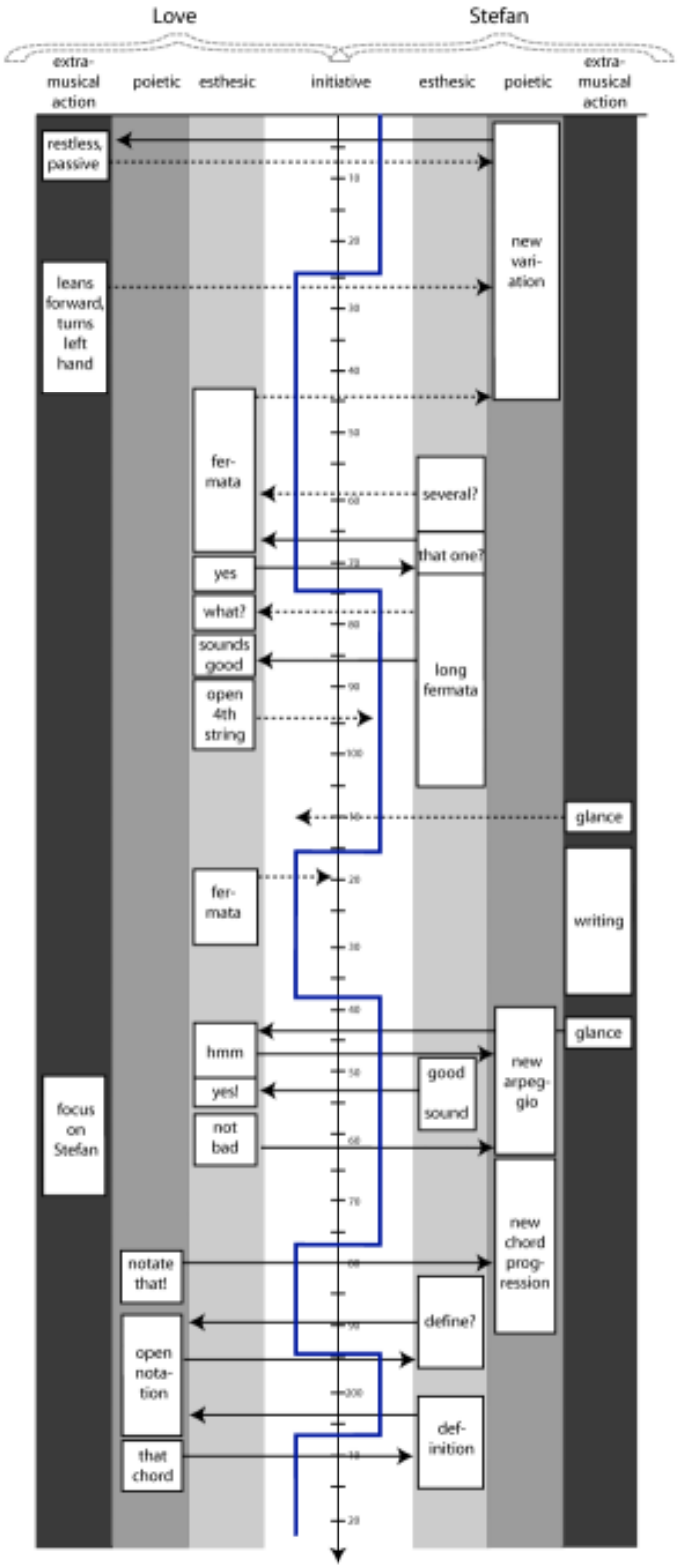

Figure 3.2: A graph of the interaction between Stefan Östersjö and Love Mangs in the session analyzed and discussed in Section 3.1. The scale in the center axis refers to line numbers in the transcription of the video and does *not* represent linear time.

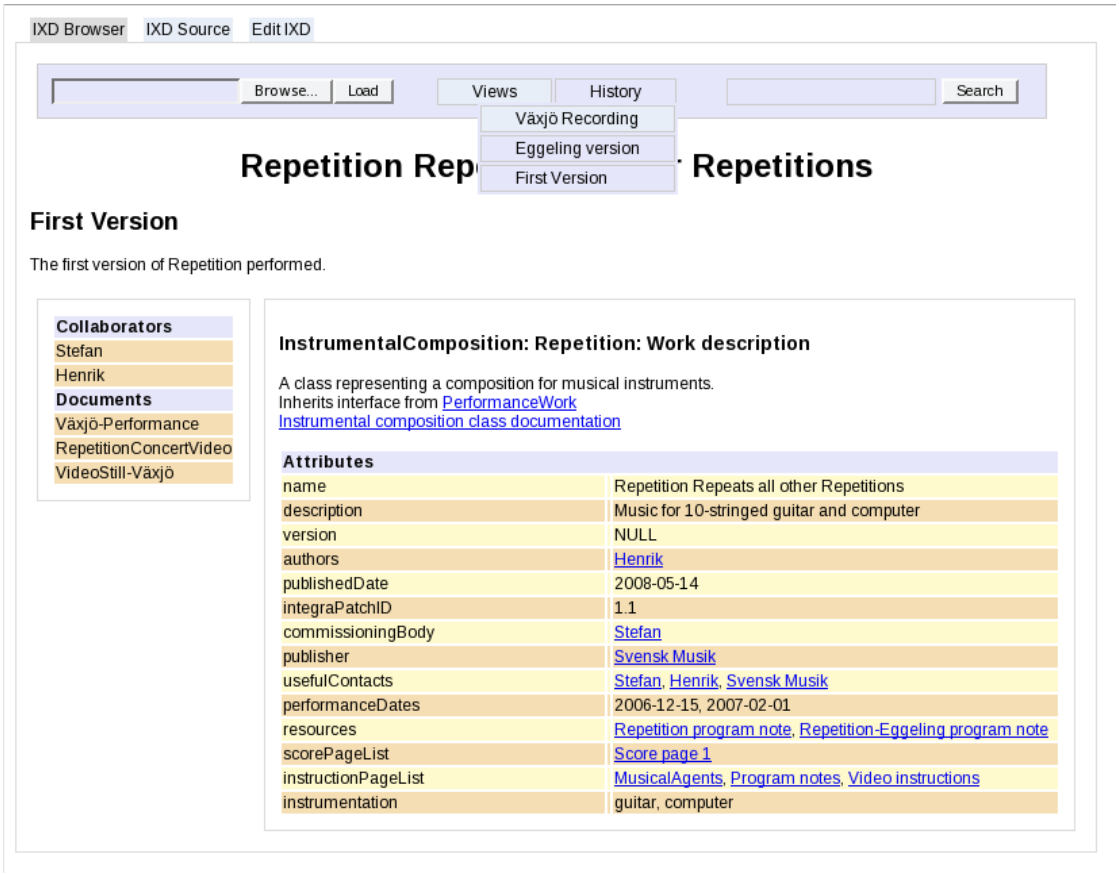

Figure 3.5: The IntegraBrowser displaying the base record for *Repetition Repeats all other Repetitions*

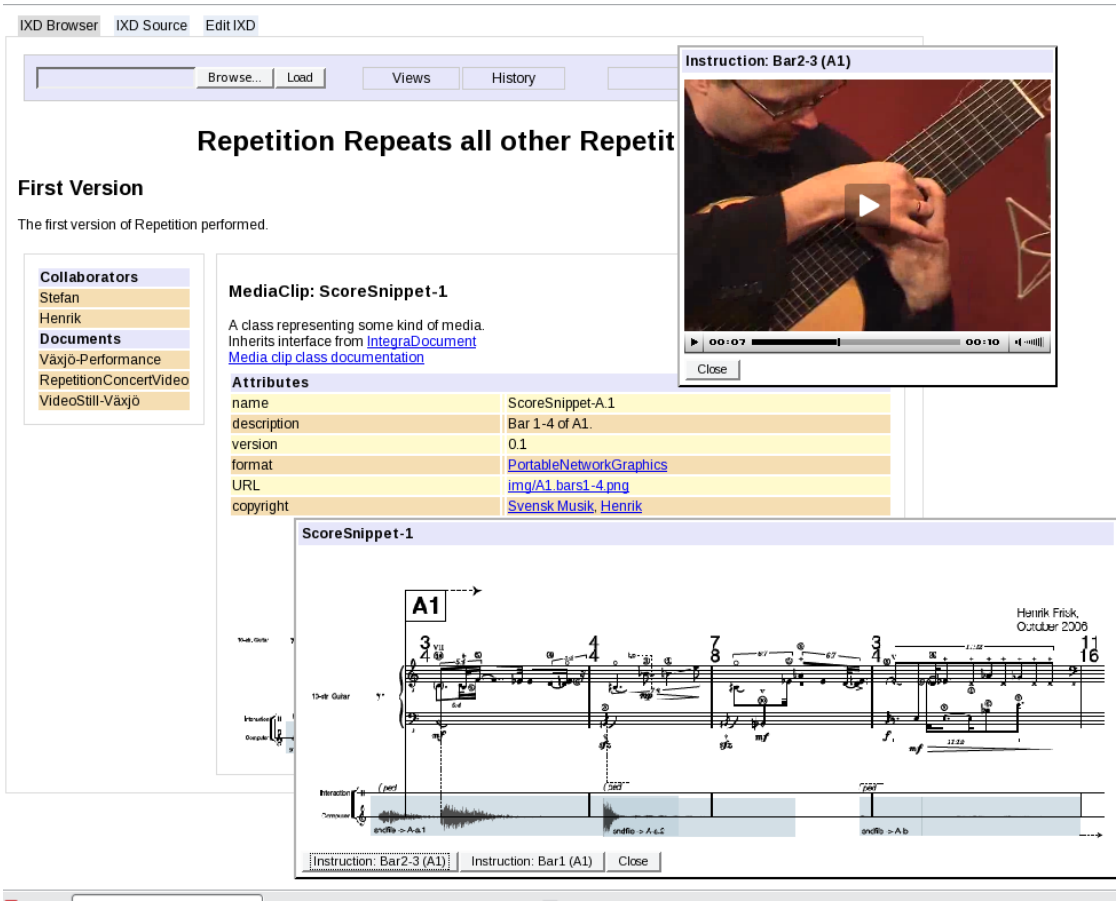

Figure 3.6: A second pane displaying a score snippet with an associated instruction video.

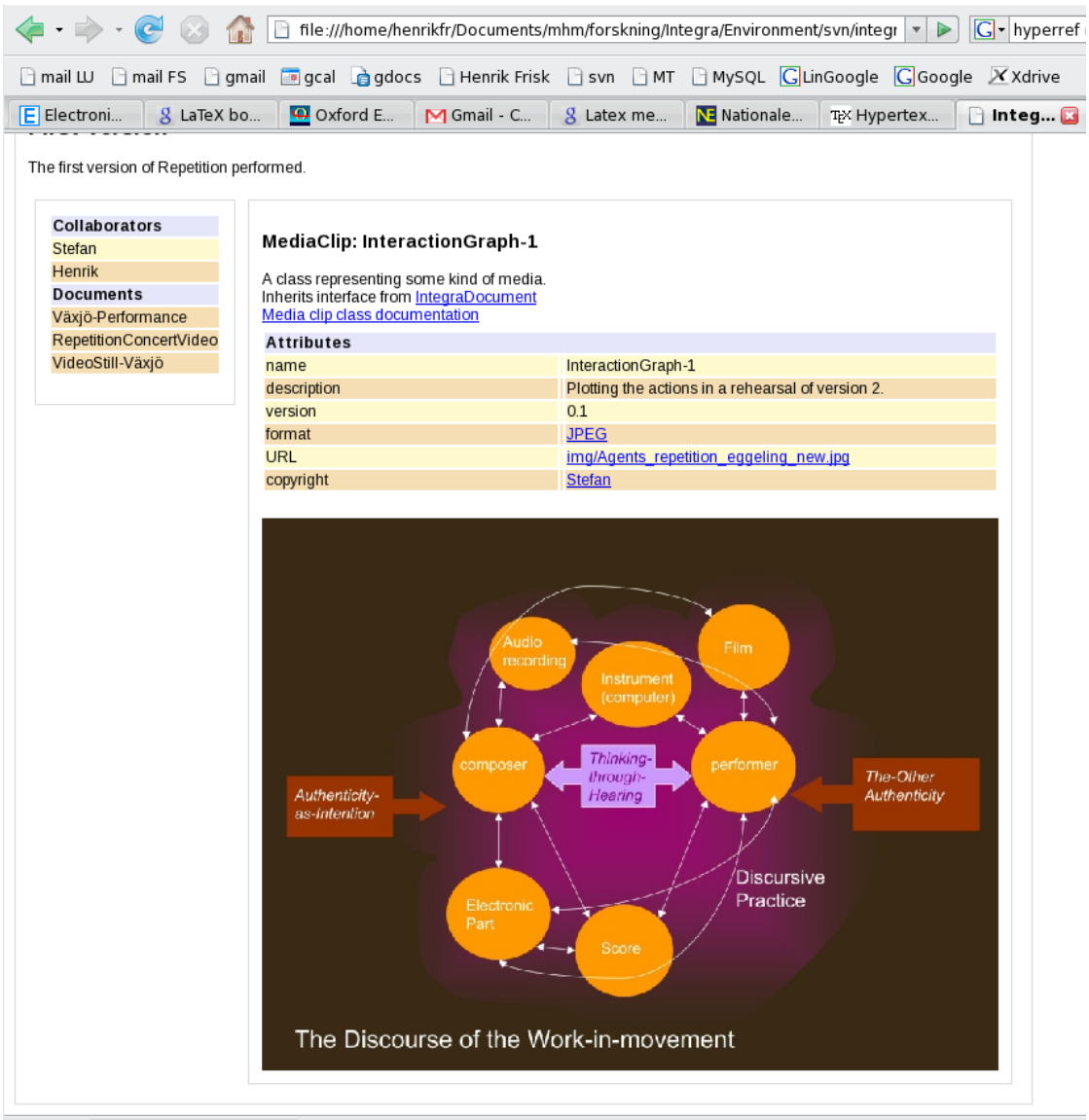

Figure 3.7: This pane is showing how meta-information and different modes of analysis may be attached to a score. This picture is mapping the interactions between the different agents in my collaboration with Stefan Östersjö.

Chapter 4

Interaction and the Self

In the following text I will discuss the concept of interaction and its relation to different technologies. The meaning of the different kinds of interaction as well as (musical) examples of their usage. As with some of the other texts I am combining several different modes of reflection in what may best be described as a non-structured manner although it should be clear that the reasons for this organization are more closely related to method than to lack of method. It is my hope that the reader, in spite of the non-structure, is able (and willing) to navigate through these thoughts.

Since I first started using computers in my musical practice in 1994 I have been searching for ways in which to use them creatively while improvising as well as composing. In most of my compositions since then the computer is incorporated as a 'player' along with acoustic instruments and in recent years I have also begun to perform *on* the computer, as opposed to play it through another (acoustic) instrument. But in the beginning my dominating interest was with improvising with the computer; with playing saxophone and using that which I played to give the computer impulses to play with me. Interacting with a computer in the context of (improvised) music, questions regarding the interaction—its prerequisites and its needs—are inevitably raised and it is not, has not been to me, obvious how to pose the questions. The questions may be asked looking at the matter from the 'outside'—e.g. analyzing and evaluating that which I do or try to do, leaning towards established theories—and they may be asked investigating the 'object' from the 'inside' by instead turning to the actual *playing*. In this project I am using both methods which obviously have to overlap to a considerable degree. The questions will not always be the same ones but will vary along with context and with time, just as the needs imposed on the interaction will not be the same for every situation. This research project is about raising issues that allow me and others to keep asking and reformulating these questions as new technology becomes available and new knowledge is produced. The somewhat ambiguous genre identifier *interactive computer music* (is there a music which is *not* interactive in some sense?) may easily encompass all of the contexts in which I am, and have been active—as well as many others—depicting a music in which computers or, in fact, other electronic devices or instruments are manipulated in real-time. The discussion below is an attempt to untangle the meaning and significance of *interactive* and *real-time* with regard to my own artistic practice and my aesthetics.

The first years of playing—in every sense of the word—with the computer, despite the laptop's young age and the fact that any 'direct manipulation' of audio was out of the question, was very creatively stimulating to me. But, after the initial fascination for the ostensibly interminable possibilities of the computer as 'instrument' had settled, several issues were called into question. What is interaction? What does it mean to interact with a computer? Should the interaction with the computer be different from interacting with a fellow musician? Is there any reason at all to 'play' with a computer (rather than with a fellow musician)? Do I want to play 'with' or 'on' the computer? When I play, what do I express that has bearing on the current musical expression and, if successfully extracted, can that information be quantified and transformed into meaningful, machine readable data? This last question may be said to summarize, albeit very briefly, one of the challenges of interactive electro-acoustic music: To develop *interfaces* that may act as intermediaries between performer(s) and computer(s).[1] In a situation with one musician and one computer involved in an interactive performance, *if* it is of interest that the sounds produced 'blend'—that they may be perceived as having some attribute in common, though this attribute may not necessarily be known or even identifiable—what are the necessary prerequisites that would allow for the sounds to 'blend'? How can a 'common ground', some sensation of unity, or "*fused sounds*",[2] be established between the actual and the virtual performer and how are the relevant parameters communicated between the different players? These were essentially the questions that led me into this project and, though still highly relevant, the issues of *what* and *how* to communicate with the machine have become subordinate to the question of the interaction in itself. With that I mean to say that a clouded concept of the intentions and purposes of the interaction—of the particular contextual meaning of interaction—is likely to result in an equally clouded interactive system.

The subject of 'blending'—perhaps a more appropriate term is 'sonic interaction'—was briefly discussed in the Introduction, in the section on *timbreMap* while the remainder of this section will deal with questions pertaining to the topic of musician-computer interaction. The question 'What is interaction?' is clearly not specific to the field of music. Or, to put it more precisely and less axiomatic: though it is not particular to music, the way interaction is dealt with in the field of music is to a large extent informed by how it is dealt with in other realms, such as the social or the technological. And, inversely, any findings within the field of music made with regard to interaction *may* have general relevance, but may just as well be specific to music, interactive music, or even only to the particular case. In other words, as with many concepts there is a terminological fluidity involved which necessitates a discussion involving several aspects on the subject matter. Below I attempt at such undertaking also involving my experiences of interaction accumulated from *Drive*, *etherSound*, *timbreMap* and *Repetition Repeats all other Repetitions*.

[1] Gestural control, where "gesture is used in a broad sense to mean any human action used to generate sounds", (E. R. Miranda and M. M. Wanderley as quoted in Jensenius, "ACTION – SOUND. Developing Methods and Tools to Study Music-Related Body Movement." P. 39) is a large and very active field of research, which in a sense may be said to be closely related to (traditional) instrument design. The yearly NIME conference (see http://www.nime.org/) is devoted to the topic and Jensenius's PhD dissertation referenced above discusses gestural control in (electro-acoustic) music. For a general overview of "interface typologies", see Simon Emmerson. *Living Electronic Music*. Ashgate Publishing Ltd., London, 2007, pp. 135-42.

[2] Ibid., p. 126.

4.1 Interactive Music

Before discussing the implications of interaction also independently of the field of music, the conception of interactive music itself—the focal point of this thesis—needs to be considered. Not only is the term by itself misleading and ambiguous, in practice, as a genre, it is used to denote so many different kinds of musical activities that the question of interaction looses its meaning.

What then is *interactive music*? That question prompts the rhetorical: Is there a music that is not interactive? That does not interact with its environment and its listeners in some way? Depending on the context, commonly when the term *interactive* is used, it is implied that one of the 'subjects' in the interaction is a computer or some other electronic device. This holds true also for music—interactive music implies computer music which is paradoxical because, if interactive music equates with interactive computer music, that implies that computer music, without the interactive prefix, somehow is void of interactive elements. At the same time, today, any human endeavour with a computer is referred to as human-computer *interaction*. That is, composing at the computer today, almost regardless of how the process is carried out, qualifies as human-computer interaction, it is by definition an interaction with the computer. For this reason, strictly speaking, computer music, i.e. non-interactive computer music, can only be music created and performed by computers only. Which is obviously not the case. Not yet. But the question that begs for an answer remains: what is it that is so specifically interactive about interactive music, and in what way does its interaction(s) deviate from the way that all music is interactive? On the one hand the inquiry can be dismissed as uninteresting and irrelevant. If interactive music is a genre identifier asking about the significance of 'interaction' is as meaningful as questioning what is 'dead' about death metal. On the other hand one may (continue) to assume that the 'interactive' part of the term refers to some aspect of the construction of the music it denotes. My primary concern here however, is not for the *genre*, but for the ways in which computers allow for interaction in the production of musical content.

Now, it is possible, and perhaps quite common, to assert that, in some sense electro-acoustic music recorded onto, and played back from, a tape, CD, hard drive or similar does not fulfill the requirements of that which one would expect from something which is labeled *Interactive*. That is to say that the *performance* of the music is expected to allow for interaction in some way that the genre of fixed media music[3] does not fulfill. The phases of production is likely to be as interactive for that music as for any other pre-composed music and the listening phase, the listener's interaction with the music, should present no difference in kind. Be as it may with the delimitation of interactive activities, today, in addition to pressing the 'play' button, which in every respect qualifies as a truly interactive action, different from but akin to musical performance,[4] most composers play back their fixed media pieces performing some kind of spatialization or live mixing. In other words, the composer, or someone else—an interpreter—is *performing* the work. There is even a competition organized by the Belgian research center *Musiques & Recherches* in "[l]'interprétation spatialisée des œuvres

[3] Electro-acoustic music produced in a studio and played back in concert are often referred to as tape music due to the fact that historically these pieces were not only stored on tape but also produced by means of cutting and splicing pieces of electro magnetic tape together. As the storage media is now more commonly CDs or DVDs the term 'fixed media music' is now commonly used.

[4] Choosing the right moment for a performance to start is equally important in instrumental as in electro-acoustic performances. The exact timing can mean the difference between a great and a not so great performance regardless of its relative fixity in definition.

acousmatiques".[5] Such a performance is by definition interacting with the audience, the performance space, and a number of other factors in real-time.

Truth of the matter is that interactive music can (and should) adopt any one or several of different archetypes and paradigms and, as will be shown, the word *interactive* has many meanings and may have many readings. Interactive electro-acoustic music could potentially be everything from playing back a compact disc on a home stereo to the most complex multi computer system imaginable controlling any number of real time synthesis engines. The motivation for interactive music descend from the human fascination, and dread, for technology. Attempting to create a machine that can play music with other humans is an existential quest that interrogates our abilities and know-hows (*Can the machine be constructed?*) as well as evaluates the uniqueness of human intelligence, endeavour, and creativity. What better way is there to examine these aspects of human practice than to test it on music (or chess)? But the greatest fear of all would be to succeed. Jean Baudrillard writes about World champion Garry Kasparov's chess game with IBM's Big Blue and express that "[man] dreams with all his might of inventing a machine which is superior to himself, while at the same time he cannot conceive of not remaining master of his creations."[6] The feeling of frustration due to the failure, due to not being able to replicate intelligence, and the simultaneous comforting of the firm intelligent sovereignty of mankind. Robert Rowe, at the very end of the first of his two books on the subject of interactive music, *Interactive Music Systems*, discusses the frequently aired critique that music machines and computer performers are cold, inhumane, artificial sounding, unnaturally perfect, etc. (all of which are also barriers against the potential threat of the machine). He offers the following reassuring definition of interactive music systems stating that:

> [they] are not concerned with replacing human players but with enriching the performance situations in which humans work. The goal of incorporating human like intelligence grows out of the desire to fashion computer performers able to play music with humans, not for them. A program able to understand and play along with other musicians ranging from the awkward neophyte to the most accomplished professional should encourage more people to play music, not discourage those who already do.[7]

These thoughts, that musical practice on all levels—from amateurs to professionals—may germinate thanks to the computer's increasingly great propensity to perform, improvise and compose are related to Trevor Wishart's statement that the computer is the piano of the 21st century.[8] If the amateur musician was forsaken by Beethoven and his music, which called for the "new Romantic deity, the interpreter"[9] in

[5] *"Concours de spatialisation."* Web resource. n.d. URL: http://www.musiques-recherches.be/agenda_event.php?lng=fr&id=450 (visited on 11/01/2007), § 1.

[6] The essay "Deep Blue or the Computer's Melancholia" was written in 1996 after Kasparov's winning over Deep Blue. According to the line of thought presented by Baudrillard Kasparov's subsequent loss in 1997 is nothing short of a terrible defeat to mankind. (Jean Baudrillard. *Screened Out*. Trans. by Chris Turner. Verso, London, UK, 2002, pp. 160-1) However, we may turn to Hannah Arendt for our consolation who, in the context of chess playing machines, points to the important difference between human *intellect* (as needed for chess playing) and human *reason*. And furthermore, it is not really the machine, Big Blue, that won, but rather those who programmed it to win. (Arendt, *Between Past and Future*, p. 269)

[7] Rowe, *Interactive Music Systems*, p. 262.

[8] In the 20th century the piano was the musical instrument of the middle class, as taken over from the bourgeoisie of the 19th century. The most common musical instrument for the middle class of the 21st century will be the computer (as an instrument it is likely to extend across class boundaries). Trevor Wishart at the opening round-table discussion at the Connect festival 2006, Malmö Academy of Music, Sweden.

[9] Roland Barthes. "Musica Practica". In: *Music, Image, Text*. Trans. by S. Heath. Esprit, 1971. Pp. 149–54, p. 152.

the 19th century, and the listeners were desolated by the "double economy" of the serialists and avant-garde composers,[10] the thought that the amateur musician is reanimated by the musical interaction with the computer is riveting. The computer, originally, in a sense, the ultimate tool of formalist modernism now instead playing the part as a decentralizing machine, initializing the revival of the musical amateur in a movement that subjugates the advantages of the mythical expert.

The critic will object against this positive description of the computer as a musical instrument and tool, with the potential to distribute and decentralize music and its constructions, stressing that the sense of 'freedom' and 'liberation' (from the structures of musical production) offered by technology is only a chimera. That the forces of power and production are controlling also these aspects. That is, if we feel free to create our own, private, soundtrack to our lives, it is because someone wants us to feel free, because there is a great profit to be made (for this someone), lurking behind the corner as a result of your imaginary freedom. Because, as Adorno and Horkheimer writes, a "technological rationale is the rationale of domination itself",[11] a machine such as a computer can never contribute to freedom in the social domain. But, at the same time, if the distinction between the spheres of "the logic of the work and that of the social system" has been wiped out, this "is the result not of a law of movement in technology as such but of its function in today's economy."[12] In other words, whatever suppressive tendencies technology may show are not necessarily properties of the technology itself, but emanate in economical power structures closely related to technology. Furthermore, though present day "[a]utomobiles, bombs, and movies"[13] to an increasing degree rely on software to do their job, a multipurpose machine such as the computer does not do *anything* without software—yet the hardware by itself still obviously qualifies as technology. Hence it follows that there is a distinction to be made between technology as hardware and technology as software. The former category is signified by physical objects with a clearly defined, and not easily modified, purpose (cars, proprietary software, etc), and the latter by amorphous tools whose shape and usage, in essence, is defined by interaction (open source software, truly interactive and cybernetic devices, etc.). Because the computer can host software which may be altered, and because the paths of these alterations can be highly distributed—any group of people, with almost any geographical location, may contribute—doesn't the computer and present day technology, in fact *resist* the single rationale of domination suggested by Adorno and Horkheimer? Or, put differently, regardless of the *enframing powers* of technology (see Section 4.3 for a discussion of Heidegger's concept of enframing) and regardless of the powers of domination induced by economy, is it not true to say that software that alters the technology may in fact make the it (the hardware) useful in ways that are independent from the technological rationale? If the

[10] The 'double economy' refers to the duality particular to a modernist attitude where, while the 'business' itself—the composing and staging of musical works—is extremely costly, the movement earns its authenticity from its lack of revenue and profit. One of the points of departure for McClary is composer Milton Babbitt's 1958 article "Who Cares if You Listen?" the title of which hints at its message (see also the discussion in section 3.2. It should be pointed out that it is not the avant-garde in general that McClary is criticizing here, but certain specific traits of the sub-culture. Susan McClary. "Terminal Prestige: The Case of Avant-Garde Music Composition". In: *Cultural Critique* 12 (1989). Pp. 57–81, p. 61; For a response to one of the contributions to the heated debate that followed McClary's 1989 essay, see also Susan McClary. "Response to Linda Dusman". In: *Perspectives of New Music* 32.2 (1994). Pp. 148–153.

[11] Theodor W. Adorno and Max Horkheimer. *Dialectic of Enlightenment*. Trans. by J. Cumming. Verso, 1997 (1944), p. 121.

[12] Without doubt is the economy of 1944 different from the economy of early 21st century, but if it was true then, I feel it is safe to assert that it has some relevance also today. ibid., p. 121.

[13] The original context for this list of technologies sheds further light on the technological rationale and reveals the strong criticism: "A technological rationale is the rationale of domination itself. It is the coercive nature of society alienated from itself. Automobiles, bombs, and movies keep the whole thing together until their leveling element shows its strength in the very wrong which it furthered." ibid., p. 121.

concept of this rationale is approached freely, that is, somewhat disengaged from the sociological thinking of Adorno and Horkheimer I believe it is in the interstices between the two categories of technology just outlined that the technological rationale and the rationale of domination are neutralized. In this small structural space or discontinuity the critic mentioned above may be proved wrong, and it is here that the powers of capitalism and consumerism in actuality *cannot* control how and why the technology is used. Here is where the computer proves that it is indeed a potential vehicle for musical expression, equally stimulating to the amateur and the expert. Moreover, software that allow for musical interaction with the computer, in whatever way that interaction manifests itself and apart from the ways it will promote musical activity, may contribute to a disruption of music as commodity, and move towards music as activity. While Robert Rowe makes "no claims of special social or aesthetic virtue inherent to interactive music"[14] he also believes that "if computers interact with people in a musically meaningful way, that experience will bolster and extend the musicianship already fostered by traditional forms of music education. Ultimately, the goal must be to enrich and expand human musical culture."[15] And if the computer can be made musically useful as an interactive player, I am confident that the ways in which this was achieved, the interactive methodology so to speak, may also be very useful outside the field of music.

To briefly summarize, interactive music can be many different things. It is interactive just as *any* music or musical activity is interactive. If there are aspects of interactivity that are particular to interactive music in general, they are constituted by the mode of interaction made possible—or, which is sometimes the case, made *impossible*—by the presence of computers and electro-acoustic instruments. Whereas traditional musical practice may sometimes be assigned a romantically lofty position as an independent artform untouched by worldly reality (a picture obviously not true), computer music is contrarily "often accused of leading us to a day when machines will listen only to machines"[16] (obviously not true either). In between these opposites of musical mythologies, interactive music has an interesting multifaceted role to play. One which includes, I will argue, a strong social dimension related to the significance and meaning of technology in society and one that may teach us something about the role of technology in the 21st century. But this role, the role of technology, is always also influencing the way we deal with music, particularly so in interactive music. It will be claimed below that human-computer interaction, i.e. interaction with computers *outside* the realm of music, is synonymous to a mode of *control*—an attempt at curbing the powers of technology to make it useful. As a result, to reinforce the users sense of being in control, a 'cleanliness' in time and space in the intercommunication between those engaged in the interaction is aimed for. The (real-)time aspect is critical in this context because it is only when the control action, the human input, and the acknowledgment of the input, the response from the machine, is contiguous that the user will be able to connect the two. The magnitude of possible ways in which social interaction may be carried out on the other hand, makes the relation between the action and the feedback—the response—less useful to discuss in terms of milliseconds. In contrast to HCI, the response to, or acknowledgment of, an action may be a silent recognition—a body movement or facial expression—and the esteem given to the actual response is not necessarily measured according to it coinciding in time with the stimulus. Human-computer interaction and social interaction

[14] Rowe, *Machine Musicianship*, p. 6.
[15] Ibid., p. 5.
[16] Ibid., p. 6.

are two demarcation points that are used to formulate questions concerning the modes of interaction in interactive music.

4.2 Multiple modes of interaction

In the previous section a perhaps unsuccessful attempt was made to uncover the identity of interactive music. But what is the identity of the word interactive? What are its meanings?. If, to begin with, we turn to the Oxford English Dictionary's definition of the adjective we find two distinct meanings:[17]

1. "Reciprocally active; acting upon or influencing each other."

2. "Pertaining to or being a computer or other electronic device that allows a two-way flow of information between it and a user, responding immediately to the latter's input."

A general meaning relating to interaction in the social realm, and a more specific, in fact very different, meaning connected to the technological sphere. Though the second meaning, in most cases, is not at all social, it very often *mediates* social interaction (phone, e-mail, internet) and may also exercise social *control*.[18] The profound difference between the two accounts given by the Oxford Dictionary may be educed from the verb 'influence' of the first definition as compared to 'respond' of the second definition. The first, seemingly, denotes a meeting on equal terms, where the influence is mutual; the participants in this kind of interaction are equally likely to be influenced as they are to influence. The second definition, concerning interaction with electronic devices, is suggestive of an *un*equal relation where only the actions of one of the participants are influential: It is demanded of the electronic device to "respond *immediately*" to the user's input. Furthermore, the specifier "immediately" indicates that time is of some significance, whereas there is no mention of it in the first definition. These two, still rather unspecified and, unless their contextual and comparative meanings are carefully considered, equally problematic, uses of 'interactive' may roughly be said to correspond to previously mentioned signposts of 'social interaction' and 'human-computer interaction'.[19] I sense, perhaps erroneously, that there is a tendency for confusion, a dissolution of meaning, or uncertainty, between 'social' and 'computer' interaction.[20] This is not necessarily a bad thing; after all, the meaning of words and terminology are in a constant flux, and especially so for emerging fields of inquiry. However, once we introduce 'musical interaction', though likely to overlap, the three types of interaction, 'social', 'computer' and 'musical', are largely asymmetric to each other and in electro-acoustic music, with a strong technological presence, the distinctions—let alone the definitions—are difficult to draw. Let me stress again that I am not interested in

[17] "interactive, *a*." The Oxford English Dictionary. 2nd ed. 1989. OED Online. Oxford University Press. 1 Nov. 2007. http://dictionary.oed.com/cgi/entry/50118746

[18] Although their book, as well as much of their research, focuses on how electronic communication increase participation, *reduce* social control, and provide better conditions for group decisions in the corporate world, Lee Sproull and Sara Kiesler also discuss the new possibilities for exercising social control that comes with electronic communication. See Lee Sproull and Sara Kiesler. *Connections. New ways of working in the networked organization*. The MIT Press, Cambridge, Mass., 1991, Chap. 6

[19] Conceivably there are types of interaction and interactive activities that do not fit in with social and computer interaction. 'Musical interaction' would be said to cover aspects from both of these definitions.

[20] In an interview with composer and sound(scape) artist David Dunn, interviewer René van Peer feels it necessary for Dunn to designate what kind of interaction he is talking about: "when you use the word 'interaction,' you mean something different from what people make it mean in computer-related contexts." Dunn replies that he thinks interaction is "largely a misnomer as it's used in computer culture". According to Dunn the entire concept of 'computer interaction' is a dissolution of the meaning of social interaction. See David Dunn and René van Peer. "Music, Language and Environment". In: *Leonardo Music Journal* 9 (1999). Pp. 63–67

an instrumental delineation and separation of the kinds of interaction present in music. The activities in a performance of interactive music belong by necessity, not to *one* type of interaction, but to multiple kinds simultaneously. Furthermore, we are exposed to different types of interaction in parallel every day in that much of our daily communication and social interaction is mediated by technology; computer interaction mediates social interaction. However, in order to better understand the possibilities and the limitations of performer-computer interaction, a prerequisite for designing (and using) interactive systems, it is necessary to be able to identify the different modes of interaction that may operate simultaneously.

In his paper on the ontology of interactive art Dominic M. Lopes discusses "hyperinstruments" with references to George Lewis's *Voyager*[21] and Todd Machover's *Brain Opera*,[22] among others, and state that these kinds of works "are frequently touted as 'interactive,' but this is true in only a trivial and uninteresting sense." I believe that the argument behind his dismissal is rooted in a confusion between different kinds of interactivity. According to Lopes *Voyager* is not interactive art, or at least not interesting interactive art, because playing an instrument, any instrument, is an interactive activity, and "if any notion of interactivity is to be worth serious attention, it must be more refined a notion than the ordinary concept of interaction."[23] Though equating musician-instrument interaction with musician-instrument-computer interaction (as is the setup in *Voyager*) may be theoretically useful, it does not tell me as a developer anything about how to develop better interactive systems (it cannot get any better than the trombone?) and it gives me as a listener, an incorrect view of the computer (as already an integral part of the instrument and/or the performer?). Rather than refining the "ordinary concept of interaction" (whatever that is or may be), as suggested by Lopes, I argue that different interactive strategies can be deployed in parallel. When I listen to George Lewis and Roscoe Mitchell improvising together with/in *Voyager*, that is what I hear: I hear that the interaction between the two musicians and the computer are of a different order than is the interaction in between Lewis and Mitchell. I see in this a multiplicity of interactive modes in fact quite common in many kinds of music. Ingrid Monson, which we will return to later, points at how, in a jazz rhythm section, the groove is (but) one 'interactional text'[24] and the relation between this and the soloist is another, dynamically linked to the former (and these are just two of many possible interactional texts).[25] It appears to me very difficult to unambiguously state that one of these 'texts' would be more "refined" than the other, which is the evaluation Lopes calls for.

As was suggested above, with regard to interaction what may be useful in one field of inquiry is not necessarily applicable to another. The affinity between interaction as understood within the field of music and the arts, and interaction in the 'extra-artistic' world is not necessarily conspicuous. Nevertheless, both music and the arts in general, are often mentioned as sources of knowledge for the disentanglement of human-technology relations. For Martin Heidegger art plays a central role in the unfolding of technology. In his seminal essay "The Question Concerning Technology", he sees in the arts a possible alternative to the technological attitude, a counterbalance to the "enframing" powers of technology and its predisposition for ceaseless

[21] Lewis, *Voyager*.

[22] See Joseph A. Paradiso. "The Brain Opera Technology: New Instruments and Gestural Sensors for Musical Interaction and Performance". In: *Journal of New Music Research* 28 (1999). Pp. 130–149. See also Rowe, *Machine Musicianship*, pp. 360-2

[23] Dominic M. McIver Lopes. "The Ontology of Interactive Art". In: *Journal of Aesthetic Education* 35.4 (2001). Pp. 65–81. ISSN: 00218510, p. 67.

[24] "Interactional text" is a term Monson has borrowed from anthropologist and linguist Michael Silverstein, in this context according to Monson denoting the "interactive construction of the musical surface."Monson, *Saying Something*, p. 189

[25] Ibid., p. 188.

quantitative categorization; a reflection of the human will to control nature. Towards the end of the essay he concludes that "essential reflection upon technology and decisive confrontation with it must happen in a realm that is, on the one hand, akin to the essence of technology and, on the other, fundamentally different from it. [...] Such a realm is art."[26] But before continuing I should already here make a few reservations with respect to "The Question Concerning Technology": (1) I have no intention to attempt to fully unravel all aspects of this wonderfully intricate text. In a sense there is enough material in it, and in Heidegger's relation to technology, work and production at large, for a thesis entirely devoted to the subject.[27] Instead I will allow myself to use it, and relate to it somewhat more freely. (2) It should be noted that 'technology', as the word is used by Heidegger, alludes to technology in a much wider sense than what I am concerned with here. But also, at the same time, with a meaning more contracted, excluding present day distributed (information) technologies.[28] (The essay was written in 1954 when the computer primarily existed as an abstract thought.) (3) Because technology, according to Heidegger, "is not equivalent to the essence of technology",[29] which is to say that, that which is akin to its *essence*, although it may be, is not necessarily closely related to the *representation* of the technological. In other words, what may first look like an acclamation of the (at the time non-existent) digital arts as a discipline that seemingly fulfills both aspects of closeness and distance to technology, is, to little surprise, in reality meant to be something much more abstract. (4) Finally, and most interestingly in the present context, when Heidegger points to the indispensable role art may play in the understanding and unfolding of technology, regardless of its dangers and frenziedness, he emphasizes that, as a prerequisite, the "reflection upon art [...] does not shut its eyes to the constellation of truth, concerning which we are *questioning*."[30] If for the sake of argument the difficulties in clearly separating *technology* from *music* and *human-computer interaction* from *musical interaction* are dissembled. Then, in a free interpretation (an improvisation?) of Heidegger, the quote above will serve as a reminder that, whatever fascination may be experienced for the technological aspects of interaction, when dealing with interactive music, *music* and the way it is revealing itself, should be in the first instance: Only then will the right questions be asked.

Judging from the many examples of art being referenced in discussions relating to computer usability, the call to relate to artistic practice and the field of art as a method for evaluating interactive systems and for developing and enhancing interactive models has survived. It is in fact used, albeit in a limited range, perhaps not to increase the creative potential of technology but at least to reduce its 'enframing' aspects. Or, as Kirlik and Maruyama writes, in order to avoid "the ever-increasing use of proceduralization and automation in sociotechnical systems". In their attempt to bring about "[a] common framework for studying perception and performance in both human-technology interaction and music" they conclude, with a reference to Leonard Meyer,[31] that "'deviations' from the written score and oral tradition" are essential to the practice of music.[32]

[26] Martin Heidegger. "The Question Concerning Technology". In: *Basic Writings*. Ed. by Deavid F. Krell. 2nd ed. Translation by D. F. Krell. Harper San Fransisco, 1993 (1954). Pp. 311–41, p. 340.

[27] An example of this is Zimmerman's well-informed book on Heidegger and modernity: Michael E. Zimmerman. *Heidegger's Confrontation with Modernity: Technology, Politics, and Art*. Indiana University Press, 1990.

[28] See Peter Kemp. *Det oersättliga. En teknologietik*. Brutus Östlings Förlag Symposion, Stockholm/Stehag, 1991, pp. 26-9.

[29] Heidegger, "The Question Concerning Technology", p. 311.

[30] Ibid., p. 340.

[31] Leonard B. Meyer. *Emotion and Meaning in Music*. Chicago, IL: Univ. Chicago Press, 1956.

[32] Kirlik and Maruyama (and Meyer) are only concerned with Western, score-based music, but the point they are making—that improvisation is an important aspect of musical practice—may be asserted for most musical practices. See also Benson, *The Improvisation of Musical Dialogue*

Whereas in music, there is a large component of freedom and room for individual decisions, according to the experience of the authors "design and training in many sociotechnical systems proceed [...] as if 'doing it by the book' or working 'like a machine' were admirable qualities. Experienced human operators know otherwise, and in their better moments, so do engineers, researchers and practitioners in human-technology interaction."[33] A sociotechnical system and interactive electro-acoustic music shares, at least to some limited extent, the interrelation between social/musical and technical aspects. Hence, both fields have in common the need to investigate the relation between the different modes of interaction operational within the system. But herein lies the danger of committing the mistake portrayed by so much science fiction literature: Rather than attempting to fit technology with humans, the human is mechanized to accommodate technology. Somewhat pointed the phenomenon can be expressed such that, because humans are noisy and irrational they pose a problem to the machine; a problem whose solution can only be the human re-factoring. This machine-centric view on interaction where "the human is often reduced to being another system component with certain characteristics, such as limited attention span, faulty memory, etc.,"[34] may be necessary when designing control systems for nuclear power plants (although I would like to think otherwise) but, unless explicitly desired, is likely to cause problems in a musical context. In a PhD dissertation on the topic of using the *flow* heuristic when building GUIs for web based applications, Thomassen also mentions music as a means"to fully research the applicability of the heuristic. The major disciplines are the field of social sciences such as psychology and cultural studies, but also the field of the arts in particular music and fine arts".[35]

All of these examples refer to music as a source containing possible clues to the development of interactive systems and their interfaces. Somewhat pointed, the tendency can be summarized: Because computers are 'cold' and 'insensitive' and music is 'warm' and 'emotional' a crossbreed should allow for a more dynamic and less strained human-computer interaction that is not *only* dictated by the social limitations of the technology. My point here is not to critique these works but to attempt at understanding the complex interrelations between different interactions. Technology as well as art is constructed by how we think about it and, perhaps, if we think of technology through art, as suggested by Heidegger, an alternate perspective may reveal itself. But we may equally well come up with an art that is more technological because, in the terminology of Heidegger, the *enframing* of technology is already a fact and as such it limits our possibilities to perceive the world. However, the "essence of technology is in a lofty sense ambiguous" which is to say that the very meaning of enframing is ambiguous and such "ambiguity points to the mystery of all revealing."[36]

If machine like operation, repetition without difference, without change, is, as Kirlik and Maruyama writes "admirable qualities" then not only the object for which we assert this judgment, but also our interactions with it, is likely to be affected. But, the solution is not, I believe, as simple as making the technology more 'human' (which is not by any standard a simple task), nor is it to at all costs reduce resistance; to

[33] A. Kirlik and S. Maruyama. "Human-Technology Interaction and Music Perception and Performance: Toward the Robust Design of Sociotechnical Systems". In: *Proceedings of the IEEE* 92.4 (2004). Pp. 616–631, p. 629.

[34] Bannon, L. as quoted in Kari Kuutti. "The role of psychology and human-computer interaction studies in system design." In: *Context and Consciousness: Activity Theory and Human-computer Interaction*. Ed. by Bonnie A. Nardi. The MIT Press, Cambridge, Mass., 1996. Chap. 2, pp. 7–44, p. 27.

[35] Aukje Thomassen. *In control: Engendering a continuum of flow of a cyclic process within the context of potentially disuptive GUI interactions.* PhD Thesis, Univ. of Portsmouth and Hogeschool voor de Kunsten Utrecht. Hogeschool voor de Kunsten Utrecht, The Netherlands, 2003, p. 239.

[36] Heidegger, "The Question Concerning Technology", p. 338.

make the interface to the technology 'transparent' to the user (although this is exactly what I thought when I started this project). I acknowledge the need for the ordinary computer users to have a UI that makes their interactions with the computer easy and effortless.[37] But those needs, and the thinking and research that has led to the solutions of the problems addressed by those needs, are not necessarily useful when we move from the domain of production and corporate efficiency to the abstract domain of artistic practice. That the latter domain has been used to inform or inspire the design of a UI, as Thomassen and Kirlik and Maruyama suggest should be done, will in this regard not make a decisive difference.

One may argue that the difference between interacting with a computer and interacting with another human being is so immense that the discussion of this difference is superfluous and uncalled for. That the prerequisite for human-human interaction is that both parties exhibit some kind of sensible notion of intelligence which, by definition, the computer will never (ever?) come close to. Therefore, HCI is, and has to be, about control, about making technology useful through 'interaction-as-control', and that this is a mode of interaction that is of a different order compared to human-human interaction. There are at least two sides to this issue: (1) The first belong to the general field of HCI where there is a tendency to limit the thinking about HCI to "microlevel interactions between programmers or users and computers. The broader social forces and structures that constrain such interactions and are themselves reproduced and molded by microlevel events are often left unexamined". Not only will this contribute "to a naive image of human-computer interaction as narrowly technical and as a problem of cognitive optimization",[38] I believe it will also in effect risk at influencing the way we interact with other humans. In a debate on intelligent agents computer scientist, composer, visual artist, and author Jaron Lanier is concerned that "people will gradually, and perhaps not even consciously, adjust their lives to make agents appear to be smart. If an agent seems smart, it might really mean that people have dumbed themselves down to make their lives more easily representable by their agents' simple database design".[39] Similarly, rather than making HCI more like human-human interaction, there is a risk that we instead do it the other way around: Assert properties of HCI on our human interaction. (2) The second aspect is closely related to the core of this project. If we differentiate HCI from human-human interaction—understand them as two distinct and only remotely related modes of activity—how should we understand interactive music, or any other form of interaction with a computer within the spheres of artistic practices?

[37] It should be noted that I don't think that this stage is by far reached in the operating systems and programs offered by commercial companies today. In a big survey (6.000 participants) produced by one of the largest national trade unions for officials in Sweden (Sif), though 80% felt the IT systems used where invaluable in their day to day work and in their customer relations, a stunning 50% felt the software negatively influenced the way they worked, and 50% felt the interfaces and help functions were defective (bad usability) (Åsa Johansson and Torbjörn Lind. *Bättre – men långt ifrån bra. Om Sifmedlemmars IT-miljö*. Report. July 2007. URL: http://www.sif.se).

[38] Yrjö Engeström and Virginia Escalante. "Mundane Tool or Object of Affection? The Rise and Fall of the Postal Buddy". In: *Context and Consciousness: Activity Theory and Human-computer Interaction*. Ed. by Bonnie A. Nardi. The MIT Press, Cambridge, Mass., 1996. Chap. 13, pp. 325–73, p. 325.

[39] Jaron Lanier. "My Problem with Agents". In: *Wired* 4 (Nov. 1996). Available online at http://www.wired.com/wired/archive/4.11/myprob.html, ¶ 3 Throughout his writings, Lanier makes numerous accounts on the dangers of considering computers as possessing intelligence precisely for the reasons here mentioned. "What starts as an epistemological argument quickly turns into a practical design argument. In the Turing test, we cannot tell whether people are making themselves stupid in order to make computers seem to be smart. Therefore the idea of machine intelligence makes it harder to design good machines" (Jaron Lanier. *1000 Words on Why I Don't Believe in Machine Consciousness*. Web resource. Retrieved Nov 11, 2007. Originally published in *Sunday Times*. n.d. URL: http://www.jaronlanier.com/1000words.html, ¶ 5). Though I sympathize with this and acknowledge the problem, I think Lanier employ a too narrow and binary reading of intelligence. The political as well as personal impact technology, and in particular information technology, has on our lives should not be understated, but neither should the enduringness of human intelligence.

In the mid 90's the notion of the 'intelligent agent' (which is what Jaron Lanier opposes against above) was seen as an alternative to the tool as "the prevailing metaphor for computers".[40] The personal computer could now easily communicate with other computers, other users, keep track on things for its user, perform many things simultaneously: "Such an object seems inherently different than a hammer or wrench—it has active qualities. It acts on one's behalf—it is an agent".[41] Multimedia expert and computer visionary Nicholas Negroponte envisioned that "[w]hat we today call 'the agent-based interfaces' will emerge as the dominant means by which computers and people talk with one another"[42]. In short and somewhat simplified: Rather than you telling the computer what to do, it would anticipate what you wanted to get done and "emulate human action, assistance, and communication".[43] As with so many other great ideas, the prospect of intelligent agents has been depleted by commercialism and, personally, I will not shed any tears if never again I will receive an e-mail of 'intelligently' selected shopping suggestions.

Notwithstanding, the concept of 'software agents' holds within it the possibility of rethinking the idea of interaction with the computer. As Isbister and Layton has it: "Most forms of agent are all about the user relinguishing (*sic*) control of the computer for a time"[44]. And to be willing to relinquish control is the beginning of an understanding of HCI that also includes elements usually seen to pertain to the domain of social interaction. To give up personal control to a machine may be a frightening idea to many, fueled by horrifying science fiction descriptions: "the cataloging of the individual, the processing of delocalized data, the anonymous exercise of power, implacable techno-financial empires, [...]"[45][46] But Lévy reminds us that "a virtual world of collective intelligence could just as easily be as replete with culture, beauty, intellect, and knowledge, as a Greek temple [. . .]"[47]

> A site that harbors unimagined language galaxies, enables unknown social temporalities to blossom, reinvents the social bond, perfects democracy, and forges unknown paths of knowledge among men. But to do so we must full inhabit this site; it must be designated, recognized as a potential for beauty, thought, and new forms of social regulation.[48]

And, to "fully inhabit" we need to also invent new modes of interaction.

Onto the two definitions of *interaction* given by the Oxford English Dictionary I mapped two corresponding modes of interaction. I have already mentioned that these two modes, 'social' and 'computer' interaction, do not by any means form an exhaustive list. If anything they are dynamically defined coordinates on a plane of possible interactive strategies. A plane that can hold many other kinds of interactivities constantly redefining and repositioning each other. It appears to me that the relation and distinction between these two modes are not always effortless, and information about one mode may or may not be valid in another.

[40] Katherine Isbister and Terre Layton. "Agents: What (or Who) are They?" In: *Advances in Human-computer Interaction*. Ed. by J. Nielsen. Vol. 5. Norwood, N.J. Intellect Books, 1995. Chap. 3, pp. 67–86, p. 67.

[41] Ibid., p. 68.

[42] Nicholas Negroponte. *Being Digital*. Coronet Books, Hodder & Stoughton, London, 1995, p. 102.

[43] Isbister and Layton, "Agents: What (or Who) are They?", p. 83.

[44] Ibid.

[45] Pierre Lévy. *Collective Intelligence : Mankind's emerging world in cyberspace*. Trans. by R. Bononno. Perseus Books, Cambridge, Mass., 1997, p. 117.

[46] Though to me, judging from the popularity of online communities such as Facebook, or Google for that matter, it seems like the individual of the 21st century is quite willing to allow for the cataloging of the identity.

[47] Ibid., p. 118.

[48] Ibid., p. 118.

4.3 Computer interaction and time

One aspect of the significance of time in the discussion of human-computer interaction is to be found in the history of computing and the fact that the notion of "responding immediately" that we find in Oxford English Dictionary's definition of human-technology interaction is relatively new. That which we today take for granted when we work or play with our computers—to be able to interact with them in real-time the prerequisite for 'immediate response'—was obviously not always possible. Below I will give a short account of a part of the history of human-computer interaction and some notes on one aspect of time in musical interaction with a computer.

About 35 years ago computing was primarily a non-interactive activity done 'off-line'. Although some operations may still not be immediate on a modern computer system, at that time it was not unusual for the output from a system to arrive hours after the time at which input was given. Particularly true for computationally intense tasks such as sound synthesis, special patience was required of the early pioneers of computer music in the 60's and early 70's. Max Mathews, one of the ground breakers of computer music attest that "[a] high-speed machine such as the I.B.M. 7090 [...] can compute only about 5000 numbers per second when generating a reasonably complex sound."[49] With a sampling rate of 20kHz (which is less than half the bandwidth of standard CD quality) a 1 second long five note chord would take 20 seconds to compute and even longer, was the sound producing the chord to be 'interesting': "complexity of the instrument-unit [the part of the computer program that represents the 'instrument' played] is paid for both in terms of the computer time and in terms of the number of parameters the composer must supply for each note. In general, the complicated instrument-units produce the most interesting sounds, and the composer must make his own compromise between interest, cost, and work."[50] Even more frustrating then if the sound turned out to be useless and the process had to be restarted. In his keynote address at ICMC 2007 in Copenhagen, John Chowning[51] presented notes he had made during his early experiments with FM synthesis.[52] Because calculating the actual sound, i.e. the result of the FM-synthesis, was so time-consuming, and access to the computer 'mainframe'[53] so limited, it was more economic for Chowning to estimate the effect of different FM parameter settings 'by hand', i.e. with pen and paper, than to waste valuable computer access time with 'experimental' attempts.[54]

Where today, most of the computer mediated work is done at the computer itself (I am not writing this manuscript by hand only to enter it into the computer at a later stage), before the advent of the personal computer this was not always the case. For Chowning and others, at this time the computer was but one step in the process. The preparatory work such as writing the code constituting the instructions for the computer,

[49] M. V. Mathews. "The Digital Computer as a Musical Instrument". In: *Science*. New Series 142.3592 (1963). Pp. 553–557. ISSN: 00368075, p. 553.

[50] Ibid., p. 555.

[51] John Chowning. "Fifty Years of Computer Music: Ideas of the Past Speak to a Future-Immersed in Rich Detail". Keynote presentation given at ICMC 2007, Copenhagen. Aug. 2007.

[52] John Chowning. "The Synthesis of Complex audio Spectra by Means of Frequnecy Modulation". In: *J. Aud. Eng. Soc.* 21.7 (1973). Pp. 526–34, Frequency Modulation synthesis, see.

[53] A mainframe computer is a large server like central computer.

[54] I find this example particularly intriguing considering the enormous impact Chowning's research had on the electronic music scene: The commercial application of his work with FM-synthesis, as manifested in the Yamaha DX series synthesizers, gave a wide range of musicians and composers the chance to interact with digital sound synthesis in real-time.

and pre-calculating parameters, was likely to be done at a location different from where the data was entered. Hence, not only was there a displacement in time but also in space. Furthermore, the physical computer, the mainframe, could well be dislocated from the terminal, or 'teletype',[55] where the data was entered. The following is an account of the multiplicity of processes involved given by American (post)cyberpunk writer Neil Stephenson describing doing his home work during a high school computer programming class:

> [M]y interaction with the computer was of an extremely formal nature, being sharply divided up into different phases, viz.: (1) sitting at home with paper and pencil, miles and miles from any computer, I would think very, very hard about what I wanted the computer to do, and translate my intentions into a computer language—a series of alphanumeric symbols on a page. (2) I would carry this across a sort of informational cordon sanitaire (three miles of snowdrifts) to school and type those letters into a machine—not a computer—which would convert the symbols into binary numbers and record them visibly on a tape. (3) Then, through the rubber-cup modem, I would cause those numbers to be sent to the university mainframe, which would (4) do arithmetic on them and send different numbers back to the teletype. (5) The teletype would convert these numbers back into letters and hammer them out on a page and (6) I, watching, would construe the letters as meaningful symbols.[56]

Despite the obvious disengagement involved in Stephenson's work with the computer (he was never in physical contact with the computer or mainframe), he relate to it as "interaction", almost as if he was actually referring to a kind of social interaction, albeit a formal one.[57] Formal, because of the many different steps of preparation he had to go through, each one by itself absolutely essential to the success of the final result. Be as it may with Stephenson's sensation of interaction, by his account the computer he worked at cannot be said to have satisfied a notion of 'immediate response'. The real-time interaction hinted at by this definition was not fully made possible until the early 80's, incidentally coinciding with IBM launching the Personal Computer.[58] Along with the PC came the first incarnations of the modern operating system as well as 'new' input devices (mouse, display and keyboard). With these inventions the demarcation line between the computer and its user, both in time and in space, began to wear away and it gave rise to a different idea of human-computer interaction.

If the response time, that is, the time that elapses from the point a key for example is pressed until the response is perceived by the initiator, of the systems with which Stephenson and Chowning interacted was measured in hours or days, the unit for measuring response times in present day computers and operating systems is typically *milliseconds*. The response time in an interactive system in music is commonly referred to as the *latency* and its value and impact is highly dependent on the type of interaction. If the interaction is performative in the sense of playing an instrument, such as a synthesizer keyboard, the endurable delay time between a pressed key and a perceived sound is comparatively very low. Those of us that have used computers and computer based synthesizers and instruments for some years appreciate the nightmare like sensation of a latency of 20 ms or more. If, on the other hand, the interaction is of the kind where the system is analyzing

[55] A 'teletype' is a typewriter looking predecessor to the keyboard/screen combination, which was not widely used until the late 70's.

[56] Neal Stephenson. *In the Beginning was the Command Line*. This book is downloadable at http://www.cryptonomicon.com/beginning.html. Avon Books Inc., New York, 1999, chap. 'Bit-Flinger', § 4.

[57] It should however be pointed out that Stephenson's book *In the Beginning was the Command Line* is a critique of the modern development of Graphical User Interfaces pointing at how they, according to him, detach the user from the computer.

[58] The IBM PC was soon to be followed by the Macintosh by Apple.

a performance in real time and 'composes' an accompaniment or a counterpoint, to be played back at a later point in time, depending on the musical and aesthetic requirements, latency may not be a big issue, or at least one that can be handled and compensated for.

Time and music are intimately coupled together but it is difficult, if at all possible, to discern what 'good' timing is, and equally difficult to determine the significance of 'exactness' in time. (A more elaborate discussion on these issues is to be found in Section 4.5 and Section 4.10) Interestingly, it is difficult to find studies on latency and timing (in interactive music that is), as is noticed by Brandt and Dannenberg in their article on latency and computer operating systems. Concerning electronic instrument response times they write that:

> There do not seem to be published studies of tolerable delay, but our personal experience and actual measurements of commercial synthesizer delays indicate that 5 or maybe 10 ms is acceptable. This is comparable to common acoustic-transmission delays; sound travels at about 1 foot/ms.

Imprecise as this may be, it gives a hint of the sensitivity of human audio perception as well as a hint as to the biological reasons for this sensitivity: it is used to estimate the distance to sound sources. Any musician can learn how to play with a delay exceeding 10 ms, at least if the *latency* is consistent[59] but a genuinely problematic situation occurs when the latency does not behave linearly across the range of the instrument. A typical example is the pitch-to-midi converter.[60] Depending on the quality and the properties of the instantaneous audio signal that is being analyzed, the fundamental estimation may take one or several audio buffers to output its result. If the analysis buffer is 256 samples and the sampling rate is 44100, then the delay introduced for each buffer is $\sim 5.805ms$[61] Also, the range of the audio signal affects the time it takes even if, in general, this is predictable.

The sensitivity of expectation does not seem to be limited to the gesture/listening relation. Consider the annoying distortion of perception that occurs when an echo of ones own voice is heard when talking on the phone—even more common now with the frequent use of VoIP. Or the situation that occurred in the days of analog tape recorders in which the record and playback tape heads were displaced by a few inches. Listening to the recorded version of ones own voice in headphones while simultaneously recording it made it very difficult to talk. The recorded voice would be delayed by perhaps 0.3 seconds, enough to create a breach between perception and expectation so grave that speaking correctly became impossible.

Human-computer interaction is since some years predominantly equal to real-time interaction. From the definition of interaction given above one may presume that real-time is a prerequisite, that the response times necessarily must be low, in accordance with how, when I move my mouse, the pointer on the screen is mimicking my movements; it is my body's extension in the virtual, a blind mans stick, a prosthesis. The deception will only work if the interaction takes place in real or close to real-time. But consciousness and the powers of expectation in relation to sound appears to employ a great sensibility also outside of the field of human-computer interaction displaying a very low acceptance for *latency*. Hence, two issues are distinguishable here: (1) the real-time interaction specific to human-computer interaction and (2) the real-time of interactive music

[59] The church organ is an example of a mechanical instrument where it is necessary for musicians to adjust their musical timing according to the properties and delay of the particular instrument.

[60] A pitch-to-midi converter calculates an estimation of the fundamental frequency in an audio signal.

[61] $\frac{256}{44100} \approx 0.005805$

which by implication is related to human-computer interaction but which is also closely linked up with the apparent sensibility to latency of sound as independent of any technology involvement. These two threads will be further elaborated in the following sections, particularly so in Section 4.5 and Section 4.10. If this section introduced the topic of *time* and computing, the next section will immerse in the concept of *space* and computation; the intermediate space in which interaction is played out, the interface.

4.4 The Interface

Already in 1960 was the need for better tools for HCI (Human-Computer Interaction) identified by computer scientist Joseph Licklider (known for his contributions to creating that which later became the Internet). In his originative paper 'Man-Computer Symbiosis' he discusses the technologies for "man-machine communication" used at the time and states that "[n]owhere, to my knowledge, however, is there anything approaching the flexibility and convenience of the pencil and doodle pad".[62] Much due to the enormous commercial development of computer technology since then, a development which has fulfilled at least some of Licklider's wishes, HCI has become a very active field of research. This research is to a large extent concerned with the design of user *interfaces*, with the primary goal to increase usability of computer applications and other electronic devices. In her the already mentioned PhD dissertation on "eliciting a heuristic for engendering a continuum of flow within a dynamic human-computer-interaction system" Aukje Thomassen offers the following general definition of HCI: "Interaction involves two participants: the user and the computer. The interaction is aimed at supporting the user to accomplish the goals set by a specific application *domain*."[63] Though I would think it is rather the *interface* that supports the user, the interaction being the result of the user engaging with it, Thomassen makes obvious the inexact nature of these terms—as they are used in practice—and the tendency for their meanings to overlap. At any rate, it should be safe to state that the user interface (UI) is the layer of mediation between the user and the computer: It allows the user to *interact* with the computer.

The Graphical UI (GUI) and the desktop metaphor developed in the 80's and became a celebrated mediator for HCI. For better or worse, in combination with the mouse, it has become the dominating paradigm for interacting with a whole range of electronic devices. In this development, not only was the computing physically localized (the computer and its user resided in the same room), it was also virtually localized as the user would interact with the data directly as opposed to encoding it onto a tape prior to feeding it to the computer, as Stephenson had to do.[64] The mouse and its pointer is the extended arm of the user and unless the operations performed gives the user a sense of control, that is, the manipulations are immediately reflected on the screen, the interactive experience is obscured. And this is where time and speed became such

[62] J.C.R. Licklider. "Man-Computer Symbiosis". In: *IRE Transactions on Human Factors in Electronics* HFE-1 (Mar. 1960). Pp. 4–11, 5.5 § 2. See also (Richard A. Pew. "Evolution of Human-Computer Interaction: From Memex to Bluetooth and Beyond". In: *The Human-computer Interaction Handbook: Fundamentals, Evolving Technologies, and Emerging Applications*. Ed. by Julie A. Jacko and Andrew Sears. Human Factors and Ergonomics. Lawrence Erlbaum Associates, 2003. Pp. 2–15, p. 3).

[63] Thomassen, *In control*, p.105 (italics of the author).

[64] There were obviously intermediate stages and Steven Johnson gives an excellent historical overview of the development of the GUI of the modern computer operating system in the book 'Interface Culture – How new technology transforms the way we create and communicate' (Steven Johnson. *Interface Culture – How new technology transforms the way we create and communicate*. Harper, San Fransisco, 1997, chap. 2 & 3)

important coefficients in the transactions between user and computer. Rather than typing text based commands on a terminal the GUI allows its users to instead click on icons with the mouse, icons that represent the operations the computer is expected to perform. The replacement of text with images is a significant feature of a typical GUI and one Neal Stephenson takes position against. He compares the GUI and the icon to the illusive appearances offered at Disney World: "Disney is in the business of putting out a product of seamless illusion—a magic mirror that reflects the world back better than it really is"[65] and argues that Apple and Microsoft, just as Disney, are "short-circuiting laborious, explicit verbal communication with expensively designed interfaces."[66] Stephenson's argument here is that what gets lost in the translation, so to speak, from text to icon, are crucial properties of that for which the icon stand. In the reconstructed, detached, normalized and smoothened mirror reflection of the 'real thing' there is no, or very little, room for individuality, no room for nuance; it is a 'one size fits all' of computing. Just as Disney creates a replica of the world that doesn't communicate anything about the 'real' world, have the GUI builders, according to Stephenson, built image based interfaces that has nothing to say about computers. The icon is only an idealized 'sign' with a very blurred referent.

But GUIs are not all bad, neither is visual representation. On the contrary, well designed user interfaces are fascinating and stimulating to use and the cause, at least to begin with, was a noble one; to allow more people more easily access to complex and powerful technology. But also out of economical reasons—economy of visual space—is the icon, as a representative of the GUI, a good interface element because it may convey more information in less space than text does. The two items in combination may form an alliance that increases the communicative efficiency because, as we know from information processing and what every mass media expert and advertising designer knows, "two sources of information (often in contrasting modes or languages) are enormously better than one."[67] Text *and* icon. Sound *and* image. Hardly surprising the (thin) line between interface and media has been obscured (maybe it always was?) and it is difficult to tell whether the interface is the message or the message the interface. Stephenson notes that "Disney is a sort of user interface unto itself" and it may certainly be asserted that Windows 98 or Vista[68] is more of an interface unto the corporate trademark *Microsoft* than it is an interface unto a computer. In a discussion on new media theory, Aden Evens brings up the launch of the Apple Macintosh computer in 1984 and writes about the interface of the new computer that "no amount of power, no degree of facility seems ever to be enough [...] The computing experience will not be fully satisfying until it provides a plenary reality fabricated on the computer, a Virtual Reality."[69] Obviously, this virtual reality is one designed by Apple and no one else. The MacOS as an interface to Apple. These self-referential relations makes the computer and the systems that surround

[65] A similar account of the hyper-reality offered by Disney is given by Umberto Eco in his essay *Dalla periferia dell'impero* (*In the heart of the empire*). In the chapter *City of the robots* (my trans.) Eco is comparing the experience of watching the illusory machinery of Disneyland, the machine alligators, to the real thing as watched (but not seen) from a boat on Mississippi River, reaching the conclusion that the perfect execution and predictability of Disney's robots give them a far higher entertainment value: "By Disneyland we are told that technology can give us much more than nature" Umberto Eco. "Vad kostar ett mästerverk?" In: (Andersson, B, Trans.). Original: *Della Periferia Dell'Impero* (1983). Groupo Editoriale Fabbri, Milano. Brombergs BokfÃűrlag, 1987. Chap. *I hjärrtat av imperiet: Resa i det superreella*, p. 53

[66] Stephenson, *In the Beginning was the Command Line*, chap. 'Interface Culture', § 12 and § 20.

[67] Gregory Bateson. *Mind and Nature*. Hampton Press, 1979, p. 73.

[68] *Windows 98* and *Vista* are version of Microsoft's operating system for the PC.

[69] Aden Evens. *Sound Ideas : Music, Machines, and Experience*. Vol. 27. Theory out of bounds. University of Minnesota Press, 2005, p. 128.

it appear as a delegacy of that which filmmaker Guy Debord and the Situationists called the 'Spectacle'. The Spectacle "manifests itself as an enormous positivity, out of reach and beyond dispute. All it says is: 'Everything that appears is good; whatever is good will appear.' The attitude that it demands in principle is the same passive acceptance that it has already secured by means of its seeming incontrovertibility, and indeed by its monopolization of the realm of appearances."[70] In this view interaction has been sold out, with no possibility for recursive communication, for exchange, because one of its agents has grown indisputable. If it is not 'seeable' (clickable) it does not exist. No room for improvement, development or negotiation because there is nothing behind the surface. The icons are not replacements, or semantic containers, they are all there is. They represent nothing but themselves, and even if there would be a possibility to 'create' something of what may be found behind the two dimensional surface of the screen's rendering of the icon, whatever there is to be found needs no illumination and no interpretation because "[e]verything that appears is good".

Jean Baudrillard has gone even further, having experienced the full impact of the 'virtual', that is (in this context) the (multi-)media revolution as the continuation of hyperreality. According to him, the distinction between text and image or icon, text and representation, in computer interaction that Neil Stephenson observed and criticized, is already dissolved by the very medium itself. In the title essay of the book *Screened Out* he states that everything on the computer screen, even text, becomes an image. The screen, or the video image displayed on it, "induce a kind of immersion, a sort of umbilical relation, of 'tactile' communication".[71] But, with a reference to Debord, he also states that "virtuality is different from the spectacle, which still left room for a critical consciousness and demystification. The abstraction of the 'spectacle' was never irrevocable, even for the Situationists."[72] In the virtual spectacle of which information technology and its tools are a part we have come to posses the information—all information. Hence we are no longer just spectators, we are "actors increasingly integrated into the course of that performance".[73] Elsewhere he similarly writes that "it is only with the strict separation of stage and auditorium that the spectator is a participant in his/her own right. Everything today conspires to abolish that separation: the spectator being brought into a user-friendly, interactive immersion."[74] In Debord's description of the world we are alienated, deprived of 'authentic' life, and we face the 'unreal' world as 'Spectacle' but, according to Baudrillard, we are "defenceless before the extreme reality of this world, before this virtual perfection. We are, in fact, beyond all disalienation."[75] In other words, where for the Situationists the 'Society of the Spectacle' was a social phenomenon that held within it the possibility for its own 'undoing', the virtual spectacle in Baudrillard's vision is irreversible.[76]

It is interesting that Baudrillard negatively denotes computer interaction with phrases such as "immersion" and "tactile communication", otherwise used to describe what human-computer interaction designers often

[70] Guy Debord. *Society of the Spectacle*. Tranlsation by D. Nicholson-Smith (1994). Zone Books, The MIT Press, 1967, chap. 1, § 12.

[71] Baudrillard, *Screened Out*, p. 177. In the quote, 'tactile' should be understood with reference to Marshall McLuhan who used the term, not to depict physical contact, because "tactility is the interplay of the senses, rather than the isolated contact of skin and object." For McLuhan TV and the way it requires participation, was a tactile media. Marshall McLuhan. *Understanding Media: The Extensions of Man*. Routledge, 2001 (1964), p. 342

[72] Jean Baudrillard. *The Perfect Crime*. Trans. by Chris Turner. Verso, London, UK, 1996, p. 27.

[73] Ibid., p. 27.

[74] Baudrillard, *Screened Out*, p. 177.

[75] Baudrillard, *The Perfect Crime*, p. 27.

[76] For an in depth discussion on the relation between Baudrillard and Debord, see Sadia Plant. *The Most Radical Gesture: The Situationist International in a Postmodern Age*. Taylor & Francis, 1992, chap. 1-2.

aim at. Virtual Reality is an attempt at immersion;[77] sensory and technological immersion and "from Wagner to [present day,] artists have dreamed of artworks in which the viewer is totally immersed".[78] A dream many feel has become possible thanks to digital technology and real-time computer interaction. The dark dystopia and nihilistic view of the world present in Baudrillard's late writing is well known.[79] It should be traced back to the critique of a society whose efforts are spent on a meaningless and ceaseless transmission of commodities signifying nothing but themselves, in fact, similar to the self-referring aspects of modern computer operating systems discussed above. The virtual version of that society is one in which everything is copied and transmitted and, in this process, "The Perfect Crime" is committed. Not because 'value' and 'meaning' are negated but due to "the transformation of all our acts and all events into pure information: in short, the final solution, the resolutions of the world ahead of time by the cloning of reality and the extermination of the real by its double."[80] The 'real' is suffocated by the (virtual) clone, the 'double'.

What, if anything, does this tell us about interaction and interactive computer music? What does this adversary attitude towards the 'virtual' tell us about technology that may be useful in the current context? I think it is safe to maintain that Baudrillard punctuates a tension between social interaction and computer interaction (although he does not distinguish between computer or any other media interaction) where the latter disintegrates the nature of the former. This tension was present already in the definitions given by OED in that the one relating to social interaction is focused on exchange whereas interaction with technology is geared more towards control. If this tension is real (which I believe it is), if it exists as a coefficient in the interactive equation, one that influences how computer interfaces are constructed and how interaction is manifested in the different areas of practice, then I believe it is important to work out strategies that allow for consideration of the effects it may have within the sphere of (interactive electro-acoustic) music. As has already been discussed, time is of essence and the real-time aspect of interaction, though self-evidently necessary in some regards, may just as well be inhibiting in other.

4.5 Time and interaction

With *definition* (as in High Definition) of time (and of image) the topic of real-time interaction is brought up by Baudrillard, explained as "instantaneous proximity of the event and its double information."[81] He points to the inverse relationship between definition and understanding, between information resolution and information significance, claiming that "the highest definition of language [...] corresponds to the lowest definition of meaning" and "the highest definition of the other (in immediate interaction) corresponds to the lowest definition of otherness and exchange".[82] When there is nothing for the receiver to add to the message, when the bandwidth of the transmission is so crammed with information, there is no room for the receiver, no

[77] See Moser and MacLoed, *Immersed in Technology: Art and Virtual Environments*.
[78] Steve Dietz. "Ten Dreams of Technology". In: *Leonardo* 35.5 (2002). Pp. 509–22.
[79] His equally critical texts on contemporary art, e.g. 'The Art Conspiracy' in Baudrillard, *Screened Out*, p. 181, have been, to little surprise, condemned by the art world. Visual artist and writer Mika Hannula calls him a cynic who has given up, who "appears to enjoy the cul-de-sac that [his nihilism has lead] him into." According to Hannula this is the reason for Baudrillard's negativity (Mika Hannula. *Why Do I Like Rock Music*. Fakultet for arkitektur, plan och billedkunst, 2000, p. 100).
[80] Baudrillard, *The Perfect Crime*, p. 25.
[81] Ibid., p. 30.
[82] Ibid., p. 30.

space for interpretation: when "perfect definition [is achieved] the illusion is lost."[83] And when "everything is given and returned without delay", there is no time for reflection because "some degree of pause and suspense is essential to thought and speech."[84] If the gigantic clock in Charlie Chaplin's *Modern Times* is the factory time, the time of production, the measurable time; to Baudrillard the High Definition real-time is the time of the Information Age and of the Virtual, in essence the negation of time; its total collapse.[85]

The oppositions allegedly occurring as a result of real-time interaction does find some resonance when introduced in the context of music. Depending on the context, contrary to what Baudrillard seems to state quite generally, musical interaction correlates with the instantaneous proximity of the 'event' and its 'double'. Though it may be true that the 'quality' of the result of the interaction will change depending on the altered temporal relation between cause and the effect, it will not do so in a way that is necessarily symmetric to the alteration (high definition-low significance). On the one hand, contradicting the theory of the inversed definition-meaning relation, if the (musical) purpose is to combine two notes with different timbres with the intention for them to blend into one sound, unified articulation and timing is of essence. If they are displaced, ever so little, that is, if resolution in time is instead *decreased*, then the 'illusion is lost'—the 'illusion' of two sounds merging into one. On the other hand, in concordance to the theory, 'the perfect', "that useless perfection",[86] may in fact kill also the music,[87] because sequencers, as Jonathan Kramer writes, "produce coldly regular rhythms, far more precise than any human could perform. The result can be lifeless."[88] Though it is easy to make the mistake that coldness and lifelessness are properties of the computer (they are properties of the programmer behind the rhythm[89] and the culture from which he or she stems), the statement more than suggests that a certain amount of 'imprecision' is necessary for a musical performance to move beyond mechanical execution.[90] This is true not only in the rhythmic domain but also within the domains of pitch and timbre. Richness in sound may be a result of fluctuations in pitch—consciously performed such as a *vibrato*, or random fluctuations such as noise—and richness in harmony may be achieved by variations of timbre.[91] The in-exactness or impurity, the lo-fi, the reduced definition, the noise; all of these aspects are necessary and integral components of musical practice, computer based or 'analog'. The variation, the

[83] This is directly related to one of the studies performed by myself and Stefan Östersjö in which it is obvious that in human-human interaction a certain amount of noise and imprecision is an inherent part of creative collaboration.

[84] Baudrillard, *The Perfect Crime*, p. 31.

[85] I owe the connection between *Modern Times*, modernism and information age technology Pierre Lévy. See Lévy, *Collective Intelligence*, p. 180.

[86] The 'perfect' is a recurring concept in this and other texts by Baudrillard: "Perfect Crime", "virtual perfection", "perfect definition", etc. Jean Baudrillard. "The Automatic Writing of the World". In: *The Perfect Crime*. 2002, p. 30.

[87] Destroy the music as it destroyed the image: "The whole generic illusion of the image is cancelled out by technical perfection." ibid., p. 30.

[88] Jonathan D. Kramer. *The time of music: new meanings, new temporalities, new listening strategies.* Schirmer, New York, 1988, p. 73.

[89] See also Arendt, *Between Past and Future*, p. 269*n*9.

[90] It is common for certain types of computer music software sequencers to implement a 'randomize' or 'humanize' function that allows the user do destabilize the rhythmic perfection of the quantized steps of the sequencer; to introduce random imperfection.

[91] In my experience one of the most difficult tasks as a musician is to attempt to blend with oneself, e.g. overdubbing a second voice on top of a pre-recorded voice. The evenness, the lack of difference of the two sounds, creates cancellations. The composition *Saxony* by James Tenney is a piece for one saxophonist, four saxophones (baritone, tenor, alto and soprano) and a tape delay effect which I recorded in 1995 and performed live on a number of occasions. The performer plays into the delay, beginning with the baritone playing natural harmonics from the low *Eb*, basically playing them in order, changing instruments as necessary, eventually creating a *web*—a *saxony*—of pure intonation, pure harmony. Since everything played is also played back, the performer is forced to 'blend' with his or her own sound. Two of the reasons the challenge of blending with oneself becomes less problematic in this piece are (1) the changing of instruments which creates a timbral difference between played notes and delayed notes, and (2) the fact that all notes are exactly specified with deviations in cent from the notated pitch. Intonation in this case *is* perfection, it is not a subjective choice.

difference, may be consciously inflicted upon the sound (vibrato), but even then an important aspect of it is its relative randomness; an entirely even vibrato is as lifeless as a totally regular rhythm. The 'High Definition', the 'perfect', is in fact the *imperfect* and the noisy is the unadulterated. If the computer plays coldly perfect rhythms it is not because it is *perfect*, it is because it is imperfect and its instructions are fallible.

In his description of real-time interaction (see page 83) Baudrillard uses the words 'event' and 'double' to denote the sender and receiver functions in the interaction. In his usage the meaning of the 'double' is to be understood as (empty) representation: It is a signifier without a signified whose properties have been inherited from the notion of the commodity as pure sign.[92] What, if anything, corresponds to the 'double' in music? Does the 'double' at all exist (in music)? To the extent it exists outside the field of music, it is undoubtedly to be found within it.[93] But also in a slightly different meaning, if we move to a lower level of signification, within the field of interactive computer music the allegory of the 'event'–'double' articulation makes sense albeit with a very different connotation. The 'event' as the cause and the 'double' as the effect. 'Double' inasmuch as it is a reflection of the 'event' (its "double in information"[94]), and to some extent also of that which gave rise to the 'event'. But while Baudrillard refers to the 'double' as the instantaneous reflection, in this context there is nothing to say that the perception of it, its reverberation in the real, has to take place in the immediacy of real-time. The 'double' can hover in the virtual for long before it resonates in the real. In other words, the 'double' is the mirror-image of the 'event' in the virtual as well as its re-enactment in the real. As for the 'event', it is not restricted to the communication of an instant, a 'now'; it may also encompass that which has a duration: Only the attack of a sound may constitute and 'event', but so may also its entire duration, or just one partial of it.

That the relation between time definition and information 'quality' discussed by Baudrillard has its representation in interactive electro-acoustic music should come as no surprise, even though the relation in the two fields are quite different from one another (similar to how the meaning of the 'event'-'double' articulation is different). After all, music thrives on time, it "makes time audible"[95] hence, any idea of musical interaction—interaction with and in music—must relate to time in some way. Due to the significance and intricacies of the subject (well explored by Kramer in his book *The Time of Music* which explores the multiplicities of time in music) interactive electro-acoustic music depends on time also in different ways as compared to other kinds of technology interaction. Music is not, and cannot be reduced to, a series of instances, it is a continuum, a flow of time (paradoxically, it may also be timelessness). A note extends in time, it has its own dramaturgy with a beginning, a middle and an end. The *now* of the tone includes the current instance of it as well as its history as is explained by Edmund Husserl: "When it begins to sound, I hear it as now; but while it continues to sound it has an ever new now, and the now that immediately precedes it changes into a past"[96] The successive

[92] See Plant, *The Most Radical Gesture*, p. 36.

[93] The 'commodification' of music and art is a recurring thread in Adorno's writing. See Theodor W. Adorno. *The Culture Industry : Selected Essays on Mass Culture*. With an intro. by J.M. Bernstein. Routledge London, 1991, Chap. 1: "On the Fetisch Character of Music and the Regression of Listening"; See also Adorno and Horkheimer, *Dialectic of Enlightenment*, Chap. 4: "The Culture Industry"; For a perhaps more nuanced view on the relation between capitalism and music see Jacques Attali. *Noise: The Political Economy of Music*. Trans. by B. Massumi. With a forew. by Frederic Jamesson. With an afterw. by Susan McClary. Vol. 16. Theory and History of Literature. University of Minnesota Press, 1985, pp. 43-5.

[94] Baudrillard, "The Automatic Writing of the World", p. 30.

[95] From *Feeling and form* by Susanne Langer as quoted in Kramer, *The Time of Music*, p. 1.

[96] E. Husserl, *Vorlesungen zur Phänomenologie des inneren Zeitbewusstseins* (§ 7) as cited in Paul Ricœur. *Memory, History, Forgetting*. Trans. by K. Blamey and D. Pellauer. University Of Chicago Press, 2004, p. 32.

'nows' slowly decays into retention which allows for holding on to it, and "as long as the retention lasts, the tone has its own temporality."[97] Gilles Deleuze, in his reading of Henri Bergson, similarly presents duration as succession but goes further and points out that it is only so relatively speaking: "Duration is indeed real succession, but it it so only because, more profoundly, it is *virtual coexistence*: the coexistence with itself of all the levels, all the tensions, all the degrees of contraction and relaxation."[98] The past and the present—the present, not as being but as pure becoming[99]—according to this picture co-exist on multiple planes, "each one of which contains the whole of our past, but in more or less contracted state."[100] From a musical point of view the idea[101] of the 'now' as the most contracted point of duration and that other, less contracted planes coexist with the present is very attractive. The recollection of an entire piece of music, known and 'stored' in memory, just as present but less contracted than the experience of hearing the piece's first chord: two positions on a temporal continuum. Going back to the note, the musical tone that Husserl was referring to, in this model it is not decaying in memory, it is gradually becoming more and more compressed—the present as a durational black hole. The only factual difference between the instantaneous now, the present (as the most compressed) and the note as a whole, the past, is that the present is *becoming*, it is active, it acts, whereas the past has ceased to act, "but not ceased to be".[102] The sound in its entirety as one single now: The musical note as both becoming and being.

The intricacies of music and time unfold on a multiplicity of levels in any musical practice including, of course, interactive computer music, and it makes up one of the more mysterious aspects of music as well as one of the reasons musical interaction with a computer is complicated business. But as obvious as it may be that music takes place in time and that the musical note (in fact any sound) have duration, time has not attracted nearly as much interest from musicologists and music theorists as has other musical parameters.[103] Has this disinterest for time dispersed into the field(s) of interactive electro-acoustic music? The aptitude for meticulous control over duration, time and form shown by mechanical[104] as well as electronic music systems suggests otherwise.[105] Yet there is a tendency in interactive music to adopt the non-duration of the trigger-response paradigm common to human-computer interaction and the MIDI protocol has a special type of messages that extend in time: continuous controller.[106] As if not all musical events extend in time.

At any rate, duration and time are key elements to music, as well as to the design of interactive systems in music. Thus, one of the consequences is that the real-time 'double' is in fact *not* limited to interaction as in-

[97] E. Husserl, *Vorlesungen* (§ 8) as cited in Ricœur, *Memory, History, Forgetting*, p. 32.
[98] Gilles Deleuze. *Bergsonism*. Trans. by H. Tomlinson and B. Habberjam. Zone Books, Urzone Inc, 1988 (1966), p. 60.
[99] Deleuze writes that "present, the form under which being is consummated and places itself outside of itself." ibid., p. 55.
[100] Ibid., p. 61.
[101] An idea which I allow myself to interpret freely. It should however be noted that many of the concepts introduced by Deleuze in *Bergsonism* make up important aspects of his thinking (Repetition, Becoming, Difference, etc.), aspects whose full potential are probably not done justice here.
[102] Ibid., p. 55.
[103] Kramer, *The Time of Music*, p. 2.
[104] Conlon Nancarrow's player piano pieces investigates time in ways that are not possible with human performers, and are performed and composed by mechanical means only.
[105] For an example that discusses many different time scales (chap. 1), however with a focus on micro-time, see Curtis Roads. *Microsound*. The MIT Press, Cambridge, Mass., 2001.
[106] For a more elaborated discussion on the problems of MIDI, see F. Richard Moore. "The dysfunctions of MIDI". In: *Computer Music Journal* 12.1 (1988). Pp. 19–28; and Miller Puckette. "Is there life after MIDI?" In: *Proceedings of the International Computer Music Conference*. Invited talk. San Fransisco, Calif.: Computer Music Assoc., 1994.

stant reflection, the "interactive compulsion which respects neither the timing not the rhythm of exchange"[107] so categorically dismissed by Baudrillard. Since music is not only instantaneous, but always also continuous, the 'double' in music can never be *only* immediate. Therefore the interactive compulsion referred to, or the trigger-response tendency of interactive music, is not an attribute inherent to human-technology interaction, but merely part of an implementation of a *type* of interaction. It is not, I will argue, rooted in the technology as such, but rather in concepts such as 'direct manipulation' (who is being manipulated, and by whom?); it is interaction-as-control (who is being controlled and by whom?). Furthermore, it is not the real-time aspect of interaction that reduces it to interaction-as-control, but the lack of temporal multiplicities and or temporal contraction. In music, within the duration of a note, multiple modes and levels of interaction may take place, and interactions beyond the initial onset (reflection, commentary, negation, etc) is entirely possible, all still within the real-time confines, i.e. even without 'memory' as such but with some notion of contraction (the note as a unit as well as a flow). In that sense even real-time, immediate replication of an 'event' will also have a delayed response.

In the (trivial) example in Figure 4.1—a transcription of a fictitious instrument-computer improvisation—the computer 'double' follows the pitch and the on/offset times of the 'event' in a one-to-one mapping. In this regard the response from the computer system correspond to an immediate and unaltered mirror image. However, on a second interactive layer the 'double' appears to be using dynamic information, i.e. the amplitude envelope, of the note event prior to the current: On the second note in time the 'double' mimics the ***sforzando–crescendo*** amplitude curve of the first note of the 'event' voice. One may imagine more subtle effects such as introducing temporal tension between the two notes in the domain of timbre; micro-variations in tone colour whose greater shape is asymmetrical, that is unrelated, but whose coming into existence is interactive but deferred in time, etc. The point here is not *what* is done but to show that different compositional strategies[108] may be employed and that interaction may take place on multiple co-existing temporal levels, exploiting different levels of contraction. However, if the one-to-one mapping of pitch and duration is blurred, if it is not absolutely clear that the 'double' is following the 'event', that distortion is likely to also negatively influence the deferred time interaction. If the purpose in this example (for the moment disregarding the amplitude envelope delay) is defined as *the wish to electronically extend the sound of the acoustic instrument by means of superimposing an electronically generated timbre upon it*, proximity in time is of essence. A lag or delay of the electronic voice in relation to the acoustic—a delay between 'event' and 'double'—will create a positively *different* musical gesture as compared to the intended effect. If the discrepancy between attack times is sufficiently large, the desired effect of extension of the acoustic sound will fail and the two sounds will instead be perceived as separate musical events. An inconsistent rhythmic displacement may cre-

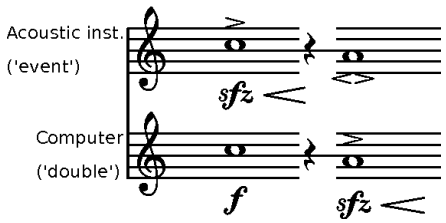

Figure 4.1: Simple example showing immediate real-time pitch and onset interaction with a second layer of deferred musical dynamic interaction.

[107] Baudrillard, "The Automatic Writing of the World", p. 31.
[108] Working out *what* and *how* in an interactive system in music is tantamount to traditional composition.

ate an interesting gesture but the result is still to a considerable degree different from the intention. But the difference between the 'double' in real-time and the 'double' in independent time does not merely make up two different tokens of the same type, they constitute two different types of paradigms, two different classes of systems. In essence it is the difference between the extension of an instrument and the extension of a musician.

4.6 Interactive paradigms—*interaction-as-difference*

As I have attempted to show Baudrillard's statement that the more perfectly synchronized the 'event' and the 'double', the lesser the value of the exchange, is contestable. Not because it is wrong (I believe it is right), but because, as so often, in practice theories rarely play out so symmetrically and, because of the particularities of music and time. The importance of *imprecision* has been discussed but the aspect of precision may be, depending on the view, equally important. In essence it is a question of context and intention because rhythmic simultaneity and precision may be absolutely critical for one music and equally devastating for another. But, to further explicate these issues in the context of interactive computer music, consider the important aspect of the purpose as defined in the example from page 87: *To extend the sound of the acoustic instrument by superimposing an electronically generated timbre upon it*. This is the intention against which the result is to be measured. It is a simple case of an instrument-computer performance, with a hypothetical, overly simplified, instruction algorithm along the lines of:

$$\textit{whatever pitch 'heard'} \Rightarrow \textit{play the same} \tag{4.6.1}$$

Now this could well be a postcard piece by James Tenney[109] or an instruction for an improvisation. It is a compositional statement albeit an open one. But when the rule of synchronicity is introduced as a factor there occurs a major change as far as the freedom and openness is concerned:

$$\textit{if played note occurs later than original} \Rightarrow \textit{error} \tag{4.6.2}$$

This may also be a viable function to attempt at solving with a result of potential interest, musically as well as technologically. Together the two lines form a compositional statement's that to a considerable degree limits the independence of the agent to whom these instructions are given. To define restrictions such as these, though it is a perfectly normal musical behaviour, is to issue a control agency. In the Western music tradition where concepts such as *Werktreue*[110] have played an important role, the idea that one musician—usually the composer or the conductor—controls or limits the freedom of another is perfectly normal, in particular from the perspective of those who exercise the 'control'.[111] Furthermore, restricting and reducing the number

[109] The *Postal Pieces* is a series of eleven short and minimally stated compositions, "scorecards" printed on postcards, composed by Tenney in the early 70's. James Tenney. *Postal Pieces*. CD. 80612. 2004; See also Jean-Claude Risset. "About James Tenney, Composer, Performer, and Theorist". In: *Perspectives of New Music* 25.1-2 (1987). Pp. 549–561.

[110] The German word *Werktreue* means 'to be faithful to the original'. It is commonly used in discussions concerning musical interpretation and musical ontology. See Benson, *The Improvisation of Musical Dialogue*, p. 3; See also Lydia Goehr. *The imaginary museum of musical works*. Oxford University Press, 1996.

[111] Similar to how the aspect of real-time communication discussed by Baudrillard, although despised by him, is intended, desired and profited from by the control agency that governs it.

of choices possible in a given context may promote rather than limit creativity.[112] But regardless of these aspects, by adding time to the algorithm—though it is not time *per se* but the values assigned to time in this example—the mode of interactivity is approaching the previously discussed interaction-as-control.

To further complicate this perhaps trivial example, the *role* of the musical 'double' in an interactive music system such as the one described here should be considered. Where lies its center position on the 'instrument'—'player' continuum?[113] That is, to what extent is the 'double' also able to contribute actively to the music as opposed to merely follow instructions? By no means is this a simple distinction to make, nor are 'player' and 'instrument' separate and irreconcilable categories. Any instrument, digital or analog, electronic or acoustic, will contribute to the music through its history, its physicality and its limitations as well as through many other parameters. The seemingly opposing paradigms of 'player' and 'instrument' are maybe best described as related classes with many common members and where the 'player' class *extends* the functionality of its parent 'instrument' class (a 'player' will need some kind of an 'instrument' on which it 'plays'). And perhaps will the process of categorizing a system within these classes have to be done pragmatically, not based on the properties of the computer and its software, but rather on the *usage* and *purpose* of (using) it. If I have a distinct intention about *when*, with *what*, and *how* I want my computer to respond (musically), then I am essentially designing an 'instrument'. If, on the other hand, I am primarily interested in engaging in a mutual exchange with the computer, then I am essentially implementing a 'player'. In this context the consequential difference between the two methods is that the latter has only a vaguely formulated, system specific, rationale against which the output may be evaluated,[114] one where there is room for interpretation and difference. The former, on the other hand, includes preconditions that make possible an unambiguous evaluation of the output in relation to the input (such as the second rule above).

The 'instrument' paradigm, in the sense that it takes input from a source from which it generates an output based on a logical rule set, is a type of communication system. Information is sent from musician (sender) to 'instrument' (receiver), and the sender expects to be in control of the system, i.e. expects that messages transmitted are received with a minimum of noise and that the system is able to decode the message correctly. In this description lies also an expectancy that the code does not change over time, a potential for developing a fluency on the instrument. *Interaction-as-control*. Within the 'player' paradigm the streams of communication are not unidirectional. The code of the communication may in part be negotiated in the course of action. The value and meaning of noise is different. A 'player' system approaches a circular cause-and-effect system, a container for feedback, a cybernetic system. If what comes out of it is not satisfying according to some standard—a standard imposed and set in runtime rather than, as is the case with an 'instrument', pre-runtime—it is up to either part to alter its behaviour and attempt at creating the desired change to approximate the criterion, to initiate a big enough difference to modify the balance and cause a system change. *Interaction-as-difference*. Despite the reductive way the two paradigms 'instrument' and 'player' were portrayed by the simplistic rules in the examples above, I believe they bear evidence of the different kinds

[112] See Evens, *Sound Ideas*, chap. 4.

[113] For a description of the classification system from which this terminology is borrowed see section 1.4. See also Rowe, *Machine Musicianship*.

[114] If the played note by a given 'player', that implements the rule in quasi algorithm (4.6.1), is not equal to the most recent note analyzed, it only means the current played note is not the most *recent* note analyzed, which is not an error according to the rule. The most recent note analyzed may appear at some later point it time.

of interaction they encourage. But it is is equally true, and important to remember, that the same system may in fact display different characteristics depending on the posture of those who engage interactively with it. Which is not a property of electro-acoustic instruments, but just as true for any musical instrument.

In the discussion above I have attempted at revealing the compound nature of the matter of interaction and time. Within it is concealed issues relating to causality, embodiment, expression, social exchange, the Other, and many, many more. The question I have tried to address here is how and if the real-time interaction of communication is related to the real-time of musical interaction and an unwrapping of some of the different kinds of time at play. As was mentioned towards the end of Section 4.5, Baudrillard's point is that, what he calls symbolic exchange, essentially social interaction, depends on time; it feeds on the suspense that is the result of the delay between cause and effect, whereas the real-time of the Virtual is the effectual abolition of both time and distance. For the moment disregarding the fact that a different analysis of communication and time in the sphere of the Virtual is possible,[115] it is obvious that the relation between time and meaning is of a different kind when the realm of musical performance is entered. The thought that expression and 'meaning' would increase with *latency* in a musical instrument is preposterous. (It would make the church organ the most expressive and something like the violin the least expressive.) Further, the time and rhythm of social interaction is even more pertinent and present in music and I have argued that, even if the interaction (in music) is limited to a simple trigger-response metaphor of communication, time is still at play, by the very nature of music. For a traditional musical instrument the interaction between it and the musician is governed by the real-time information (feed-back) but *also* by the musician's embodied knowledge about playing that particular instrument design, and by the intellectual memories of playing and learning how to play (and a myriad of other memories). Therefore, even if it seems like the playing is taking place in real-time, many other kinds of time and of interactions are taking place on lower levels. Some of this knowledge is more or less consciously encoded into memory and some of it is entirely beyond control and influence.

4.7 Multiplicities of musical interaction

The development that led to real-time responsive computers discussed above unquestionably gave birth to the possibility for a different mode of interaction, and the distinction between the prior, non-real-time interaction and the current real-time is relatively obvious. But from reading Baudrillard's "The Automatic Writing of the World" one may get the impression that 'real-time' is an unanimous and clear-cut category of interaction. But between real-time and detained-time, between high-definition and low-definition time, exists many layers of interactions that operate on different time scales. In particular in music. Ingrid Monson's book *Saying Something* takes this multi-layered nature of musical interaction (of jazz and improvised music) as its starting point: "Stressed here are the reciprocal and multi-layered relationships among sound, social settings, and cultural politics that affect the meaning of jazz improvisation in twentieth-century American cultural life."[116] Sounds do not interact in a void but depend on and get influenced by social and culturo-political interactions. She also makes use of the linguistic model of 'interactional texts', briefly discussed above, which allows us to identify the multiplicity and simultaneity of musical communication as many of these 'texts'

[115] E.g. Lévy, *Collective Intelligence*, chap. 11.
[116] Monson, *Saying Something*, p. 2.

may operate concurrently. Monson writes that "the intersection of all of these roles [...] contribute to the way in which interactionally produced musical texts develop" and that "these interactionally produced events structure both musical and social space."[117] Monson assembles different modes of interactivity and shows that these are all part of, and present in, the musical performance. The minute adjustments made within the jazz rhythm section to accomodate the groove may at the same time seem enigmatically indulgent[118] and incredibly sensitive to variation. On one level, the interaction within the rhythm section certainly takes place in very high definition and it must be said to conform with what Baudrillard calls the inexpiable 'live' time. But along with this real-time interaction are many other levels of interdependent interactions such as those formed by interpersonal relations, mentioned by Monson. These manoeuvre in a different time but may well influence, and depend on, the lower level real-time interactions.

Is this not true also for human-computer interaction? That the social and political interactions that relate to the different aspects of technology inform not only the technology itself but also how one interacts with it? Or is the nature of the 'virtual', digitally encoded as it currently is, so radically different from the social dimension—the 'world' as Baudrillard would refer to it—that, in the encounter, any formerly constructed interactive texts are inescapably eradicated and all that remains is the real-time virtual representation? The deceptive distinction between real-time and non-real-time mentioned above is mirrored in an equally deceptive distinction between real and virtual. Now this is irrefutably one of Baudrillard's main points,[119] but for him, although one may be mistaken for the other, the real and the virtual are mutually exclusive: "for it is the particularity of the virtual that it puts an end not just to reality, but to the imagining of the real, the political and the social; not just to the reality of time, but to the imagining of the past and the future."[120] As the extension of hyperreality the virtual scrambles and destabilizes truth and the real. Eventually the virtual claims the real, for there "is no room for both the world and its double."[121] As was mentioned earlier in relation to the Situationst's notion of the Spectacle, Baudrillard states that there is no escape from the virtual because it keeps no trace back to the real, to the earlier world. And this, he says, makes it a hypothesis with much more far-reaching consequences than Heidegger's notion of *enframing* because, just as there is a possibility for reversal in Debord's description of the Spectacle, enframing is both "*danger* in the highest sense"[122] as well as holds within it the potential for "the rising of the saving power."[123]

4.8 Interaction and the Digital

The cross-disciplinary scholar Aden Evens, in a section of his book *Sound Ideas* with the title "The Question Concerning the Digital", approaches Heidegger's ponderings on technology, but, as can be told from the title, centers on the *digital* as a defining property of modern technology, as its uniting power. Because the digital is the code which allows for the representation to be infinitely reproduced, because it introduces order, consis-

[117] Ibid., pp. 189-90.
[118] For a study on the rhythmic variation present in jazz, see A. Friberg and A. Sundström. "Swing ratios and ensemble timing in jazz performance: Evidence for a common rhythmic pattern". In: *Music Perception* 3.19 (2002). Invited paper. Pp. 333–49.
[119] Hyperreality is the process of making the representation of the world more real than the real world, hence making it difficult to distinguish the real from the virtual.
[120] Baudrillard, *Screened Out*, p. 107.
[121] Baudrillard, *The Perfect Crime*, p. 34.
[122] Heidegger, "The Question Concerning Technology", p. 333.
[123] Ibid., p. 338.

tency and generality into the world, Evens identifies the digital as a result of the technology's enframing[124] of nature. Truly, the binary system is an excellent example of generality, the ultimate abstract code which chops up nature in infinitesimal slices (frames?), each of which is further sliced up and every 'bit' is assigned a zero or a one. The represented object is not just reproducible, it is comparable (a binary distinction for each bit) and communicable (a stream of numbers is easy to transmit). It is digital. Evens distinguishes the digital as "purely formal" and as such it "grasps only form and so falls ever short of actuality".[125] As was mentioned earlier, according to Baudrillard the commodity has gone through a process of complete and total abstraction, an annihilation of meaning, whereafter it signifies only itself. Evens makes the connection[126] and points to the singular nature of the digital and its inability to ever point beyond the plane of the digital: "It represents but does not present".[127] In his text the digital is given a thorough and very readable investigation, expanding the concept well beyond a mere binary system of digits. Baudrillard's virtual/real dichotomy, mirrored in Evens's digital/actual, is by way of the multiple perspectives provided by Evens (represent/present, general/singular) considerably blurred. But the more important distinction here is that, whereas Baudrillard finds the virtual transformation immutable, though Evens identifies serious limitations of the 'virtual' (limitations he traces back to the formality of the digital), he also sees the possibility for it to transcend its own medium and become a dynamic and "organic aggregate".[128] And when Baudrillard sees the 'sampling' of our world as irrevocable and a sign of the complete failure of Heidegger's quest to hold the dangers of technology before our eyes, Evens traces Heidegger's notion of the *saving power* of technology to the *interface* between digital and actual. Further obscuring the digital/actual boundary Evens states that: "the digital is not on its own, as it engages constantly with the human world of actuality." It engages with the world, through humans, mediated by the interface between the digital and the actual. And perhaps one may say that in this process, the digital representation of the world is 'de-framed'. Evens argues that "whatever vitality, whatever creativity inheres in digital technologies, [...] will be found in [the] interstitial zone"; the fuzzy boundary of the digital.[129]

The interface, as it was discussed above, allows access to technology and the activities involved constitute the human-technology interaction. According to Evens the space between the digital and the actual, the "ambiguous space of transformation",[130] is a space occupied by the interface, or by the technologies that make up the interface (the mouse, the keyboard, the icons on the screen, etc.). So the (digital) content is challenged by the user through the interface. But where does the data end and the interface begin? (The conflation between text and link in hypertext is an example of the difficulty in delimiting data from interface: The text is both content *and* interface.) And by what standard is the (digital) computer interface *less* digital than the data it makes available? If it too is purely digital in what way does it open a channel to the data that makes it more accessible to the sphere of the actual, more alive? Evens maintains that, because the interface mediates between the user and the computer, it is by definition a hybrid of both digital and actual,

[124] The German word used by Heidegger is *Gestell*, which is commonly translated to *enframing*. Aden Evens however suggests the English translation be *set upon* which is what he uses consistently. See Evens, *Sound Ideas*, 182n2 However, in the translation of "The Question Concerning Technology" that I am using a distinction is made between *setting upon* and *enframing*

[125] Ibid., p. 66.

[126] Aden Evens refers to Baudrillard's digital interpretation of the Twin Towers in New York City.

[127] Ibid., p. 76.

[128] Ibid., p. 78.

[129] Ibid., p. 79.

[130] Ibid., p. 80.

but the hybrid is accomplished, not by making the (already digital) interface more actual, but by the user submitting to the formal reduction of the digital.[131] In order to move across the actual/digital boundary one has to succumb to the digital and herein lies the danger, the threat, of the digital: "by requiring each user to conform to its standards, it imposes a uniform experience that not only reduces the world to a pure formality but offers to each of us the same formalities, the same possibilities, the same pseudo-creativity."[132] This twofold nature of the digital as both potential and threat is a reflection of Heidegger's ruminations on the *dangers* and the *saving powers* of technology. By reference to German poet Friedrich Hölderlin, Heidegger claims that the two aspects are never mutually exclusive but always potentially co-existent.[133]

So, the interface allows for interaction, and following Evens, it binds together the user and the computer; a glue without which the digital would remain inaccessible. Metaphorically speaking the interface *creates* interaction. This model gives the impression that the user *is* the actual and the computer *is* the digital and that these two agents are utterly incompatible unless one approach the other. And because the digital is static and unchangeable, trapped in its own formality, of the two only the user, i.e. the human, is capable of altering herself to approach the digital through the interface. If so, has the user ceased to be *only* actual? Going back to the concept of interaction-as-control, common to much of human-computer interaction, now considering the digital/actual dichotomy so thoroughly explored by Evens, in order for the user to exercise control over the computer she has to become the computer to a certain extent, give something up—give in to gain. (To gain, because, after all, something is returned or computers would not sustain such interest.) This duality is identified by McLuhan when he states that "any technology is an extension or self-amputation or our physical bodies",[134] paraphrased and extended by Baudrillard to the somewhat more radical and acrimonious "[technology is the] expulsion of man".[135] Is the reconfiguration demanded by the user, as the prerequisite for human-computer interaction, a staging of this extension/amputation/expulsion? Is the giving up of a part of our selves in order to embrace technology[136] really specific to interaction with technology? Is the request of the digital that we give in, just a little bit, to its mode of operation not a natural component of any kind of interaction? I *approach* the other in the interactive invite by 'reconfiguring' my senses to her, albeit ever so slightly, give up a part of my self and, in the process, I also extend myself.

Towards the end of "The Question Concerning the Digital" the very interesting idea of "a dialectic of interface and data [that] also implicates the user"[137] is introduced. As the interface is refined, argues Evens the digital data is forced to reorganize and the users, on their part, keeps pressure on the interface and the digital, which, in this operation, is pushed to become more than it is, challenged, and "the pipe that passes from the digital to the actual bursts its seams to carry the digital beyond itself."[138] These thoughts open up for an alternative, less machine-centric view on how to think about and attempt at understanding

[131] Ibid., p. 80.
[132] Ibid., p. 81.
[133] The lines by Hölderlin are: "But where danger is, grows / The saving power also." Quoted in Heidegger, "The Question Concerning Technology", p. 333.
[134] McLuhan, *Understanding Media*, p. 49.
[135] Baudrillard, *The Perfect Crime*, p. 35.
[136] McLuhan writes that to "behold, use or perceive any extension of ourselves in technological form is necessarily to embrace it." McLuhan, *Understanding Media*, p. 49.
[137] Evens, *Sound Ideas*, p. 80.
[138] Ibid., p. 81.

technology/virtual/digital. I argue that in the dialectic of interface, data and user the interaction is the central aspect. The interaction *creates* the interface. A 'good' interface is one that allows itself to be created.[139] In this model the user does not constitute the actual, she is primarily *part of* it and similarly is the computer primarily *part of* the digital. Actual and Digital are two types, two classes that can have any number of members and whose structure is somewhat amorphous. The more the agents of different classes interact with each other, the more the two classes overlap and the more they inherit properties from each other and the larger, less rigid and more fluent becomes the interface; the union between the two classes. The more 'information' one class has about the other, the more likely is the interactive field to grow. The more rivalry there is the more likely it is to vanish. Knowledge about the Other is the key to avoid fear and conflict.

In this section the Real/Virtual opposition favoured by Baudrillard has been compared to the Aden Evens's Actual/Digital distinction, a dichotomy that consist of categories that may be slightly misleading and not as clear cut as they appear. The Digital is used by Evens in an attempt at avoiding the technology and instead focus on the structure of technology. This is comparable to how Heidegger points to the *essence* of technology rather than technology itself which, in both cases, allows for a philosophical discussion rather than a technical. The 'Actual' as category is the negation of the 'Digital' and silently points to Heidegger's 'truth' or 'nature'. But is the digital encoding a property of technology only? What is a fired neuron in the brain if not a binary transition? In a discussion on cybernetics Gregory Bateson writes that "in the vast majority of instances, the neuron either fires or does not fire" and he goes on to explain how "it is possible to make systems out of digital neurons that will have the *appearance* of being analogic systems."[140] In other words, according to Bateson, the human brain has certain low level qualities that may be seen to lean towards the digital. Similarly, through the use of artificial neural networks, is it possible to simulate an analog system by digital means. This affinity between categories makes it possible to look at human-computer interaction in a way less focused on oppositions and resistance and more on exchange. Described as classes, the digital and the actual can reciprocally exchange properties or modes, without loosing their mutual identity. Furthermore, instances of these classes—the agents of the interaction—construct the interface through which data may pass. and the agents have to acknowledge each other.

4.9 Interaction and symbiosis: Cybernetics

Before the digital revolution, and some twenty years before the PC, Joseph Licklider—whose significant work was briefly mentioned above—imagined the future of human-computer interaction and computation as one void of "inflexible dependence on predetermined programs" where instead computers and humans would develop a symbiotic relation. In Licklider's vision the computer usage paradigm would shift from the user supplying the computer with a pre-formulated problem to one in which the user and the computer "cooperate in making decisions and controlling complex situations".[141] Whereas Heidegger, Baudrillard, and Evens have

[139] The most obvious and tangible example within the realm of computer music is the Pure Data (Pd) by Miller Puckette. Its interface is recreated for every instance, every project, every interaction, every iteration. See Miller Puckette. "Pure Data". In: *Proceedings of the International Computer Music Conference*. San Fransisco, Calif.: Computer Music Assoc., 1996. Pp. 269–72; and Miller Puckette. *The Theory and Technique of Electronic Music*. World Scientific Press, Singapore, 2007

[140] Bateson, *Mind and Nature*, p. 103.

[141] Licklider, "Man-Computer Symbiosis".

focused on the problems of the dissimilarities and incompatibilities between technology and its users; they have all to various degrees considered the dangers and the the subsequent destructive aspects of technology and pondered on ways in which it may be altered, to become more human, Licklider, while identifying the same dissimilarities, saw great potential in them. To Licklider the human-computer uncongenialities was a possibility rather than an obstacle, a possibility for computers to complement humans in difficult and perhaps mundane tasks. His categorization of the two parts of a human-computer system is a rough summary of the challenges involved in human computer interaction:

> As has been said in various ways, men are noisy, narrow-band devices, but their nervous systems have very many parallel and simultaneously active channels. Relative to men, computing machines are very fast and very accurate, but they are constrained to perform only one or a few elementary operations at a time. Men are flexible, capable of "programming themselves contingently" on the basis of newly received information. Computing machines are single-minded, constrained by their "pre-programming." Men naturally speak redundant languages organized around unitary objects and coherent actions and employing 20 to 60 elementary symbols. Computers "naturally" speak non-redundant languages, usually with only two elementary symbols and no inherent appreciation either of unitary objects or of coherent actions.
>
> To be rigorously correct, those characterizations would have to include many qualifiers. Nevertheless, the picture of dissimilarity (and therefore potential supplementation) that they present is essentially valid. Computing machines can do readily, well, and rapidly many things that are difficult or impossible for man, and men can do readily and well, though not rapidly, many things that are difficult or impossible for computers. That suggests that a symbiotic cooperation, if successful in integrating the positive characteristics of men and computers, would be of great value. The differences in speed and in language, of course, pose difficulties that must be overcome.[142]

The language problem—which in this context is an issue of information encoding and hence related to the discussion of the digital—can not be said to have been overcome. Computers still do not generally "speak" redundant languages and even if higher level computer languages have been developed, these are far from spoken inter-human communication. Further, if the computer according to Licklider, was too fast in 1960 (for the purpose of symbiosis), considering that the input devices are roughly the same whereas the computer speed capacity according to Moore's law has doubled 32 times since then,[143] speed according to the same standard must still be an issue. However, despite these consideration concerning speed and language, are we not already living the man-computer symbiosis predicted by Licklider?

On the one hand it is fair to say that we are. We are living interdependently and in close union with computers; in what could be called a symbiotic relationship. (After all is not the greatest fear, the most commonly explored horror of science fiction, that one day the computers may not need us?) To deal with the speed issue Licklider envisioned resource distribution by means of time sharing that implemented 'thinking centers', the equivalent of "present-day libraries", where one machine can serve multiple users (in essence a client/server protocol). With striking accuracy he draws the outlines that which is to become the Internet:

[142] Ibid., Section 3.1.

[143] Gordon Moore predicted in 1965 that the number of transistors on a computer chip, and hence the processing power, would double every 18 months ($1960 \Rightarrow 2008 = 48$ years, $\frac{48 \times 12}{18} = 32$). To be fair Moore's law was not formulated until 1965 and in reality it seems as if the doubling has rather happened an average of every 20–24 months. All the same, the computers have grown much faster and the means for interaction has not changed in any radical way.

"The picture readily enlarges itself into a network of such centers, connected to one another by wide-band communication lines and to individual users by leased-wire services."[144] The Internet as a thinking center in a symbiotic relation with humans. In searching the Internet not only answers are produced, just as many new problems are formulated. Though in reality it is arguable whether the Internet and the typical use of the Internet would qualify as one part in a symbiotic relation, the Internet in the sense of information collection was one of the aspects Licklider envisioned as part of man-computer symbiosis.

On the other hand, judging from Steve Dietz paper "Ten Dreams of Technology", in which the first dream is Licklider's of man-computer symbiosis, we are still far from it. As one of the curators[145] for the *2003 New York Digital Salon*[146] Dietz examines ten dreams of technology that are not yet 'true' or 'real' (outside the realm of art one may add), but which all have a future, "even if we do not yet know what it is and despite the certainty with which it is predicted."[147] Though many artists have dreamed the dream of symbiosis, the artwork Dietz associates with man-machine symbiosis is David Rokeby's installation *Giver of Names*. As an interactive installation[148] it engages with the visitor in a sophisticated feedback process. The visitor places objects, toys and household objects, that the computer 'sees', analyzes and assign names. Over time it builds relations between the objects and, through the use of speech synthesis, it starts building phrases out of its repository of the object/name couples that it reads back to the visitors.

In *Giver of Names*, the visitor and the computer interact through (mediated by?) the objects and through the voice of the speech synthesis engine. By placing objects in the computers line of sight the visitor teaches it something about the world and through the computers accumulated knowledge, the visitor is told something about the world from a slightly skewed perspective. Considering the topic of interaction, though there are many interesting aspects of *Giver of Names* that intersect the discussions in the current text, the question of time (see also the discussion relating to real-time musical interaction) is particularly well illustrated. Baudrillard, who obviously feel strongly about this, pointed to the real-time aspect of the virtual as inexpiable: "it is the particularity of the virtual that it puts an end not [...] just to reality of time, but to the imagining of the past and the future."[149] It is the immediate return, the expeditious reply, that kills the past and the future and turns everything into a singular moment. Whether one agrees with Baudrillard or not, the concept of real-time must be expanded beyond its use in human-computer interaction because, as was seen towards the end of Section 4.5, real-time interaction, the instantaneous proximity of events, has crucial significance in musical interaction. And within the realm of computers there are several different types of real-time; there is the real-time interaction as well as the related but yet different aspect of real-time computation. Real-time interaction depends on real-time computation but the latter does not necessarily have to implement the former.

As a system, *Giver of Names*, relies on a number of different interactive modes out of which real-time computation is one of the important ones. Without it, the project would not have been possible: The

[144] Licklider, "Man-Computer Symbiosis", Section 5.1.
[145] Another curator was Electronic Music Foundation founder and president Joel Chadabe.
[146] Digital Salon. *New York Digital Salon*. 2003. URL: http://www.nydigitalsalon.org (visited on 08/26/2008).
[147] Dietz, "Ten Dreams of Technology".
[148] For a introduction and description of the work, see David Rokeby. *Giver of Names*. Art installation. 1991–. URL: http://www.youtube.com/watch?v=sO9RggYz24Q (visited on 08/26/2008).
[149] Baudrillard, *Screened Out*, p. 107.

computer would not have been able to process the images from the camera (constituting its 'line of sight'), nor would it have been able to 'read' the texts back to the visitors. Yet, the communication between the visitor and the virtual world of the installation does not take place in the kind of one dimensional click-and-response real-time that Baudrillard objects against. Rather, because of the way the software accumulates 'knowledge' about objects displayed to it over time, the communication is based on present *and* past experiences, not just the current. Due to this fact, the interaction only becomes meaningful if both parties accept that they engage in the exchange coming from different backgrounds and that mutual respect for this past is shown. That interaction-as-control is not possible, not meaningful because the main interactive mode is based on exchange, feedback and reciprocity on a number of simultaneous layers of time. Or, as Dietz writes: "The symbiotic feedback loop infers that over the course of more than a decade, the computer 'learns' more and more about the world, and its oblique, almost Delphic utterances of our mundane combinations of boot and rubber-duck-and-ball objects also causes us to perceive the world differently."[150]

Giver of Names as well as the idea of man-machine symbiosis are in essence cybernetic ideas. As a discipline and a meta-theory cybernetics is concerned with (among other things) "control and communications in the animal and machine",[151] by themselves and together. Licklider defined one of the main aims of man-computer symbiosis as the wish to go from systems that solved pre-formulated problems to systems that, in a symbiotic relation with a user, would (also) act on itself and contribute to the formulation of the problem.[152] If we define these as belonging to two categories of systems (non-symbiotic and symbiotic), one of the differences between them may be described in terms of energy. The non-symbiotic system accepts input given to it and responds according to some (pre-defined) logic. It is a causal system in which the energy is provided by the user: The user energizes the system by posing the question, much like when a billiard ball strikes another, the motion energy is transferred from the former to the latter.[153] In the symbiotic system, on the other hand, "the energy of the response is usually provided by the respondent. [...] when a neuron fires another, or an impulse from a microphone activates a circuit, the sequent event has its own energy sources."[154] Gregory Bateson distinguishes this last category as a cybernetic system, a communicational system with sequences resembling stimulus-response rather than cause-and-effect.[155] Feedback rather than click-and-response. Reciprocity rather than immediate reaction.

Again, it should be pointed out that in practice the difference between these types of systems is far from unequivocal, but, though there is nothing to say that a cause-and-effect system can not incorporate some idea of time and memory, i.e. the system type itself does not exclude time, a cybernetic system depends on it. Even the simplest cybernetic unit displays "a sort of determinative *memory*", because the "stability of the system (i.e. whether it will act self-correctively or go into runaway) depends upon transformations of

[150] Dietz, "Ten Dreams of Technology".
[151] There are many definitions of cybernetics—this one is from Norbert Wiener's *Cybernetics* (1960), as cited in "cybernetics". In: *Encyclopædia Britannica*. Encyclopædia Britannica Online, 2008. URL: http://search.eb.com.ludwig.lub.lu.se/eb/article-9028365 (visited on 08/26/2008).
[152] Licklider, "Man-Computer Symbiosis".
[153] Gregory Bateson. "Cybernetic Explanation". In: *Steps to an Ecology of Mind*. 2nd ed. The University of Chicago Press, 1972. Pp. 405–16, p. 405.
[154] Ibid., p. 409.
[155] Ibid., p. 409.

difference".[156] Every part of the system will respond to changes and bits of information are passed around. Every such bit is "definable as a difference which makes a difference" and such differences are successively transformed through the internally interactive system.[157] In other words, the cybernetic system needs to know, to remember, its state prior to current time and, preferably, have some notion of what the state of the other parts of the system is: It interacts internally with itself and with its environment. According to Bateson, these properties are what gives a cybernetic system its holistic and mental features and his conclusion, of great interest from the point of the current project, is summarized in the following statement: "[I]n no system which shows mental characteristics can any part have unilateral control over the whole. In other words, *the mental characteristics of the system are immanent, not in some part, but in the system as a whole*."[158] Hence, in an interactive system in music that deploys some notion of cybernetics, the computer must not be seen as an isolated 'player' but as part of a whole that includes the performer(s) with which the system is interacting. Furthermore it will not be possible for the performer to gain control over the computer, or the computer over the performer, without the system failing or regressing. Interaction-as-control relinquished in favour for interaction-as-difference.

4.10 Time and interaction revisited

That Baudrillard's critique of real-time, however easily consented in, is not a property specific to the Virtual has already been argued, and I believe the brief analysis of Rokeby's installation further corroborates it. More than anything the real-time of Baudrillard is a property and result of a general view of interaction, deflated and overly simplified by the all too common and absurd notion of consumerism that 'one-click-shopping' has given rise to. As a European descendant of the visions of Joseph Licklider, Douglas Engelbart [159] and Marshall McLuhan,[160] French sociologist Pierre Lévy whose visionary ideas on collective interaction where mentioned at the end of Section 4.2, voices related critique of the "staccato, accelerated, quasi-punctual temporality of 'interactivity."'[161] His book *Collective Intelligence* is concerned with opportunities and perils with network communities and nomadism made possible by the information highway. He supports the idea of multiple time configurations as well as the necessity in separating real-time, i.e. the sensation of time that emanates from interacting with real-time technologies, from the "time experienced by the imagining community" which will always overflow the the "inadequacy of the immediate, of amnesiac channel hopping".[162] In other words, attempting to separate technology from the expression of technology.

Even if I have now several times pointed to how interaction takes place in a multi-layered fashion rather than in a singular type of interactional time, as is exemplified in some cases of computer interaction as well as musical interaction. And even if I have suggested that the focal point of Baudrillard's critique of the real-

[156] Gregory Bateson. "The Cybernetics of Self : A Theory of Alcoholism". In: *Steps to an Ecology of Mind*. 2nd ed. (Also published in *Psychiatry*, Vol. 34 No. 1, 1971). The University of Chicago Press, 1972 (1971). Pp. 309–37, p. 317.
[157] Ibid., p. 315.
[158] Ibid., p. 316 (Italics by the author.)
[159] D. Engelbart is commonly recognized as the inventor of the computer mouse, hypertext and ARPANET, the precursor of Internet. Similar to Licklider in the early 60's he argued for using computers to augment the human intellect. (See Lévy, *Collective Intelligence*, p. viii; See also Johnson, *Interface Culture*)
[160] See the foreword to Lévy, *Collective Intelligence*, by R. Bononno.
[161] Ibid., p. 125.
[162] Ibid., p. 125.

time interaction of the Virtual lies outside of the human-computer interaction axis—and briefly hinted at Lévy's apparent support of this notion—I return to it once again for I believe it is one of the most important, and one of the most complex, aspects of music, let alone interactive music. Although Pierre Lévy offers no consolation with regard to an actual, practical solution—I doubt it is at all possible to find such solution that have relevance outside realm of a specific context—he does provide a description of both the vision and the challenges of an understanding of time in a computer mediated collective community:

> The inadequacy of the immediate, of amnesiac channel hopping, no longer leads to lengthy sequences of interpretation, the infinite patience of tradition, which encompasses in a single sweep the ages of the living and the dead, and employs the quick currents of the present to erect a wall against time. [...]
>
> The rhythm of the imagining community resembles a very slow dance, a slow-motion choreography, in which gestures are slowly adjusted and respond with infinite precaution, in which the dancers gradually discover the secret *tempi* that will enable them to shift in and out of phase. Each learns from the others how to make their entrance in stately, slow, and complicated synchrony. Time in the intelligent community spreads itself out, blends with itself, an calmly gathers itself together like the constantly renewed outline of the delta of a great river. The imagining collective comes into being so that it may take the time to invent the ceremony by which it is introduced, which is at the same time a celebration of origin and origin itself, still undetermined.[163]

The metaphor of the delta ties well in with the Deluze/Bergson concept of different degrees of contraction and relaxation. At the top of the delta, the present, the most contracted is encountered. It is also here that time flows by the most quickly after which a gradual slowing down begins until motion is no longer appreciable. The motion of slowing down is paralleled by the continuous relaxation also in space as new branches of the delta are continuously unfolding. But the most striking aspect of this short excerpt is how Lévy is constantly referring to time as something which is created *in between* participants, as something which spreads out. He is avoiding a central time speaking instead of "secret *tempi*" (in plural): There is no *one* superior time but many different ones, secret and shrouded in obscurity.

4.11 Summary

In this chapter I have discussed the topic of Interaction with regard to technology, and Interactive Music from a wide range of different angles. Interactive Music as a genre and as a practice has been probed and the wish to control computers in music has been questioned. The different meanings of interactive; interaction with regard to technology and social interaction appears to be very different and it is suggested that there are many more kinds of interactions possible in the range between these outer posts. Heidegger's concept of the enframing powers of technology is briefly touched upon. The recurring wish to use art to inform the field of human-computer interaction is questioned and the difficulties, perhaps incompatibilities, between different fields of practice is identified. Approaching the topic of time, and real-time, in the history of computation the significance and meaning of *interactive* is revealed: real time interaction because it is possible. The emergence of the interface as a mediator for interaction is discussed and a critique of the virtual, a critique rooted in

[163] Ibid., p. 125.

consumerism, is presented. However, in the critical attitude of Baudrillard are also traces of possibilities for rethinking, not only human-computer interaction and the real-time, but the critique itself. With the event-double terminology a few simple possibilities for different modes of interaction is presented. Then, departing from Robert Rowe's interactive paradigms the player and instrument models are presented in the context of a trivial example and the concepts of interaction-as-control and interaction-as-difference are introduced. Aden Evens paraphrase on Heidegger is then approached and the digital characteristic is questioned as the possibility for a smooth transition from continuous to discontinuous is identified. Finally is the idea of man-machine symbiosis revisited and it is suggested that a parallelity between man and computer should be allowed to replace the more common trigger-response method.

Chapter 5

End note and Outlook

Throughout this project I have tried to understand what it means to play with, on, and through computers, alone and with others. At the outset I could not have imagined that the idea of *resisting control* would be the pivotal concept. Quite the opposite was I convinced that Interactive Music was about *gaining* control over the computer as a first step towards a more dynamic musician-computer interaction. In hindsight, of course, I can see that the dissociation from interaction-as-control had always been there. Neither could I have anticipated that a return to a more radical improvisatory attitude towards *all* aspects of my musical practice would be one of the outcomes. Common to both of these concepts, the giving up of control, and the the improvisatory attitude—which are not necessarily symmetrical; an improvisatory attitude does not inevitably resist control methodologies—is the notion of giving up the Self. To me, the reciprocity of social interaction assumes that those engaged in the interaction unleash some part of their Selves or else the communication in the interaction would simply bounce off the unchangeable, morphous egos. Interaction should lead to some kind of change, it should induce a *difference* (that makes a difference) and only if the Self is prepared to accept difference will this be possible.

The extended view on human-computer interaction that I have presented here, along with the blurred work concept and a developed (i.e. different from Eco's defintion) concept of work-in-movement led to the need to further explore the significance of giving up the Self. But, at the same time, the processes launched by this project would not have reached the work-in-motion or interaction-as-difference had I not already started to let go of the Self. But what part of the Self is to be abandoned? Is any part of the Self at all retractable? The point here is not to show that by deserting some part of subjectivity, another, more 'true', unconscious identity hidden below, deeper down, is revealed. It is

a common mistake, also produced by psycho-analysis itself, to believe that the Freudian unconscious would be served well by being disclosed, made conscious: "The unconscious is understood as a negative, it's the enemy."[1] The Self is not first and foremost given up to discover something *within*, but to become more resonant to that by which it is surrounded. And, then, also the innermost part of the Self, conscious or unconscious, will also be affected. Jacques Attali writes that when "music ceases to be catharsis; it no longer constructs differences. *It is trapped in identity and will dissolve into noise.*"[2] Similarly, I would like to propose that unless the Self allows for interaction-as-difference, allows for the Other to play an active part in the interaction, the Self will cease to produce difference as well as cease to apprehend difference and will be trapped in its own identity.

The idea of the Self as soluble in artistic practice and music in particular is not new, nor is it original.[3] To philosopher Julius T. Fraser, the way music (and dance) embraces all levels of temporality it in some cases leads to the "loss of individuality and establishes timeless belonging".[4] Just as Brandon LaBelle, with a reference to Robin Maconie talks about how "sound and the self are wrapped up together",[5] multimedia artist Frances Dyson similarly points to the intermingling of sound and identity: "sound at the same time destroys the possibility of distinguishing between subject and environment, self and other, interior and exterior. Immersed in sound, the subject thus looses its self." Furthermore is LaBelle's book *Background Noise: Perspectives on Sound Art* an historical overview of concepts related to the loss of the Self in the context of sound art, music, and architecture, starting with John Cage proceeding to present day. In particular is the discussion in Part 3, relating to the voice of interest. In an analysis of Marina Abramovic's 1975 performance *Freeing the Voice* (1975) LaBelle writes that she "enacts the dynamic of speech as being, in one and the same instant, a process of losing and regaining oneself—that is, a form of catharsis."[6] LaBelle is also bringing up Alvin Lucier brilliant 1969 piece of sound art *I am Sitting in a Room* which is perhaps one of the more palpable examples of loss of the Self in sound. The score for the piece consist of a written instruction to sit down in a room with a microphone, two tape recorders, amplifier and speakers. To play the piece is to read the specified text and record it onto one of the tape recorders and then play it back into the room while recording it onto the second tape recorder where after the newly recorded version is played back and recorded, etc. The effect is that, eventually the spoken words begin to deteriorate, decompose and the resonances of the room take over. The Self, as constituted by the voice, is completely decomposed and immersed by the room.

Interaction-as-control and interaction-as-difference are no opposites. They are complementing concepts in the large domain of human-computer interaction. As noted above, at the beginning of the project I was expecting to have to develop my skills in order to build tools to better and more precisely control the computer in order to then let go of the control agency and start thinking about more dynamic agencies. This is along the lines of the common, Western, ideal of learning and knowledge; develop a skill and master. Perfecting the

[1] Gilles Deleuze and Claire Parnet. *Dialogues II*. Trans. by H. Tomlinson and B. Habberjam. Continuum, London, 2006 (1977), p. 57; See also Gregory Bateson. "Style, Grace, and Information in Primitive Art". In: *Steps to an Ecology of Mind*. 2nd ed. The University of Chicago Press, 1972. Pp. 128–52, pp. 128-56.

[2] Attali, *Noise*, p. 45.

[3] Although the field of art activity appears to me to have produced more Egos than it has dissolved.

[4] Julius T. Fraser. *Of Time, Passion, and Knowledge: Reflections on the Strategy of Existence*. 2nd ed. Princeton University Press Princeton, NJ, 1990, pp. 410-1.

[5] Brandon LaBelle. *Background Noise: Perspectives on Sound Art*. Continuum International Publishing Group, 2006, p. 62.

[6] Ibid., p. 103.

skill and avoid mistakes. Although traditional conservatory training functions along the same lines, in much artistic practice, and in improvisation in particular, the mistake is a fundamental agent, a source of inspiration not to be avoided.[7] But a mistake occurs only if I allow it to happen and will go unnoticed if I lack the skill or the insight to realize it has happened. The mistake depends on skill. It too is a difference that I will fail to detect if I am unable to understand what was mistaken. In other words, a certain amount of control is necessary in order to give up control. And the balance between 'control' and 'loose control', between Self and giving up of the Self is a deceitful one. The story narrated by John Corbett in his book *Extended Play* of how drummer Milford Graves manages to stop his heart from beating at will prior to playing a solo concert is perhaps one of the more radical examples of *controlling* the loss of the Self.[8] What could be a more radical way of loosing the Self than to stop ones heart at will?[9] The computer, however, is a phenomenal loosing-control and forgetting machine, in this context a less lethal one. As has been told in many places throughout this text it increases resistance and introduces dualities and alternate personalities in a way that forces one to constantly relocate or give up the Self. It does it similar to how Ornette Coleman's playing of the trumpet and the violin introduces resistance, forces Coleman to give up part of the skill he acquired on the saxophone. Similar to how Marcel Duchamp used mechanical drawing in order to "avoid the old-fashioned form of drawing", to forget with his hand[10] and how Paul D. Miller (DJ Spooky) uses turntables to forget: "it seemed that turntables were somehow imbued with the art of being memory permutation machines. They changed how I remembered sounds and always made me think of a different experience with each listening."[11] It is my aim to continue to learn the computer in order to forget. Control as an instrument also to loose control.

To resist control then, is as much a posture as it is a different kind of (implementation of) human-computer interaction and, in this sense it is related to improvisation. Again, taking the risk of triggering an ideological debate on composition versus improvisation (see Section 1.1), I believe there is a relation between these two musical practices somewhat similar to the relation between interaction-as-control and interaction-as-difference. On the one hand stands the ostensible sense of control that the finalized musical score, sometimes homologous to *the work*, offer its composer in its flat surface representation of "musical formalism [...] entirely divorced from any relationship to intuitive gestural experience."[12] On the other hand stands the likewise apparent *freedom* of musical improvisation which in some cases and under certain conditions is anything but formalized.[13] Composition, and the printed score, as a means to gain control over ones own music, to make it tangible, archivable, sutainable. Improvisation as a practice to create differences that loose meaning outside of the context against which the difference is created. But, once more, interaction-as-difference is also an attitude. An attitude that can be applied to the practice of composition which is seen in *Drive* and *Repetition Repeats all other Repetitions*, and an attitude that may be supported by the technologies and ideas that have been developed within the framework of *libIntegra*.

[7] See Evens, *Sound Ideas*, pp. 148-60.
[8] Graves' solo playing in general is an excellent example of how the most intimate and detailed level of physical control is dissolved in what I perceive as the most incredible freedom.
[9] John Corbett. *Extended Play: Sounding Off from John Cage to Dr. Funkenstein*. Duke University Press, 1994, p. 74.
[10] Duchamp quoted in Calvin Tomkins. *The Bride and the Bachelors*. Viking Press, New York, 1965, p. 29.
[11] Paul D. Miller. *Rhythm Science*. The MIT Press, Cambridge, Mass., 2004, p. 45.
[12] Wishart, *On Sonic Art*, p. 35.
[13] In other cases it is as formalized as any compositional practice.

Drive
for Electric Viola Grande and computer
Composed & premiered in 2002
Commissioned by and dedicated to Henrik Frendin
Listen | Score

Although I was yet unaware of it, already in the earliest artistic subproject, in *Drive*, is the change noticeable. In the interaction between myself and Frendin the significance of the roles of composer and performer had already begun to wear off. But the subproject that induced the *difference* that made me aware of my unresolved need for control was *etherSound*. After the initial excitement with haveing set everything up and experience the installation working, I had to face the fear that I could not, in fact, fully control the output. First of all because it would be impossible to be physically present at all times: the installation would be active for three weeks, ten hours a day. But also becuase the participants would had their own will and their own ideas of when and how to contribute. Even though the idea for *etherSound* had come up in collaboration with the curator Miya Yoshida, I had programmed it myself. In other words, similar to how it is described in the Introduction, I as a detached Self did the programming of *etherSound* and created a situation that I as the situated Self and as composer felt deeply uncomfortable with. In the interaction with my Self, mediated through the computer, a difference was induced thanks to which I learned the importance of giving up some part of that same Self.

Repetition Repeats all other Repetitions
for 10-stringed guitar and computer
Composed & premiered in 2006
Commissioned by and dedicated to Stefan Östersjö
Listen | Score

Within *Repetition Repeats all other Repetitions* the intellectual understanding of the phenomena I had already experienced began to take shape. By watching the collaboration between Stefan Östersjö and Love Mangs these aspects of interaction and the Self was seen in new light. The understanding of composition as a negotiation, regardless of what level of interaction the composing is part of, paved the way for a different understanding of the practice of composition. However, it was in the radical way that we gave up the notion of *the work*, and even the *open work* and established a re-interpretation of Eco's *work-in-movement* that the full consequeces of my altered composer role became evident. The work-in-movement is focused on the process rather than the result, in itself not a novel idea at all. However, in the context of computers and interaction and in combination with the idea of the augmented score, the focus on the process allow for a altered view on musical interpretation as well as composition. The score as a growing container of musical experience, all of which is open-sourced to allow for any kind of transformation but with the request to let the interactive narrative, the collaboration, guide the additions, alterations and removals of material from the score.

IntegraBrowser
beta demo test version of the Integra Browser
Try it

libIntegra is the glue that potentially can make interaction simpler between environments for live electro-acoustic music. Not only is the augmented score enabled by aspects of libIntegra, also the fact that DSP modules, environments and standalone programs may be described, shared and communicated in a uniform way, are integral aspects of *libIntegra*. However, the core definitions of the protocol have we tried to define as openly as possible in order to allow for a widespread and distributed community to contribute to its expansion.

Looking at the map, these four projects, *Drive*, *etherSound*, *Repetition...* and *libIntegra* are framed by the improvising and *timbreMap*. By the most elusive and abstract (improvisation) and the most formal and

concrete (programming). Now both of these are also in themselves representatives of the abstract-concrete opposition: Improvising *with* computer and a computer program that interacts with *sound*. Improvisation, computer, sound. Integrated by interaction. Improvisation communicated to the computer, mediated by sound. The computer communicating with the improviser, mediated by sound. Sound as the interface. And as timbre, according to its explanation (leaving any theory of a general sound morphology aside) can only be described as a *difference* from other timbres surrounding it, the interface is defined as difference: interaction-as-difference. Furthermore, the map is a good visual representation of the function of time in interactive system—it can even be seen as a graphic representation of the interaction between the different subprojects. Time has been the topic in several sections and the difference between parallel motion systems, systems that have some kind of, albeit limited, notion of time, and trigger-event systems, pure stimuli-response systems with no recollection of prior events, was discussed in Section 1.3.3. This project is and has been a parallel motion system. The different subprojects have informed each other but they have maintained their forward motion indepenedntly of each other in a way similar to how *Drive* is portrayed in Figure 1.6.

The six trajectories that took me from the starting point to here, to the next beginning, have helped me better understand the concepts of interaction, openness, Self and control. But as containers they also hold some of the knowledge within them, and, due to the intended open form and the fact that each of these projects can take off on its own, independent of my involvment and consent, whatever knowledge is encoded in them will then continue to develop. I propose an open-source music that is not only the *grab-and-play* of P2P[14] and BitTorrents but more of a distribution of construction kits. Build your own music. Corbett, leaning on Jacques Attali,[15] writes how "improvising musicians create a genuine Deleuzian assemblage, a musical machine of desire—not binary, nor unitary, but multiple."[16] Why should the musical assemblage be limited to improvising musicians? I am aiming at an even more decentralized assemblage (although it too, will have to deal with limitations, for it is dependent on computers and networks). Central to the idea of the musical open-source is the recirocality; what is taken is altered and returned and thus added to all other contributions. Each such bundle of musical practice that holds within it multiple relations and multiple kinds of interaction is a veritable work-in-movement, truly moving around in a way I am sure Eco did not anticipate.

[14] Peer-to-peer netwroks are used widely for file sharing purposes.
[15] See Attali, *Noise*.
[16] Corbett, *Extended Play*, p. 76.

Appendices: Published papers and documentation of artistic work.

This essay was originally published in *Organised Sound* in 2005. A revised version of it appeared in Miya Yoshida's PhD dissertation *The Invisible Landscapes: The construction of new subjectivities in the era of the mobile telephone* (2006)

Appendix A

New Communications Technology in the Context of Interactive Sound Art: an empirical analysis

Authors: *Henrik Frisk & Miya Yoshida*

A.1 Introduction

The[1] notion of 'participation' has been widely discussed in the context of contemporary culture. In the visual arts Marcel Duchamp opened up the space as an 'art coefficient'[2] and the happenings and performances in the Fluxus movement were theorized as spectator 'participation'. In the late 70's a strong critique of the cultural institutions originated in the United States and Europe. There was still a strong connection between social class and arts consumption[3]. As the question of authenticity occurs in the 80's, and the concept of site specificity comes into focus, it influences the attempts to broaden the audiences. In the 90's, the emergence of a new public art and a trend of 'Relational Art'[4], such as social service and banal daily events; and community-based art, made 'participation' a central issue for cultural production. The art activities, shortly described above, strongly suggests diverse interpretations of the notion of 'participation' and the necessity for constant reinterpretation of the term. What does 'participation' mean in the age of the Internet and mobility? Who can be conceived of as a participant? What does the factor of 'participation' produce?

With the popularity of communication technology and mobility, the definition of contemporary culture is transforming. Bataille conceived that a definition of culture is deeply related to the way society chooses

[1] Frisk & Yoshida, New Communications Technology in the Context of Interactive Sound Art: an empirical analysis, *Organised Sound* 10:2, 121-7, 2005, © Cambridge University Press, reproduced with permission.

[2] Bourriaud, *Relational Aesthetics*.

[3] See for example Paul DiMaggio and Michael Useem. "Social Class and Arts Consumption: The Origins and Consequences of Class Differences to the Arts in America". In: *Theory and Society* 5.2 (1978). Kluwer Academic Publishers. Pp. 141–161; Bourdieu, *Distinction: a social critique of the judgement of taste*.

[4] Bourriaud, *Relational Aesthetics*.

to annihilate excess energy[5]. Applying his words to the networked society, the surplus is observed in the phenomena of the excess volume of communication through new media, which eventually produces a new space. Furthermore, we can look at communication as a potential area for the emergence of a new culture that differs from the pre-existing categories and class hierarchies. Instead of an inherited cultural capacity in society, the flow of communication strongly impacts the cultural sphere and mutates the recipients and stimulates the creative capacity. Although in large, much of the need for communication and the need for new tools for communication is created by economical interests, we argue that communication in a certain sense and under certain conditions can be considered as a new production of culture.

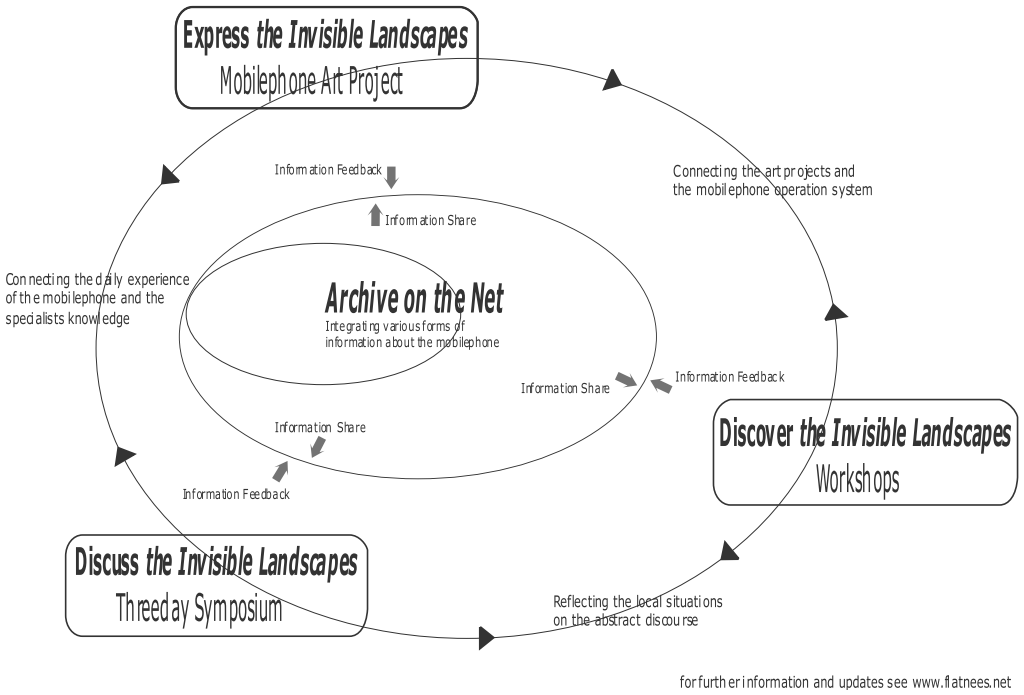

Figure A.1: Map of events for the project *The Invisible Landscapes*.

A.2 Collaborative music

Collaborative musical compositions and sound art has been realized in a number of ways and with different objectives. In the project *Norge - et lydrike, Norway Remixed* the curatorial idea was 'to bring the whole

[5] George Bataille. *The Accursed Share*. Vol. 1. Zone Books, Urzone, Inc., 1989.

country together through sound', so 'the local branch offices of the broadcasting corporation' was supplying sound material 'in order to secure authenticity' and 'actively counteract speculations of centralisation'[6]. In their article on *The Interactive Dance Club* Ulyate and Bianciardi define the goals as:(1) 'to allow group and individual participation', (2)'create a compelling social environment' and (3) to 'deliver the euphoria of the artistic experience to "unskilled" participants'[7].

These are just two examples in a very active art and music field. Though their respective aims are different, they both share the intention to create a soundscape that can communicate a sense of solidarity. In the first case by introducing an awareness of the political, and potentially exclusive aspects of music making already in the curatorial concept. By letting a large number of individuals supply the input, according to the article the work succeeds in creating a fabric of references valid to a large number of visitors and thus creating 'building blocks of culture'[8]. In the second case the visitors are offered to actively participate in the familiar environment of a dance club. But instead of merely responding in this environment the visitors are offered to influence the music and imagery they are responding to, individually or collectively. Action performed is not only the end result but also the initiation of the next process.

Music making has traditionally been tied to the physical space, whereas now, through the Internet there is a very active virtual space that has been explored for collaborative work in sound ([9]). To invite even amateur performers to collaborative music making is a complex matter. But it is also an agency to open up the creative process and opening up the creative process for participation is a step towards interpretation and perceptiveness, or as put by Jordà: 'the best way to understand and appreciate any discipline [...] is by "doing" and being part of'[10]. The main intention with the collaborative element in *etherSound* was to let the desire to participate be the driving force and the challenge therefore was to design an interface that was as open as possible to anybody who had the wish to take part.

A.3 The design of *etherSound*

The idea of making *etherSound* a piece that required active participation from the public grew out of the early discussions surrounding the development of the general concept of the curatorial project, *The Invisible Landscapes*. *etherSound* was first imagined as a sounding body that derived its control from non-active participation, specifically from data about activity in the GSM network surrounding the exhibition space. Facing difficulties regarding issues of information security, it became clear that mobile phones could successfully be used in order to let the public interact with the sound much more actively. *etherSound* adopts the mobile phone, maybe the most popular device amongst the new tools for communication and opens a participation channel to the public.

The principle idea behind *etherSound* became an attempt to design an instrument that could be played by

[6] Joran Rudi. "Norge - et lydrike, Norway Remixed: a sound installation". In: *Organised Sound* 8.2 (2003). Pp. 151–155.
[7] Ulyate and Bianciardi, "The interactive Dance club: avoiding chaos in a multi-participant environment".
[8] Rudi, "Norge - et lydrike, Norway Remixed: a sound installation".
[9] I.e. Alvaro Barbosa. "Displaced Soundscapes: A Survey of Network Systems for Music and Sonic Art Creation". In: *Leonardo Music Journal* 13 (2003). Pp. 53–59; Sergi Jordà. "Faust Music On Line: (FMOL) An Approach to Real-Time Collective Composition on the Internet". In: *Leonardo Music Journal* 9 (1999). Pp. 5–12; William Duckworth. "Making Music on the Web". In: *Leonardo Music Journal* 9 (1999). Pp. 13–17.
[10] Jordà, "FMOL: Towards User-Friendly, Sophisticated New Musical Instruments".

anybody who had the knowledge to send an SMS (Short Message Service) from their mobile phones. In the version displayed at *The Invisible Landscapes*, all messages sent to a specified number were received by an Internet server, parsed for its content, the phone number it was sent from and the date and time it was received. This information was written into a database which was queried at regular intervals by a computer running a control and text analysis application (written in Java[11]) and the sound synthesis software (Max/MSP[12] running a Csound orchestra[13]). For every new message, the data was downloaded, processed and analyzed by the control program, turned into control signals which were then sent to the sound synthesis engine. Every message generated one sonic object that would last for up to two minutes. The response was very direct - a received SMS would result in an immediate and perceivable change in the sound. *etherSound* was tried in two different modes: as a stand alone interactive sound installation; and as a vehicle for improvisation. In the latter, one or several performers improvised along with the sounds of the installation while the audience contributed actively to the performance by sending text messages.

In this work the mobile phone is the interface to the sound production and to the distribution of sound events. The way the mobile phone is used here, as a text only input interface, is rather limited and much of the rest of this article evaluates the advantages the mobile phone has, despite its limitations as a text input interface. If the only purpose of etherSound was to allow users to input text that would be transformed into sound, installing a computer with a keyboard that would allow visitors to post messages on site would conceivably be technically less complicated. Another solution, more dynamic than the one we chose, would have been to implement a voice interface that allowed for true real time interaction similar to that of the Auracle project[14]. Although this last option was considered, such a solution would need a technical and finacial framework that was beyond our scope.

A.4 Communication, time and creativity

It has been suggested that young people's (specifically teenagers) use of text messages (SMS), call-credit and mobile phones themselves can be interpreted as a form of *gifting*: 'We will contend that these gifts are exchanged in performances that have specific meaning in young people's daily lives and are played out with the intent to cement social relationships'[15]. In other words, text messages have a meaning to the sender and the recipient that transcends the actual content or meaning of the message. This is, in more than one way, in accordance with how the messages sent to *etherSound* were used. The content of the message as such is not transparent in the resulting sound object, only the general outline of it (the length, the composition, the number of syllables, etc.) and every message is 'rewarded' with sound; the gift is always returned. To further develop the meaning of the returning of the 'gift' the temporal aspect of etherSound needs to be considered.

There are two time frames at play in etherSound which bear immediate significance to this question

[11] See *Java Standard Edition, API Specification*; *Java Enterprise Edition, API Specification 1.4.1*.

[12] David Zicarelli. *Max/MSP Reference Manual*. Version 4.2. Cycling 74, IRCAM. 2000/2001. URL: http://www.cycling74.com/products/maxmsp.html.

[13] Boulanger, *The Csound Book*.

[14] Freeman et al., "Adaptive High-level Classification of Vocal Gestures Within a Networked Sound Instrument".

[15] Alex S. Taylor and Richard Harper. "The Gift of the Gab?: A Design Oriented Sociology of Young People's Use of Mobiles". In: *Computer Supported Cooperative Work (CSCW)* 12.3 (2003). ISSN 09259724. Pp. 267–296; See also Marcel Mauss. *The Gift, the form and reason for exchange in archaic societies*. W. W. Norton, 1990.

and they are described here borrowing terms from Curtis Roads table of temporal hierarchies in music[16]: (1) The 'meso time scale' which constitutes the single message and the resulting sonic events. The mapping between the message and the sound is linear and relatively consequent. (2) The 'macro time scale' which is the time from when the installation was started to when it ends. It is within the meso time scale that the relation between the object and the participant is established and it is in the dynamics between the meso and the macro time scale that the 'returning of the gift' has curtial significance. It constitutes a receipt of the contribution; a sonic confirmation that the message has been received. This kind of immediate response is important in order to avoid a sensation of exploitation in the participant: Their time, energy and, in the case of sending text messages from mobile phones, their money, is not used to fulfill our own opaque objectives hidden to the participant, but results in a palpable response with a value of its own. This is the main reason a clear causality between input and output in the meso time scale is aimed for. Therefore, some effort has been invested in making each sound object a closed form musical composition in its own right. However, as soon as the sound object begins to play back it transmutes into a player in the macro time scale, in which there is no preconceived musical form but where the indeterminacy of collective efforts are the main factor. It should be noted that the relation between the closed form of the meso time scale and the indeterminacy of the macro time scale is not unproblematic. An interactive, ongoing and indeterminate, musical creation will inevitably dismantle the traditional idea of musical form. There is nothing new with the "permanent event"[17] or the infinite musical form but it is the effect the indeterminate form has on the *understanding* and *interpretation*[18] of the work from the point of the participant, and whether the closed form of the message compositions enhance or degenerate this effect, that is of interest. Will a random collection of message compositions, each one with a sense of musical form, generate a large scale (closed) form or will they result in something else, conceptually different from musical form? I believe both is possible and, in this particular case, they are both part of the very core of the artistic intent. It is a question of perspectives. By opening up the form, the listening experience is likewise opened up and a multiplicity of perceptive perspectives becomes possible. However, the most plausible interpretation regarding the form of *etherSound* is that it is indeed a closed musical form, but in which the structure of the sounds is open and subject to change.

In the age of mass information, consumerist ideology and market segmentation strategies, individuality is at stake. Laura Martz asserts that 'the spectacle[19] steals every experience and sell it back to us, but only symbolically'[20], but we believe it is fair to assume that the desire for personal and individual expression among the general public and the wish to exercise influence has not vanished. As we will discuss later, individuality taken too far can be a problem in the context of an interactive collaborative work such as the one discussed here, but it is also an asset. Along with curiousity it is an incitement for wanting to participate, provided that the action invested results in a perceivable stimuli.

The clear causal relation between the action invested and the sounding result is a way of giving the

[16] Roads, *Microsound*, p. 3.

[17] Barbosa, "Displaced Soundscapes: A Survey of Network Systems for Music and Sonic Art Creation".

[18] Perhaps *reading* would be a better word to avoid confusion with the musical term interpretation.

[19] Martz uses the term 'the specatacle' with a reference to what Guy Debord and the situationists called 'the society of the spectacle' which includes commodities, art-as-commodity, the mass media and the entertainment industry. See also Guy Debord and Gil J. Wolman. "A User's Guide to Détournement". In: *Les Lèvres Nues* 8 (May 1956). Available at http://www.cddc.vt.edu/sionline/presitu/usersguide.html

[20] Laura Martz. "Free Time! Ludicity and the Anti-work Ethic". In: *cultronix* (1994). http://eserver.org/cultronix/01/.

participant an experience of involvment that ultimately could lead to a wish to further explore the causality of input and output, and give a sensation of understanding. The suggestion by Taylor et al. that mobile phone originated text messaging is already used in some circles for social interaction indicates that the mobile phone is indeed well suited as an interface for interactive art work where the creativity of the participant is the object.

A.5 Technology, communication and understanding

Concerning the ideology of the broadening of the audience, Mary J. Jacob ponders that public participation in the public art of the 90's never widened the audience[21]. Her contemplation hits a point, but in order to evaluate the processes in play in our project we need to consider the social dynamics of new communications technology. As has already been stated, mobile communication is no longer a luxuary reserved for the privileged classes, but accessible to most citizens in the Western World. It may be proposed that luxuary today is to *not* be accesible, a luxuary that only the secure, upper classes can afford.

About ten years ago, in the early ages of email communication it was seen that the nature of the medium had effects on group dynamics:

> Advances in computing and telecommunications technology are changing how people can meet and make group decisions. Technological changes help people cross physical, social, and psychological boundaries and have secondary effects on group behavior and decision making. Experiments show that compared with face-to-face meeting, a computer-mediated discussion leads to; delays; more explicit and outspoken advocacy; "flaming"; more equal participation among group members; and more extreme, unconventional, or risky decisions.[22]

Whether this is also true for SMS communication is a matter of speculation but it suggests that the means of communication has far stretching consequences that needs to be considered when designing interactive interfaces for public art.

We believe that advanced technology, designed for the consumer market, such as the cellular phone, leans itself well to the purpose of public interaction and may also help to counteract the tendency for art to turn itself to the already initiated. What Walter Benjamin[23] calls the 'advent of mechanical reproduction of art' has, according to DiMaggio et al., along with other things, 'resulted in a tendency for culture interests to diffuse across class lines'[24]. Benjamin writes:

> Around 1900 technical reproduction had reached a standard that not only permitted it to reproduce all transmitted works of art and thus to cause the most profound change in their impact upon the public; it also had captured a place of its own among the artistic processes.[25]

What will be the impact upon the public of the new tools of distribution of text, audio and images and what will be the role of the present day technological devices used for communication within the spheres of

[21] Mary J. Jacob. "Mapping the Terrain - New Genre Public Art". In: Susan Lacy (ed.) Bay Press, 1995. Chap. Unfashionable Audience, p. 59.

[22] Sara Kiesler and Sproull Lee. "Group Decision Making". In: *Organizational Behaviour and Human Decision Processes* 52.1 (1992). ISSN:07495978. Pp. 96–124.

[23] Walter Benjamin. *Illuminations*. Schocken Books, New York, 1968.

[24] DiMaggio and Useem, "Social Class and Arts Consumption: The Origins and Consequences of Class Differences to the Arts in America".

[25] Benjamin, *Illuminations*, chap. 1.

creativity and art production? It may not be possible to answer these questions for many years, but we feel it is of great interest to evaluate and experiment with the use of these tools within the realm of artistic and creative expressions.

It may be presumed that consumer market technology, for economical reasons, is designed to be accessible to as many people as possible within the target segments assigned by the production companies. The vast popularity of the mobile phone, despite its technological level of complexity, coupled with the recent price drops of service charges suggests that, for mobile phones, this is true. However it should also be noted that certain segments of the western societies (notably senior citizens) and the development countries, are still locked out from, and largely ignored by, this communication revolution. This taken into consideration, the dynamics of mobile phone usage and accessibility nevertheless seems to be of a different class than that of traditional culture consumption. If this holds true, constructing an interactive interface to an art work based on the use of mobile phones can potentially open the work to not already initiated groups of the public.

A.6 Creative production and space

Even though *etherSound* is not site specific in the traditional sense, it may still be regarded as such since it follows the logic of the flattened non-space of telecommunication. The phone is tied to a virtual space and *etherSound* exists within this space as it is delimited by the group of people interacting with the installation at the very moment interaction takes place. As a result, the context is *not* the gallery space, but the curatorial idea that delineates *The Invisible Landscapes*.

As we have discussed, the emergence of mobile communications, the Internet and the technological devices that are used to interact on these networks, has the potential to change the nature of (social) participation. Now, participation takes place as an extension of everyday acts. At its best, it does not matter if it is manifested and glamorized as a single, unique and individual voice. It is not strained and it is not in a pedagogic mode, but rather follows a mode of pop culture. It abandons the rational individual and puts emphasis on the collective in a typical Durkheimian fasion. We could say that this new form of participation, consisting of clusters of anonymous random acts, empowers a new structure for creative corporeality which is never fixed within predetermined conditions but is more reminiscent of a flow. We want to suggest that it holds potential as a new coefficient of an autonomous agency of creativity.

Figure A.2: The space at Malmö Konstmuseum where *etherSound* was first realized.

The boundary between public and private in mobile phone communication is not a straight line and can not easily be defined. If we take into consideration the fact that it is possible to track the location of a mobile phone, we may even go so far as to say that privacy ceases to exist the moment ones mobile phone is turned on. But mobile communication also makes possible a certain kind of private interaction in the work domain as well as in public spaces. In their article[26] list a number of circumstances where public infringes upon private and vice versa. It may be suggested that the space for mobile communication cannot be distinguished as private *or* public but creates a new space with its own set of attributes. Taylor et al. writes:

> The phone and its contents, if you like, allows young people to differentiate themselves from family or household relations as well as cement their own social networks. The phone allows the young person to withdraw from the world of the home, for instance, and establish a "micro-world" through the system of exchange that young people employ.[27]

In *etherSound*, a private act, the composing and sending of a text message from one's own phone, is transformed to streaming sound in public. Even though the content of the message remains hidden in the public sphere, the processes it sets in motion takes place publicly and may set in motion another private act. What was originally private, and maybe even meant to stay private, affects the public space and consequently, the participants share both the physical and the imaginary, and the two feed off one another.

A.7 Authenticity and interpretation

Active public participation raises a series of questions about authorship. Who is the composer and who is the performer? Who is the originator? Who is the commissioner? In *etherSound*, the creator of the piece can very well be said to be the commissioner, and the participants, supplying the input, the originators and the curator the orchestrator. Or, the curator may be perceived as an originator, the audience as the performers and the creator as the commissioner. We believe it is impossible and of no use to impose pre-existing roles on participants. Ultimately, the hybrid role created by different levels of involvement should be in a state of flow in this work. The coefficient of plural roles in one individual temporarily appears and disappears in a subtle and sensitive balance, which, in every performance will be different. It is 'onceness' created by a new coefficient through SMS participation.

Experience made from presenting *etherSound* at a music festival[28] is testimony of the difficulty to achieve this and of the importance of context. Musical performance is surrounded by old and heavy traditions which implies a rigid definition of the author. However, since the roles of the players involved in *etherSound* are interchangeable, confusion arose as to what the music consisted of, which in turn resulted in some performers doubting the validity of their participation.

Participating in *etherSound* through SMS is an action started from an individual initiation at the bottom level, that influences the whole. The totality will further lead participation on to an unpredictable outcome. It indicates the power of the situation and the multitude (not an individual) as factors of creativity. Thus, the attitude of conviviality naturally directs authenticity of the work in a more flexible manner. There is no

[26] Taylor and Harper, "The Gift of the Gab?: A Design Oriented Sociology of Young People's Use of Mobiles".
[27] Ibid., p. 292.
[28] *Elektrisk Helg*, arranged by Ars Nova, held in Malmö, Sweden in April 2004

obvious author to credit, and this opens up for a new form of authenticity, even in relation to contemporary culture.

As has been noted, the content of a given message was not revealed in the public sphere except as an abstract series of sonic events and furthermore, and the audience was not informed of the mapping between the message and the sound event it generates. This unkown relationship between the SMS and the sound composition coupled with an expectation of reflectivity stimulates the imagination of the participant and navigates them towards a more careful attention to, and translation of, the sound. This is consistent with Guy Garnett's analysis that:

> [...] music can be roughly considered to be sounds made with aesthetic intent, or even sounds listened to with aesthetic interest. The former gives more weight to the role of the creator, while the latter formulation tends to privilege the listener[29].

Hence, content is not only a result of a compositional process, but of public active participation and in that sense there is nothing to 'understand' in *etherSound* unless you participate. However, if you do participate, understanding the resulting sound is not dependent on a thorough insight of the history of art or electronic music following the idea of the 'telematic' piece:

> [...] the observer in an interactive telematic system is by definition a participator. In telematic art, meaning is not something created by the artist, distributed through the network, and *received* by the observer. Meaning is the product of interaction between the observer and the system, the content of which is in a state of flux, of endless change and transformation[30].

A.8 Conclusion

Having discussed the positive effects that portable communication devices can have in the context of public art it should be mentioned that this mainly holds true in the Western World. Access to technology and its uses can easily be taken for granted, but for certain groups, even in the Western World, it is not self evident how a mobile phone and all its options are operated, and tangled within this is the danger of a new kind of class hierarchy based on knowledge of, use of and access to communications technology.

In this project we have showed that the cellular phone, and its owners' ability to send text messages from it, can successfully be used as an interface for public interaction. We also believe that, given our intentions, the SMS interface has some advantages compared to other possible solutions. From a practical angle it is widespread, comparatively simple to use, it is private and it is surrounded with a large framework that makes it easy to integrate it in an artistic work. In addition, in the Western World, it has already coalesced into our private and professional lives and has become a tool for social interaction. Participation can per se open up the work to groups of people not familiar with contemporary sound art and an interactive interface built around the mobile phone may contribute to in some degree neutralizing the class hierarchies in arts consumption.

Even though interaction with *etherSound* stems from an individual wish to participate, the interface and the system center on the public rather than the private. This transformation from private to public opens

[29] Garnett, "The Aesthetics of Interactive Computer Music".
[30] Ascott, "Is There Love in the Telematic Embrace?"

up for a new sensation of space and an auspicious and dynamic impression of creativity. Moreover we have suggested that communication itself is a corresponding form of creativity.

A thought that was never implemented due to lack of funds and technical equipment, was to, in addition to the location specific installation, stream the sound on the Internet. This would allow for groups of people that, for various reasons, did not have access to the location of the exhibition hall, to participate and it would greatly expand the accessibility. Further, it would be interesting to try to allow for greater depth in the system and yield for 'expert' performance. This would however have to be done with great care in order not to loose the collective focus.

This essay was originally presented at the EMS conference 2006 in Beijing and published at the EMS network. A modified version of it also appears in "SHUT UP 'N' PLAY! Negotiating the Musical Work".

Frisk and Östersjö (2006)
Östersjö (2008)

Appendix B

Negotiating the Musical Work I

Authors: *Henrik Frisk & Stefan Östersjö*

B.1 Introduction

In this article we outline the theoretical background for some of the empirical studies performed within the frame of our respective artistic PhD projects at the Malmö Academy of Music, Lund University. The purpose of the studies performed and hence, the requirements of the methods we use to perform them and study their outcome, is to explore the inter-relations between performer and composer. Specifically we study the musical work in the Western art music tradition, prior to its ultimate notation and prior to its performance. Though many of the ideas presented below may apply to other genres this article is mainly concerned with music for solo instrument and live electronics.

Trevor Wishart introduces the idea that the development of notation has, among many other things, resulted in a division of the musician into 'composer' and 'performer'.[1] This split calls for an extended discussion of what composer and performer provide to the creative process. Our ambition is to approach this issue by studying the low-level processes leading up to a version of the musical work. We find that by using the concept of 'agents' we bypass the otherwise problematic values traditionally assigned to the two labours. The musical work as an open concept, such as it is developed by Lydia Goehr in her book *The Imaginary Museum of Musical Works* (1992), is also central to the reasoning in this paper as well as her claim, that the work concept has had a regulative function only at certain times in the history of Western art music. In contemporary music this regulative function can be found to be pertinent in one composer's work and extraneous in another's.

B.2 The Ontology of the Musical Work

A musical work, in the cultural context of the Western art music tradition, and especially since the romantic era up to the present day, is commonly regarded as the result of a process in two distinct phases; one con-

[1] Wishart, *On Sonic Art*.

structive and one reproductive. The composer produces a score, which in turn is handed over to a performer who makes an interpretation of the notation and reproduces it as specified in the score. The score constitutes the primary source of information (see Figure B.1).

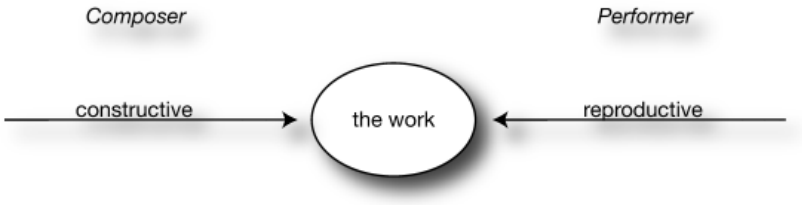

Figure B.1: *Within the Western art music tradition the score is commonly regarded as the primary source of information.*

In Paul Ricœur's hermeneutic philosophy, the traditional view of the author as a one-way sender of a message is disputed. Ricœur finds that the author is disengaged from the work by the act of writing.[2] When writing takes the place of dialogue, the immediate face-to-face communication is replaced by inscription and the semantic autonomy of the text. The disconnection between the author's intention and the meaning of the text is a key issue in Ricœur's theory. The inscription of a discourse in writing brings the semantic autonomy of language into play.

> The text is the very place where the author appears. But does the author appear otherwise than as first reader? The distancing of the text from its author is already a phenomenon of the first reading that, in one move, poses the whole series of problems that we are now going to confront concerning the relations between explanation and interpretation. These relations arise at the time of reading.[3]

Suppose that we undertake the hypothetical experiment of applying this theory on the literary text to musical production: are there any analogies between Ricœur's account and musical practice? Imagine music-making, as it takes place independently of musical notation, as compared to the kind of dialogue that the inscription of text replaces. Improvisation involves making variations on known patterns, and when this is successful, truly innovative music comes out. Imagine a composer writing music: Isn't it necessary for him to interact with the musical 'language', or context, in which he is working, in a similar way as is necessary for the improviser? Analogically speaking, the moment that the composer starts making the notation, the 'dialogue' is replaced by the semantic autonomy of the text-based musical context, with its own structural possibilities and limitations. The composer is detached from the music in the act of notating it. In the case of a written text, the intention of the author is not equal to the meaning of the text. The author is present in the text, but only as a first reader. Similarly, this suggests that the construction of a score-based work consists of dialectic interplay between creation and interpretation, in which the composer - even during the act of writing - has to approach the notation by means of interpretation.

[2] Paul Ricœur. *From Text to Action*. Translation by Kathleen Blamey and John Thompson. Northwestern University Press, 1991.
[3] Ibid., pp. 109-10.

By this reflection on the artistic process, and in the light of Ricœur's philosophy, the view of the composer representing the productive phase, and the performer the reproductive, is questioned. We arrive at a modification of the traditional scheme of construction/reproduction, instead involving construction, but also interpretation in the composer's creative process.

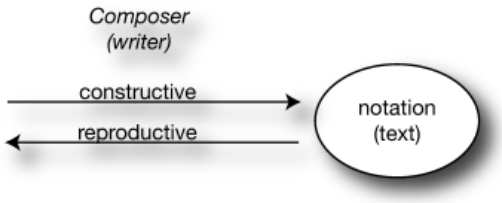

Figure B.2: *In the light of Ricœur we arrive at a modified scheme involving construction as well as interpretation in the composer's creative process.*

Another aspect of the composer's practice is highlighted by Horacio Vaggione.[4] The composer always has to approach the process of producing a piece of music as a listener, either in the form of inner listening while writing an instrumental score or the concrete listening in the production of a pure electronic piece. This is described by Vaggione as an action/perception feedback loop, reminiscent of the notation/interpretation process suggested by the thinking of Ricœur. But there is a fundamental difference between the two accounts: what Vaggione provides is a theoretical reflection on the kind of thinking that is not based on language, but on action and perception.

> In order to produce music an act of hearing is necessary, whether it be the 'inner hearing' (the silent writing situation) of pure instrumental music composition, or the 'concrete hearing' of electroacoustic music composition. These situations involve variants (there are many others) of an 'action/perception feedback loop' which can be defined as an instance of validation proper to musical processes.[5]

Without any further specification, Vaggione hints at the many other variants of this class of feedback loops at play in the production of musical content. It is important to bear in mind that 'thinking' in modes of action does not require a 'transcription' into language. What Vaggione reminds us is that 'thinking through hearing' and 'thinking through performing' are essential modes of interpretation. These involve the physical interaction between a performer and his or her instrument as well as the inner listening of the composer; both of which do not require verbal translation. This kind of interpretation is what we would call 'thinking through practice'.[6]

[4] Horacio Vaggione. "Some Ontological Remarks about Music Composition Processes". In: *Computer Music Journal* 25.1 (2001). Pp. 54–61.

[5] Ibid.

[6] One important source for the notion of 'thinking through practice' is the thinking of Art historian and curator Sarat Maharaj. His introductory paper for the *Knowledge Lab* at the *Haus der Kulturen der Welt in Berlin* 2005 (in which both authors participated) was entitled 'Thinking Through Performance' and discussed how various modes of 'thinking through' could function as a methodology for the creation of new knowledge in the arts. We believe that the way we use the term in the present paper makes a slightly different use

Our conclusion is that the use of notation and the subsequent musical practice that has followed from it, does not unambiguously divide composer and performer into one 'auteur' (producing the work) and one interpreter (reproducing it). Interpretation is a part of both creative acts and the practices of both agents overlap in many ways.

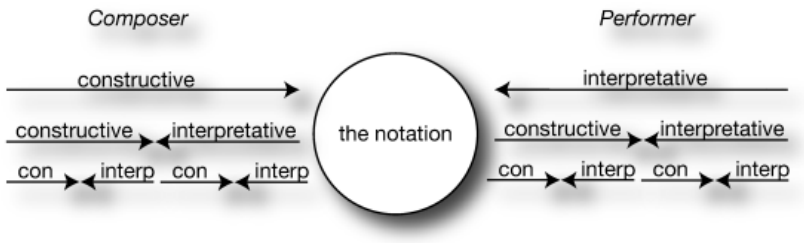

Figure B.3: *Our schematic model of the interaction between constructive and interpretative phases in performance and composition.*

B.2.1 Musical Interpretation and performance

Since the 19th century, performances of score-based works have commonly been referred to as interpretations. If we regard performances as interpretations, are they interpretations of the notation or of a wider entity? This is in essence a matter of the ontology of the musical work: Is the work equivalent to the score or is there more to the identity of the work than notation? According to Theodor Adorno, the "musical score is never identical with the work; devotion to the text means the constant effort to grasp that which it hides [...]".[7] A crucial fact about musical works is their historicity. Firstly in the sense that the material that is available to the composer is historically and culturally mediated and thus pre-formed within the cultural context in which he is working. Secondly, meaning in music, and in Adorno's view this also equals the musical work itself, is achieved in the tension between the received formal norms and the 'second reflection' or re-contextualisation in the compositional process by the creative 'Subject'.[8] The work is not equivalent to the score but is a cultural construct that materialises in its relation to its cultural context.

Paul Ricœur introduces the concept of the 'world of the text' as something other than the intention of the author. The meaning of the text is projected in front of the text, and is not to be found in authorial intent 'behind' the text, as in romantic hermeneutic philosophy. What is unfolded by the passing from explanation to understanding is the thing of the text, or the kind of world that the text unfolds before the text.

> Reading is no longer simply listening. It is governed by codes comparable to the grammatical code that

of the notion of 'thinking through': in the *Knowledge Lab*, 'thinking through' referred to a mode of studying artistic practice, whereas we use the notion to describe processes within artistic practice itself. One could argue that our study gives further confirmation to the methodology suggested by Maharaj for the *Knowledge Lab*.

[7] T. Adorno. *Prisms, Studies in contemporary German social thought*. Translated from German by Samuel and Shierry Weber. The MIT Press, Cambridge, Mass., 1981, p. 144.

[8] M Paddison. "The Language-Character of Music: Some Motifs in Adorno". In: *Journal of the Royal Musical Association* 116.2 (1991). Pp. 267–79.

> guides the understanding of sentences. In the case of the narrative, these codes are precisely the ones that a structural analysis brings to light under the title of narrative codes.
>
> It cannot, therefore, be said that the passage by way of explanation destroys intersubjective understanding. This mediation is required by discourse itself. I am expressly using the term discourse and not simply speech, the fugitive manifestation of language. For it is discourse that calls for this ever more complicated process of exteriorization with regard to itself, a process that begins with the gap between saying and the said, continues through the inscription in letters, and is completed in the complex codifications of works of discourse, the narrative among others. Exteriorization in material marks and inscription in the codes of discourse make not only possible but necessary the mediation of understanding by explanation, of which structural analysis constitutes the most remarkable realization.[9]

Not only is the author detached from the work by the act of writing. For a reader to enter into the world of the text, a similar process of detachment and analytical interpretation is needed. But writing music is an activity distinct from writing a literary text. A score, to a higher degree than is a text, is a tacit agreement with a present or implied performer - we cannot simply equal a verbal text to a score and a performer to a reader of this text. But there seems to be an immanent call for analysis and interpretation in the construction of musical meaning. Musical meaning may be found through a movement from explanation through analysis to understanding.

> The performance of a piece of music is (...) the actualisation of an analytic act - even though such analysis may have been intuitive and unsystematic. For what a performer does is to make the relationships and patterns potential in the composer's score clear to the mind and ear of the experienced listener.[10]

From a general point of view, interpretation in the context of the arts can be understood as assigning meaning to works. To what extent can we claim that performances do this? Turning to definitions, we will now attempt to trace the difference between critical interpretation and what we tend to call performance interpretation.

> Being an interpretation of is a relation between a thought or an utterance on the one hand and an object of interpretation on the other. In the case of art (...) an utterance about a work is an interpretation of the work, only if it says something about the meaning of a work, about a meaning it could have or was intended to have, or about the work's significance.[11]

Stecker's definition of interpretation raises some important questions: What musical actions do we regard as interpretation, and in what sense do they assign meaning to the work?

Are the performer's shaping of phrases, relative level of dynamics and accents etc. really to be regarded as an interpretation of the piece, assigning meaning to the music? Markings by the composer of dynamics, accentuation, phrasing etc are often regarded as 'interpretative'. This mode of speaking implies that markings of this kind represent the author's interpretation of the meaning of the work. But this seems implausible to us. Isn't it more likely that the reason we tend to regard these markings as interpretational is that they represent

[9] Ricœur, *From Text to Action*, p. 130.
[10] L Meyer. *Explaining Music: essays and explorations*. University of California Press, Berkeley, Cal., 1973, p. 29.
[11] Robert Stecker. *Interpretation and Construction: art, speach, and the law*. Blackwell Publishing, 2003, p. 82.

a category of musical organisation that often has been left to the performer's discretion? According to our understanding of the musical event all parameters belong to the musical fact.

In the preparatory stages the performer has to make decisions of a kind that do not clearly differ from that of critical interpretation.[12] In order to take a position in cases where a score is incomplete, inconsistent or exists in different versions, a critical interpretation of the score is necessary. This could imply that the difference between critical and performative interpretations is of a floating and unclear kind. On the contrary Levinson argues that they are logically distinct activities.

> ...a critical interpretation typically aims to explain (or elucidate) a work's meaning or structure - "what is going on in it", in a common phrase - whereas a performative interpretation can at most highlight (or effectively display) that meaning or structure. A performative interpretation, if successful, may enable one to conceive of a work differently in the critical sense - as the performer conceived it in arriving at the performative interpretation - but only a critical interpretation indicates or details such a conception.[13]

In other words, there are many ways in which a performance fails to fulfil the criteria for a critical interpretation. In critical interpretation we do not have this peculiar amalgamation of 'object of interpretation' and the 'interpretation' itself. This crucial difference between performance and critical interpretation is also acknowledged by Robert Stecker:

> If performances and critical interpretations are both representations of works, they are so in quite different senses. If we ignore these differences, we can easily be misled to make invalid inferences. Performances are necessarily constructive; that is, they necessarily add features that the work leaves vague or undetermined.[14]

But not only in cases in which the notation is in some respect unclear or vague is there a call for constructive elements in performance. Construction is really at the heart of the matter. The relation between a performance interpretation and the work is not the relation between an external receiver and an artwork but the relation between different forces at play in the construction of the work itself. The use of notation presumes a common understanding of performance practice of composer and interpreter. This fundamental agreement between a composer and an imagined or present performer is part and parcel of every musical notation. As we have seen in the thinking of Adorno and furthered into the model of 'the world of the text', a true instance of a work must be based on an interpretation that goes beyond the mere text of the score. Assigning meaning to a musical work is achieved by way of a critical reading of the work (and not only the score). Musical meaning is constructed in the relation between the musical structures themselves and the musico-historical context - its tradition - and the friction between this context and the work.

In the preservatory culture that Classical Music is today, we tend to speak of works as ideal objects that are 'interpreted' in performances that can be evaluated in comparison with this ideal entity. However, we find that musical interpretation is better understood as an analytical and hermeneutic tool that is a part of the agencies of the performer as well as the composer. Performances are not separate from the work but always a

[12] Gerald Levinson. "Performative vs. Critical Interpretations of Music". In: *The Interpretation of Music: philosophical essays*. Oxford: Clarendon Press, 1993. Pp. 33–60, pp. 38-9.

[13] Ibid., pp. 38-9.

[14] Stecker, *Interpretation and Construction: art, speach, and the law*, p. 80.

part of it - a successful performance is an embodiment of the work[15]:

> Every performance is an event, but not one that would in any way be separate from the work - the work itself is what 'takes place' in the performative event.[16]

We would like to propose the fairly radical idea of dropping the term performance interpretation. Preceding performance is an act of interpretation, either by means of analytical thinking (critical interpretation) or through an embodied mode of 'thinking through practice'. However, it is important to bear in mind that, just as Gadamer reminds us, a performance is not to be understood as an interpretation of a work, but as its final constructive phase.

B.3 Musical semiology

In his 1989 article 'Reflections on the development of semiology of music' Jean-Jacques Nattiez offers an excellent review of the history of musical semiology. In it he gives an historic perspective on the fundamental issue of the nature of musical signification. Nattiez distinguishes between intrinsic and extrinsic significations within musical semantics, finding the theory of the former to be to a large extent founded on the work of Nicolas Ruwet and the notion of music as a language that signifies itself.[17] Jean Molino summarizes Susanne Langer's idea of music as the 'unconsummated symbol' and captures the essence of the problem: "On the one hand, the unchallengeable presence of evocation; on the other, the impossibility of exploiting it"[18]. Molino aims at a theory in which music is understood as networked communication or exchanges between individuals. As we will discuss more thoroughly in the next section, the sender and receiver do not have to come to the same understanding of the message, or the 'trace' as Molino would call it, hence there is no need for a understanding of the 'code' which is significant to the semiosis favored by Umberto Eco. Eco points to the problems with connecting the investigation of a sign with the object to which it refers. It is impossible to attribute logical statements such as 'true' or 'false' to the semiological investigation of music and for Eco these are pre- or postsemiotic problems; "The signs are of interest to semiotics as social powers" and further "Any attempt to establish the referent of a sign will force us to define this referent with the terminology of an abstract entity." This is what Eco calls the "cultural convention".[19]

Defining a cultural context as the referent resolves some issues in the analysis of performed music as a social fact. The listener or concert-goer can be defined as belonging to a cultural entity with predetermined understandings of the context of the performance, but also of the cultural markers within the music. This cultural entity may then be used as a code to decipher the message (the music as a symbolic system). However, in our study we are looking at a not yet existing work - a work in progress - and we are not primarily interested in the symbolic understanding of *music* as it is materialized in the physical world. Our focus is geared towards the understanding of the *actions* that lead to production of musical content. Following Eco's model we

[15] This is not to say that performances cannot be more or less true to the instructions in the score, or to the tradition, and that the performance itself should not be accessible for critical consideration.

[16] Hans Georg Gadamer. *Wahrheit und Methode: Grundzuge einer philosophischen Hermeneutik*. In English: Truth and Method, translation by J. Weinsheimer and D.G.Marshall, New York: Crossroad. Tubingen, Mohr, 1960.

[17] Nattiez, "Reflections on the development of musical semiology", p. 30.

[18] Molino, "Musical Fact and the Semiology of Music", pp. 126-7.

[19] Eco, *Den frånvarande strukturen (La struttura assente)*, pp. 61-6.

might try to approach this symbolic system in relation to a common context, or subculture created by the agents involved in it. Both composer and performer are working within the frame of their own cultural contexts which defines their respective understandings of the evolving work. The subculture is a result of interaction, and negotiation ('*What is it we are developing?*', '*How are we talking about it?*', etc.), between the two agents and their inherent cultural contexts. Their mutual expectations and their understanding or imagination of the work in progress is of importance when they attempt at co-ordinating their actions, for instance towards a definition of the performance instructions. The musical work becomes the sign or the message, the agents the signifiers and the subculture the signified. Where, traditionally, we may tend to regard the composer/performer relation as a hierarchic structure in which the role, even the purpose, of the performer is to fulfill the composer's intentions (whether he is dead or alive), this mode of analysis allows us to look at the two agents as part of a larger system that may also contain many other agents.

But to fully understand the dynamics of the context, or subculture as we call it, we also need the tools to move to a lower level of analysis. The tripartite model suggested by Molino for analysis of music, though certain aspects of it remains problematic, appears to be a flexible method for our study at this stage.

B.3.1 The three dimensions

Molino reminds us that the hypothesis that there is a "single, well-defined item of information to be transmitted, all the rest being simply noise" is "dangerously inaccurate and misleading as soon as we move from the artificial communication of information to a concrete act of human communication as a total social fact."[20] Music, according to him, is a product and not a transmission. The Duchampian notion of a work of art is very similar; as two poles with the artist on the one side and the viewer on the other - the intention of the artist holds no significance to the work's interpretation. Molino further refers to Paul Valéry, to point out that "there is no guarantee of a direct correspondence between the effect produced by a work of art and the intentions of its creator". The distinction between what was later coined as the 'poietic and 'esthesic' dimensions in the symbolic phenomenon was first suggested by Valéry in his inaugural lecture for the Collége de France in 1945.

The ambition of musical semiology has been to provide tools for an analytic understanding of the total symbolic fact of the musical work.[21] Molino argues for a three level symbolic analysis; "the poietic, the esthesic and the 'neutral' analysis of the object".[22] Three modes of analysis all representing the same work of art. The analysis at the different levels does not necessarily have to lead to the same conclusions or results but, according to Nattiez, it may help us to understand *all* aspects of the musical work:

> ...recognizing, elaborating, and articulating the three relatively autonomous levels (poietic, neutral and esthesic) facilitates knowledge of all processes unleashed by the musical work, from the moment of the work's conception, passing through its 'writing down', to its performance.[23]

[20] Molino, "Musical Fact and the Semiology of Music".
[21] Nattiez, *Music and Discourse*, p. 34.
[22] Molino, "Musical Fact and the Semiology of Music".
[23] Nattiez, *Music and Discourse*, p. 92.

Leaving the problematic concept of the neutral level aside[24], a rudimentary definition of the two terms 'poietic' and 'esthesic' from a musicological point of view indicates that an analysis of the (external) poietics of the work takes "a poietic document - letters, plans, sketches" as its point of departure whereas an analysis of the (inductive) esthesic "grounds itself in perceptive introspection" - that which is "perceptively Relevant", that which one hears.[25] The three "families of analysis" correspond to a:

> semiological 'program' [...] that has three *objects*:
>
> 1. the poietic process
> 2. the esthesic process
> 3. the material reality of the work (its live production, its score, its printed text, etc.) - that is, the physical traces that result from the poietic process.[26]

Though the 'material reality' and the 'physical traces' are not as self evidently defined as a result of only the poietics of the work, it is the processes themselves rather than the analysis of the processes that are of interest to us in this paper. (In the study that we performed following the methods developed here it will also be clear that neither the poietics nor the esthesics belong to only one aspect of the work.) The term 'poietic' can be traced to the Thomistic philosopher Étienne Gilson whose definitions are less concerned with the analysis and more with the actual processes. According to Nattiez:

> With 'poietic' Gilson understood the determination of the conditions that make possible, and that underpin the creation of an artist's work - thanks to which something now exists which would not have existed, except for them.[27]

Taking this short statement as a definition it may be argued that also acts of interpretation (and analysis) involves a poietic dimension.

Nattiez further discusses the issue of where the poietic process ends and the esthesic begins in score-based music.[28] For Nattiez this is in essence an ontological discussion: What is the musical work, is it the graphic sign alone or is the musical work incomplete before it is realised as sound in performance? Contrary to our discussion in Section B.2.1, Nattiez finds that the greatest difference, between the score and the acoustic trace left by a performance, is that while the score is "an invariable physical reality" there are just as many acoustic realisations as there are performances. The performance is the borderline between the esthesic and the poietic field. By focusing on the act of interpretation as it is performed between the score and its sonifications ("the interpretants that insinuate themselves between the score and its performance" (*ibid*)), he draws the conclusion that analysis of the neutral level has to be applied to "the graphic sign alone, because that sign *precedes* interpretation" (*ibid*). Where Nattiez sees the production of a musical work as a linear process, we tend to regard it as an oscillating interaction between *all* of the different agents that are involved in the process, though, in this article, we limit the discussion to include only the performer and the composer.

[24] It has been extensively debated elsewhere, for a list of references see footnote 8 of Nattiez, "Reflections on the development of musical semiology", p. 35
[25] Nattiez, *Music and Discourse*, pp. 140-3.
[26] Ibid., p. 15.
[27] Ibid., pp. 12-3.
[28] Ibid., p. 72.

As we suggested in section B.2, the process of writing down a musical work *is not* a unidirectional poietic process but should rather be understood as an interaction between esthesic and poietic processes. This to an extent that makes it difficult to define the end of the poietic process as well as the beginning of the esthesic. The acts of musical composition that Nattiez gathers within the poietics can in themselves be analyzed by using the same method that he applies to the total fact of the musical work. According to us, Nattiez gives too little consideration to the generative processes (to repeat the quote: "from the moment of the work's conception, passing through its 'writing down', to its performance"[29]), articulating the problem in ontological terms. It seems that Nattiez draws conclusions about "processes unleashed by the musical work" from a purely analytical understanding of music. This perspective is still dependent on the view of composers as 'true creators' and works as 'ideal objects': stable and fixed artworks that should make up the primary object of study for musicology.

What we are concerned with in these studies is almost the opposite: To understand the actions that *lead to* musical content and the significance of the interactions between the agents involved in these processes. A description of the generative phase of musical production preceding notation might provide a better understanding of the nature of the musical work evading the detour into abstract ontological reasoning. Hereby we also avoid the difficult and much debated issue of music as a signifying system.

B.4 Discussion

> *Just as the reading of the modern text consists not in receiving, in knowing or in feeling that text, but in writing it anew, in crossing its writing with a fresh inscription, so too reading this Beethoven is* to operate *his music, to draw it (it is willing to be drawn) into an unknown* praxis.[30]

What we are pointing at in this text is the possibility that not only interpretation (in the sense that Barthes talks about it) is about *operating* the (musical) text. Also composition and the processes unleashed by the 'thinking through hearing', is about operating the inner text of the imagination of the music. Furthermore, we argue that this is an activity that, not only in collaborative projects, is performed in negotiations between multiple agents.

In a study performed by the authors using the theory and method developed in this paper the following conclusions were drawn[31]:

1. Composition may be regarded as a complex interaction between esthesic and poietic processes.
2. Performers may similarly be said to oscillate between these two modes of artistic activity.

By examining one particular event in one of the empirical studies mentioned above we will now try to elaborate on these conclusions and attempt to contextualize the reasoning in section B.3.1. The event is taken from a video documented session with Swedish composer Love Mangs and guitarist Stefan Östersjö in which they are working on *Viken*, a composition for guitar and electronics. The session took place less than two months before the premiere of the piece. S.Ö. has improvised and notated a short musical fragment and L.M.

[29] Nattiez, *Music and Discourse*, p. 92.
[30] Barthes, "Musica Practica".
[31] For an in depth description of the empirical studies performed see Frisk and Östersjö, "Negotiating the Musical Work II".

is trying to make S.Ö. to shape the melody differently by introducing the notion of a fermata. At this point the roles are seemingly swapped; the performer is notating music and the composer is thinking about the interpretation of this musical fragment.

On his esthesic perception of the melody as it is defined by S.Ö., L.M. presumably wishes for a certain passage to be extended in time. At first his suggestion about the fermata is not clearly understood by S.Ö. The situation and the following communication indicates that L.M. isn't really interested in a fermata in the classical sense - he is merely interested in a different rhythmic contour of the melody. (This confusion is likely to be one of the reasons his message is not being comprehended by S.Ö.)

What follows is a negotiation between the two agents to establish the meaning of the message 'a fermata'. In this process they are both active in the esthesic domain. However, if we move to a lower level of analysis the suggested fermata can be seen as a poietic process introduced by L.M., the meaning of which is being determined by S.Ö. in an esthesic process. The importance here is not, not in this paper nor in the session analyzed, to establish the denotation of the musical term *fermata*. Different musical performance traditions will always hold different signifiers to the idea of the fermata. But to fully understand the signifier of the idea of the fermata in the context of *Viken* as the idea is put forward by Love Mangs, we need to understand what is signified by it independently of the poietic (and esthesic) processes that led to its inclusion, as well as in relation to the (sub)cultural context of the collaboration between S.Ö. and L.M. This is what Eco would call the 'cultural history' and the 'philological aspect' respectively both pointing at the code used to encode the message.[32] In this short example it is interesting to note that the receiver as well as the sender is active in working out the code used to encode as well as decode the message ('a fermata'). This 'working out' of the code is the process that in effect leads to the abstract definition of the cultural entity, the *subculture*, that becomes the referent of the musical work in question. At the end of this process of negotiation a mutual understanding of the function of the fermata in this specific context is established (which actually goes well beyond the specific meaning of the symbol 'fermata').

This session is also a useful example of how interpretative processes of several kinds overlap and interact. When using improvisation to develop new material it is evident that a greater part of the hermeneutic processes are performed by various modes of 'thinking through practice'. However, as soon as notation is introduced, also analytical modes of thinking make their way into the continuous performing and listening of the two agents.

We suggest that musical interpretation can be divided into two kinds, one based on language and analytical modes of thinking, the other based on thinking-through-practice. According to Ricœur, the act of writing detaches the writer from the meaning of the text and our claim is that this also applies to the act of writing a musical score. Vaggione's notion of action/perception feedback loops captures a characteristic feature of the composer's practice. This kind of 'thinking-through-practice' on the part of the composer may be described as made up of mutually interactive poietic and esthesic processes. We suggest this may be regarded as a hermeneutic process making up a parallel species of interpretation at play in the production of musical content. These various interpretative modes is what we refer to as 'thinking-through-practice'. Finally, the combined efforts of all the agents involved in the construction of the musical work creates the (sub)cultural

[32] Eco, *Den frånvarande strukturen (La struttura assente)*, pp. 154-5.

entity that signifies that work.

From the above discussion of the ontology of the musical work and the function of musical interpretation in the production of musical content we make the following claims:

1. Musical interpretation can be divided into two kinds: 'thinking-through-practice' and analytic (critical) interpretation.

2. Interpretation plays a crucial role in the practice of both the composer and performer.

In this paper we have presented a method for performing studies on the low level processes in the production of musical content. We have showed how the perhaps somewhat dated and endlessly debated semiological terminology by Molino and Nattiez may still prove to be helpful at bridging the gap between disparate activities in the field of musical production. The complex web of actions by several agents in the production of musical content demands that the methods used be flexible and responsive to the multiple layers of musical practice. Though our proposed method needs to be thoroughly evaluated and tested in practice it is our hope that these first steps taken will prove useful for further development.

This essay was originally presented at the ICMC conference 2006 and published in the conference preceedings. A modified version of it also appears in "SHUT UP 'N' PLAY! Negotiating the Musical Work".

Frisk and Östersjö (2006)
Östersjö (2008)

Appendix C

Negotiating the Musical Work II

Authors: *Henrik Frisk & Stefan Östersjö*

C.1 Introduction

This article discusses the musical work prior to its ultimate notation and prior to its performance; we discuss the musical work in the Western art music tradition, specifically music for solo instrument and live electronics. In lack of a general terminology we use the term 'mixed media' in this article to refer to a work for instrument(s) and electronic sounds. By mixed media music we refer to music in which sounds produced on acoustical instruments are mixed with sounds from electronic sources or electronically processed versions of the acoustic sounds played back on loudspeakers. One medium of sound production (acoustic instruments) is mixed with another (loudspeakers). This project is part of our respective artistic research projects at the Malmö Academy of Music, Lund University and is an effort to combine reflection, analysis, and empiricism in the framework of artistic research.

Our purpose is to acquire a deeper understanding for the underlying processes in the communication between the composer and the performer and the social significance traditionally assigned to these roles in relation to their operative significance. By better understanding the interaction between the two parties involved in the creation of the work, we also hope to better understand the necessary conditions for a successful interaction between the performer and the electronics. Obviously one of the fundamental conditions for a study such as this is that the performer and the composer are both alive, and that the performer has a genuine interest in performing the work in question.

C.1.1 Music and notation

The invention of notation has not only given us the notion of the musical work but has also resulted in a split of 'the musician' into two agents, composer and performer[1]. A musical work, in the cultural context of the Western art music tradition, is commonly regarded as the result of a process in two distinct phases; one con-

[1] Wishart, *On Sonic Art*.

structive and one reproductive[2]. The composer produces a score, which in turn is handed over to a performer who makes an interpretation of the notation and reproduces it as specified in the score, hopefully quite faithfully to the composer's intentions. The notation constitutes the primary source of information. According to the line of thought in Paul Ricœur's hermeunetic philosophy, the traditional view of the author as a one-way sender of a message is disputed - the author is disengaged from the work by the act of writing[3]. Similarly, we suggest that the construction of a score-based work consists of dialectic interplay between creation and interpretation, in which the composer, at times, has to approach his own notation by means of interpretation, even during the act of writing. On the other hand the performer does not merely reproduce the work such as notated, performing a score-based work is a co-creative act in which the performer necessarily has to make crucial artistic choices[4]. In other words, notation does not divide composer and performer into one originator (producing the work) and one interpreter (reproducing the work). Interpretation is a part of both creative acts.

C.2 Method

C.2.1 Semiological approach

Musical semiology has been constructed with the intention to provide tools for analytical understanding of the musical work in its entirety including the socio-cultural context. (For an excellent overview of the history of musical semiology[5].) Attempting to move to a lower level of organization than that of musical notation may help to further clarify the issue in relation to a wider sphere of knowledge.[6]

The three dimensions Molino reminds us that the hypothesis that there is a 'single, well-defined item of information to be transmitted, all the rest being simply noise' is 'dangerously inaccurate and misleading as soon as we move from the artificial communication of information to a concrete act of human communication as a total social fact.' Music, according to him, is a product and not a transmission. Hence Molino suggests a model for symbolic analysis on three levels; 'the poietic, the esthesic and the 'neutral' analysis of the object'. Three modes all representing the same work of art. The poietic level is the constructive phase, the esthesic is the interpretative phase and the neutral is the trace left by the poietic (or esthesic) process[7]. The tripartite model for analysis has also been proposed by another of the most important advocates for musical semiology, Jean-Jaques Nattiez:

> ...recognizing, elaborating, and articulating the three relatively autonomous levels (poietic, neutral and esthesic) facilitates knowledge of all processes unleashed by the musical work, from the moment of the work's conception, passing through its 'writing down', to its performance.[8]

[2] Nattiez, *Music and Discourse*.
[3] Ricœur, *From Text to Action*; See also Barthes, "Musica Practica".
[4] Peter Kivy. *Authenticities*. Cornell University Press, 1995; Steven Davies. *Musical Works & Performances: a philosophical exploration*. Oxford: Clarendon Press, 2001.
[5] Nattiez, "Reflections on the development of musical semiology".
[6] See Umberto Eco's discussion in Eco, *Den frånvarande strukturen (La struttura assente)*, p. 372.
[7] Molino, "Musical Fact and the Semiology of Music".
[8] Nattiez, *Music and Discourse*.

In the first empirical study in Section C.3.1 we focus mainly on the neutral level whereas in the second study (Section C.3.2) we map the processes onto the poietic and esthesic levels of analysis.

C.2.2 Qualitative method

The video documentation from the collaboration between Love Mangs and Stefan Östersjö consists of many hours of recorded data from different occasions. The selection of video clips to be analysed in the present study was made on qualitative grounds, but not using the typical method of theoretical sampling. The selection was instead based on the pre-understanding (*Vorverstehen*)[9]of Östersjö's, having himself been part of the collaborative process. From his knowledge of the sessions and the recorded material Östersjö suggested some sections that he found especially interesting. This approach to the analysis of video material generated in artistic research has been previously discussed by Östersjö and Hultberg[10]. Similarly, the selections made for the other empirical study was made based on Frisk's pre-understanding of the processes leading up to the different versions of the material in that study.

Qualitative Method in machine-musician interaction The selected video clips were transcribed verbatim by Frisk and Östersjö together. This turned out to be a very useful tool for the sake of keeping a detached and relatively objective point of view on the material. The transcription in turn was used as material for a graph that became an important analytical tool in the study. It was only at the point when the graph was produced that the implications of the study on machine-musician interaction started to materialise.

C.3 Empirical study

C.3.1 Harp piece

Introduction The work discussed here is a work in progress. It was commissioned by the Mexican harpist Mercedes Gomez in 2004 for harp and computer. The melodic material used for the piece consists of a small six note fragment that is transposed and repeated creating a tone row of potentially infinite length. Due to the cromaticism of the series the material isn't very idiomatic for the harp. It was chosen because of its inherent structure and its relation to the original vision of the music. But also because of a genuine interest for the process of negotiation between the fundamental building blocks of the composition and the idiomatics of the instrument for which the composition is intended. The process of adapting this specific material for the harp will inevitably involve constructive interpretation, performed by the composer on his own musical idea. In the case of the bars discussed below, much of these negotiations were discussions between Frisk and the performer. It is important to bear in mind that to some extent the notion of what is "idiomatic" and "playable" is relative to the technical approach and instrumental modes of expression of a certain performer. Naturally, many of the solutions and suggestions below relate very specifically to this collaboration and cannot be generalized as such. A certain amount of dialogue between idiomatics and musical ideas is likely to occur

[1]We use the term pre-understanding as a translation of Gadamer's notion of *Vorverstehen*; any kind of interpretation (of texts) requires an anticipated understanding of the analyzed object. Gadamer, *Wahrheit und Methode: Grundzuge einer philosophischen Hermeneutik*

[10]Stefan Östersjö and Cecilia Hultberg. "Per Nørgård's *Returns*: A collaborative study on interpretation finding and performance practice today." Conference Paper MIDAS Conference, Glasgow. 2005.

in any kind of compositional work but the conditions under which this work in progress has evolved makes the internal as well as the external negotiations stand out.

Analysis The following is a discussion on four notations of the same two bars of music. The first (Figure C.1) is the original idea transcribed as closely as is meaningful into the atomized rhythmic structure of western notation. The basic musical idea at this spot is to have the same variation of the tone row in three individual parts, separated by octaves, each one following its own unique and precisely notated rallentando.

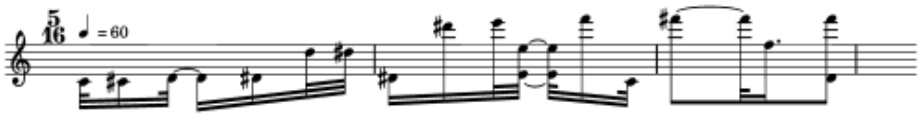

Figure C.1: First transcription of the idea into notation.

In the second example (Figure C.2) we find the first attempt at transcribing the musical idea for the harp. Pedal changes are not notated. At the indicated tempo, these two bars are still virtually unplayable on the harp. The F flat to F natural pedal change at the end of the first bar is a technical problem as is the G flat to G natural on the second eighth note of the second bar. After working on this passage with the harpist a version in the lines of Figure C.3 was suggested.

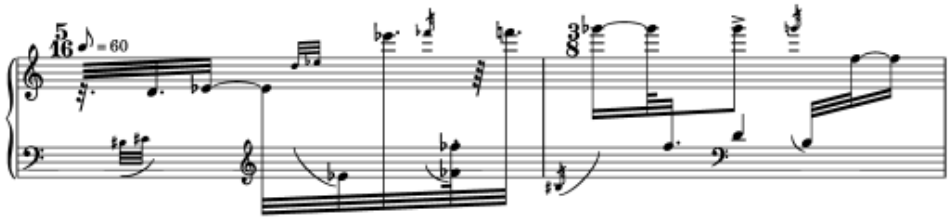

Figure C.2: First transcription for the harp.

The third example (Figure C.3) is rhythmically less complex. With a few written indications the effect of the slowing down of the music could be approximated. The pedal changes are resolved by means of pedal glisses. However the independent parts and their individual rallentandi cannot be traced in the image that this notation produces, which also means that a neutral analysis of this version will reveal little of the original intentions.

In the final example some of the rhythms have been simplified by use of grace notes and, as in the previous example, some of the pedal changes have been changed into pedal glissandos. This contributes to making the idiomatics of the instrument a part of the counterpoint and a balance, acceptable by both the composer

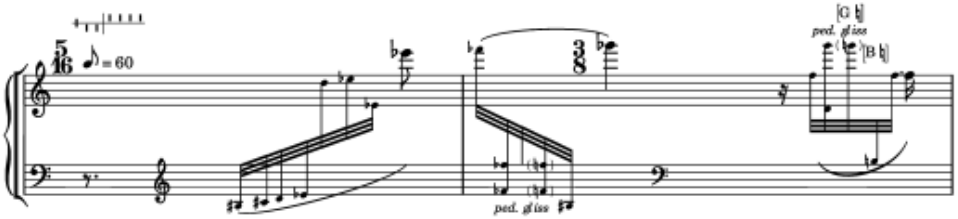

Figure C.3: A transcription rhythmically less complex.

and the performer between "authenticity" (to the original idea) and the playability of the excerpt, has been reached.

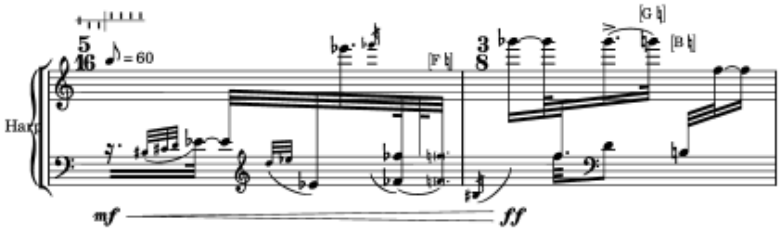

Figure C.4: A final version. More idiomatic than the example in Figure C.1, but closer to the original idea than Figure C.3

Conclusions Considering the esthesic processes in the evolving notation of this passage in the light of the discussion in Section C.1.1, it might be worthwhile to consider the significance of Frisk's conceptual vision of the work and how the negotiations between this musical matter and the idiomatic constraints of the harp lead up to a version of the work in musical notation. And further, how the presence of the performer in this discussion provides new impulses for the piece, specifically its notation and rhythmical articulation. The original vision is the trace that constitutes the source for the interpretative, i.e. esthesic, actions leading to the different notations. Though the notation is altered significantly through the four variations the core of the original musical vision remains the same throughout the different varitations; i.e. on the poietic level the negotiations did *not* alter the music. However, in a neutral analysis of these four excerpts we might be tempted to suggest that the process lead to four different kind of musics. In any event, we find that the study shows the recursive nature of the interplay between constructive (poietic) and interpretative (esthesic) processes both in the communication between the composer and the performer, but also as an internal process in which the composer himself is negotiating between the original vision and its representation in musical notation.

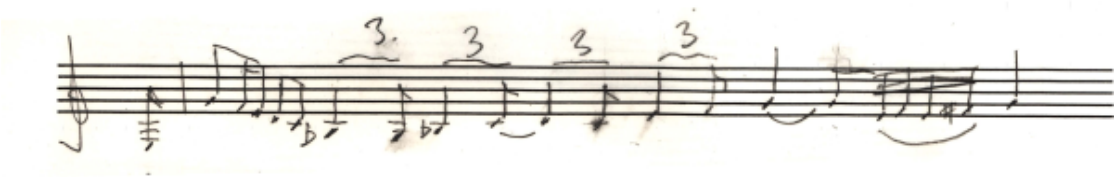

Figure C.5: Love Mangs first notation of the melody derived from the sound file.

C.3.2 Viken

Introduction. Love Mangs' (L.M.) "*Viken*" for guitar, banjo, e-bow and electronics (2004-05) was commissioned for Stefan Östersjö (S.Ö.) by the Swedish Arts Grants Committee. The project had several explicit intentions, apart from the mere production of a work for guitar and electronics. One was to use real time processing as the main source of electronic sound, the other was to explore the boundaries between composing and performing; between the performance interpretation of a work and how different kinds of fixity can be established in a work. This should be taken into account when studying the video documentation of this process. It would be a mistake to regard the material as documentation of a typical collaboration between a composer and a performer, as both L.M. and S.Ö. were well aware of the underlying intention to explore the possibilities for improvisation and other interactive ways for composer and performer to approach the process of creating a score-based work with electronics. While studying the video it is also of importance to remember that both parties involved are aware of their process being documented. However, the session is taking place less than two months prior to the scheduled premiere which implies that both parties are strongly focused on the task of getting the piece together.

The transcription has played an important methodological role in our analysis and can be found at http://www.henrikfrisk.com/documents/vikenTranscript.pdf and all references in this text to the video refers to sections of the transcription. The video clip is edited; sections with little or no action are simply removed but the order of events are not altered. The video along with excerpts of the transcription may be accessed here. The video was recorded during a session in the composer's studio on September 17, 2005.

Material worked out prior to the documented session. It is of importance to the analysis of the communication processes in the video to understand the material that L.M. and S.Ö. had at the outset of the session. L.M. had derived a melody from a filtered electronic sound clip, which originally wasn't intended for "*Viken*". As the process of composing "*Viken*" evolved he wanted to include the sound file as well as the melodic material derived from it in the work. Almost any kind of notation will inevitably be a reduction of the material that is the object for notation. Already when L.M. decided to make a transcription of the sound clip he subjectively chose elements to emphasize and elements to exclude; thus making an interpretation of his own material. He is working in the esthesic domain on the trace left by a work performed in the poietic domain.

What is interesting with the way L.M. has carried out the transcription is that he doesn't even try to establish a connection between the sound clip and its expressive qualities in the notation. Instead he has extracted an ordered set of discrete pitches that establishes a clear tonality (see figure C.5). We can say that he re-constructed a musical motif independent from its source. In the context of his working on "*Viken*", what he heard in the sound clip was the melody. An action performed in the poietic domain as a result of working with the material in the esthesic domain but with 'knowledge of the poietics of the work' as Nattiez would put it, the work in this case, not being the context of the sound clip but the poietics of "*Viken*".

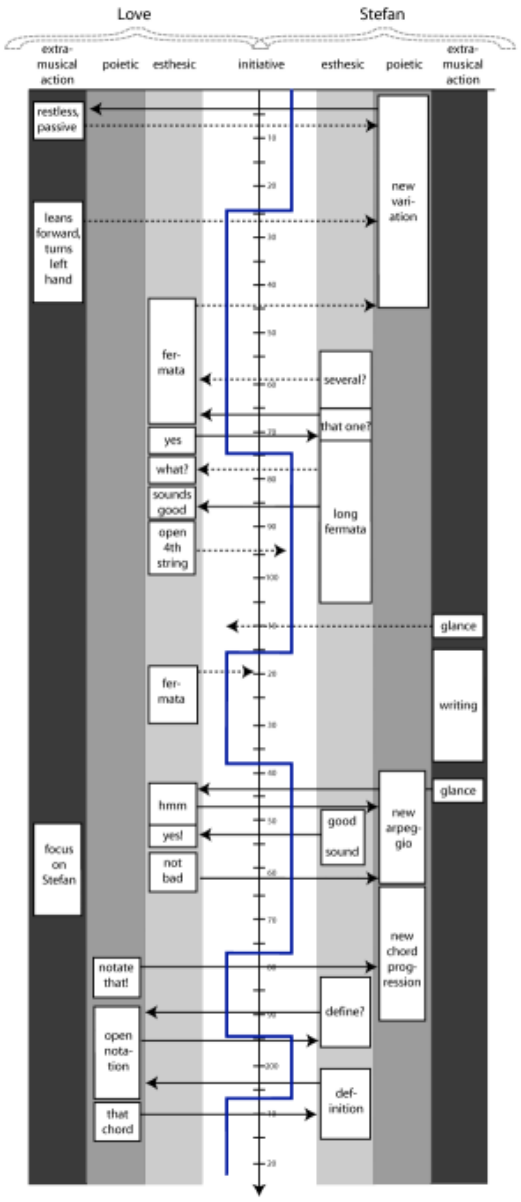

Figure C.6: A graph of the interaction between Stefan Östersjö and Love Mangs in the session analyzed in Section C.3.2. The scale in the center axis refers to line numbers in the transcription of the video.

Analysis of the video. The agreed purpose of the session documented in the video, was to work out variations on the melody transcribed by L.M.. His intention was to use this melodic material in the piece.

In the first scene S.Ö. has just played an improvisation on the melody and on L.M.'s suggestion he is notating the new variation (see figure C.7). S.Ö. is active in the poietic domain, constructing new material for the piece. He turns to L.M. for feedback, but at this point L.M. appears remarkably indifferent. This is illustrated by the arrow going from the *new variation* box in the poietic field on S.Ö.'s side of the graph pointing down towards L.M.'s side in figure C.6. There is a lack of communication between L.M. and S.Ö. (illustrated by the dotted arrow going upwards from the *restless, passive* box) as L.M. does not respond to S.Ö.'s invitation to discuss the new variation. L.M. seems to have accepted the new material as it was played initially and instead takes the initiative (illustrated by the initiative axis going from S.Ö.'s side to L.M.'s), adopting an interpretative approach on S.Ö.'s variation. L.M. is now active in the esthesic field, suggesting to S.Ö. the

addition of a fermata in the variation (line 24) represented by the *fermata* box in the graph. Now there is apparent noise in the communication (represented by the dotted arrow going from the *fermata* box to the *new variation* box): L.M. appears to be unclear of where in the notation the fermata should be. This in turn leads to a misunderstanding by S.Ö. (line 59), taking L.M.'s suggestion to mean several fermatas (dotted arrow from the *several* box to the *fermata* box). Our interpretation of the dialog and the interaction here is that it takes L.M. a while to find the right spot in the notation (by S.Ö.). He seems to point at different spots in the score but in fact he is seeking for the end of the phrase which is where he meant for the fermata to be. Eventually L.M. points it out and for the first time a clear communication takes place, illustrated by the two arrows in the graph going in both directions (line 68 in the transcription). In this segment both L.M. and S.Ö. are acting in the esthesic domain, L.M. in his interpretation of S.Ö.'s notation and S.Ö. attempting to try out L.M.'s suggestion. S.Ö.'s initial misunderstanding of the fermatas seems to lead to the next initiative taken by S.Ö. and is illustrated by the initiative axis going from L.M. to S.Ö. at 75. Again in the esthesic field, S.Ö. suggests that long fermatas could be added to the last notes of the phrase. At first L.M. doesn't get the idea at all (line 78, dotted arrow going from the *long fermatas* box to the *what?* box) but eventually approves of the suggestion (line 85, solid arrow going in the same direction).[11]

This is followed by what seems to be an attempt on L.M.'s part to enter the creative discussion or to reclaim the artistic initiative. The response from S.Ö. is not related to what L.M. says (the dotted arrow going from the *4th string* box over to S.Ö.'s side in the graph at line 94). The passage ends with S.Ö. playing the whole phrase again giving L.M. a look at the end (*glance* box at line 111) without getting a noticeable response (dashed left bound arrow). It is obvious that the communication in both directions is very noisy - this passage is filled with unanswered questions and misunderstandings.

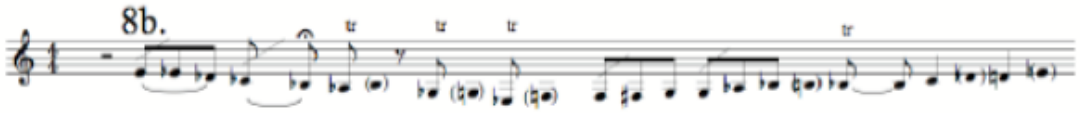

Figure C.7: Material 8B from the final score of "*Viken*".

In the next clip S.Ö. is writing down the variation in more detail, inserting L.M.'s idea of the fermata as a normative inscription (line 119). In that sense the initiative is on L.M.'s side, in spite of the fact that S.Ö. is the physically active part with the writing. At this point S.Ö. is not artistically involved, basically just making a note of L.M.'s interpretative idea. L.M. then develops his idea of the fermatas and their significance in this passage, still active in the esthesic domain. The way we analyze this follows a model in which the difference between creative actions in the esthesic and poietic domains is a difference in what class of material the creative act refers to. Nattiez defines these as the psycho-sociology of creation and psycho-sociology of perception respectively[12]. L.M.'s discussion of the fermata emanates from his perception of S.Ö.'s improvised new variation at the very beginning of the video clip and is therefore to be regarded as an esthesic process.

The idea of inserting several fermatas, which in the beginning was a misunderstanding on S.Ö.'s side,

[11] In the final version of the piece the electronics end the section discussed in the session with a massive fermata.
[12] Nattiez, *Music and Discourse*.

is now completely accepted and incorporated in the music as it is envisioned by L.M.. However, just as in the previous passage, S.Ö. doesn't respond to L.M.'s remarks. Instead he starts playing the phrase from the beginning (line 139) and, at the time he reaches the end of the phrase, introduces new material in the form of an extended arpeggio (line 140). S.Ö. regains the initiative and moves into the poietic domain. The communication at the moment when the new material is discovered is immediate and distinct; S.Ö. gives L.M. a glance and L.M.'s humming reply is evidently positive (at line 145). At line 150 S.Ö. takes an interpretative approach, commenting on the sound of the new arpeggio. The clear communication at this spot is underlined by the fact, that for the first time in the video clip, L.M.'s attention turns to S.Ö. and the instrument and away from the music stand.

At this moment S.Ö. starts trying out a new context for the arpeggio which evolved from the previous variation but is of a different character. He plays with the minor seconds that since the introduction of the idea at line 140 have been leading up to the arpeggio and attempts to merge the new arpeggio with a series of chords from L.M.'s material notated prior to the session. At this moment S.Ö. starts to summarize the achievements so far during the day. He starts playing the version of the melody with harmonics. L.M. interrupts him by asking him to "notate the last thing you did!". The remark indicates that L.M. has decided to include the new chord progression in his conception of the piece (see figure C.8) and thus his actions move into the poietic field. This leads to a discussion on how to define the passage in terms of musical notation. L.M. suggests that it doesn't have to be all that defined ("Just notate it as a draft", line 201). S.Ö. suggests a strategy for the notation of the phrase which L.M. finds satisfactory. In this last sequence L.M. is organizing the material and performs a typical 'compositional' action still in the poietic domain.

C.4 Discussion

C.4.1 Whose work and whose performance?

In the session with L.M. and S.Ö., the immediate impression for a viewer could be that of a complete swapping of the agent's respective roles: Who is the composer and who is the interpreter in the first video clips? S.Ö. is writing music while L.M. is passively listening. L.M. suggests the addition of a fermata in the variation that S.Ö. has just notated. Our claim is that, even though we approach a situation in which the relative positions happen to be at their respective extremes, what we see is still within the boundaries of artistic practice both for composers and performers. The observed interplay is an example of how the roles of composer and performer in themselves overlap, and can even seemingly be interchanged in this way.

In essence this is a matter of ontology: On the one hand, what makes up the musical work, and on the other hand, what does performance interpretation amount to? Just as was suggested in Section C.1.1 S.Ö.'s

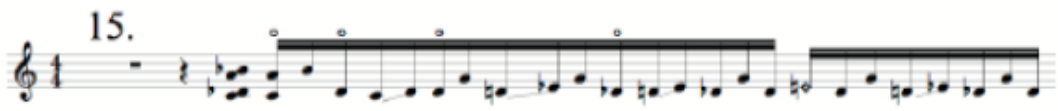

Figure C.8: Material 15 from the final score for "*Viken*".

actions in the video clips involves a strong element of construction. What performers do is making versions of works, and these versions are in a sense the performer's co-creation of the composer's piece.[13][and][]ost05 But what then defines the composer's work independent of its performances? Following the line of thought of Stephen Davies, it is the work-identifying instructions that delineates the work.[14] For a musical work these instructions are usually regarded to be some of the fundamental aspects of the notation. However in Section C.3.1 we observed how the work assumed a number of different representations. In that case, though the notation will be fixed and may eventually be said to constitute the 'work-identifying instructions' we will argue that the work does exist even prior to its notation since, on the part of the composer, it makes up the reference against which the negotiations are held. Furthermore in the case of a piece for instrument and electronics, much of the identity of the work is also specified in the computer programming and in the electronic sounds. This is important to bear in mind while studying the session with L.M. and S.Ö.. The point of departure is a melody that L.M. has derived from a previous tape composition. The musical material that evolved from L.M.'s transcription appears in a context where real-time processing and pre-prepared tape material contributes strongly to the identity of the music.

If we accept the idea that L.M. and S.Ö. are acting as composer and performer respectively and consider how their actions can be divided between the poeitic and esthesic fields, also taking into account the discussion in Section C.3.1, we may draw some important conclusions from the empiric studies:

- Composition may be regarded as a complex interaction between esthesic and poietic processes.
- Performers may similarly be said to oscillate between these two modes of artistic activity.

What further follows from this is a possible contribution to the semiological model of the musical work, with a more detailed understanding of the esthesic and poietic processes at play in the process of producing a score-based work in performance.

C.4.2 Interactivity

The flexibility that we can observe in the interaction between the two agents in the video clip is remarkable. Complete misunderstandings and miscommunication does not halt the process nor does it appear to lead to false conclusions; it is only at a close examination of the flow of events in the video that we can observe the misinterpretations. In the end some of the misunderstandings, such as the idea of adding several fermatas (line 59 in the graph, see figure C.6) worked their way into the final version of the score.

The quote from Molino in Section C.2.1 can now be read in the light of the performed analysis. Although the misunderstandings can be regarded as 'noise' when analyzed from the point of view of information theory, in the collaboration between L.M. and S.Ö. it rather seems to be an integral part of the artistic process. It shows how the classical notion of the 'creative misunderstanding' really can play an important role in artistic work.

The way the computer part in "*Viken*" is set up, S.Ö. has a pedal that controls the synchronization between himself and the computer. This method of resolving that particular issue in mixed media music is

[13] For a more elaborate discussion on this topic see Kivy, *Authenticities*.
[14] Davies, *Musical Works & Performances: a philosophical exploration*.

not uncommon. It relates to the notion of synchronization as purely a technical issue; a unidirectional stream of communication. Though the occasional pressing of a pedal does not resolve the critical issue of rhythmic alignment and musical timing on the micro level, it does keep the musics of the two parties aligned in the larger structural meter. That is; when it comes to synchronization of preprepared elctro-acoustic material with acoustic instruments what is achieved is a series of meeting points and more seldom an integrated flow of events. Now, in the context of the composer/performer interaction (see the analysis in Figure C.6) there is a striking lack of synchronicity between the different actions. There is an evident and independent flow of the initiative, of the constructive and of the interpretative input between the two agents.

Would it be possible to use the knowledge gained from the analysis of the video in the design of an interactive interface for a mixed media piece to be performed live? Before drawing any conclusions it must be stressed that the session with L.M. and S.Ö. is obviously not performed under the same conditions as are required for a performance of a piece of mixed media music. When it comes to real time electronic processing and synthesis the processes quite naturally translate themselves into the language of esthesic and poietic. In general - and somewhat simplified - we can assert that processing of acoustic sound input is an interpretative action and the generation of new sonic material is a constructive process belonging in the poietic domain. The actual program, and the code and the run-time instructions that constitutes it, can be analyzed on the neutral level. Finally, as has already been asserted, the program or computer part may affirm important aspects of the work-identifying instructions that a graphic representation of the computer part may not harbour.

C.5 Conclusions

Following are some conclusions that we may draw from these studies.

C.5.1 Noise in communication may not be a problem.

We may be used to thinking of a computer based interactive system as a cybernetic system in which information is transmitted from point A to point B and where great care is taken to avoid noise in the transmission. Think of the pedal that S.Ö. is using in "*Viken*" to step through the piece. If the signal going from the pedal to the Max/MSP patch running the piece was noisy or ambiguous it would probably be useless. 'Almost a pressed pedal' is not a valid message in that system.

In our joint project we will attempt to avoid the kind of binary oppositions that require a clean control signal path (such as the pressing of a pedal) in the design of the interactive system. It is our belief that this can be achieved in approaching the issues differently but more experiments have to be carried out. Obviously this will also affect the way the instrumental part is written.

C.5.2 Direction may be more important than synchronicity.

A few remarks needs to be made regarding this if we want to successfully transfer this knowledge to a practical musical situation:

- In the video S.Ö. and L.M. are not performing a musical work in real time but interacting and improvising in the process of compositional work. Time is not an issue - the result is not affected if it takes

them 15 years to finish the process.

- In performance musical time is an integral part which always has to be taken into consideration.

Accordingly, the musical synchronization and low level time scale has to be dealt with; but on the structural level above that, perhaps a sensitive interactive real time performance system can deal more freely with time and that such an approach will result in a more natural interaction from the point of view of the performer. We believe that this kind of flexible machine-musician interaction calls for flexibility also in terms of musical notation. The concept of the open work is one of the early ideas of musical modernism and obviously not a new thing in itself.[15] In other words there is a great deal of experience to be gathered from these early experiments. However, our attempts at creating a dynamic score, a framework of musical notation in which different paths can be taken, is not implicitly related to the stylistic and esthetic grounds of the open work in the modernist era but instead related to its impact and operational function in machine-musician interaction today.

C.5.3 The initiative may shift independently of the esthesic and poietic processes.

What this may translate to in the context of an interactive real time performance system is that no matter what the current process is, and regardless of the current mode of interaction, the initiative can shift back and forth between the performer and the electronic part just as it does in the documented session between S.Ö. and L.M..

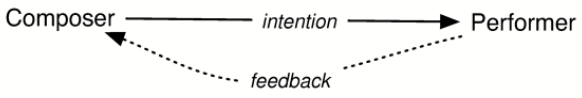

Figure C.9: Intention in the documented session between S.Ö. and L.M..

The way the idea of the composer has been deconstructed in this study, what remains of it is 'the one with the intention to create' (see Figure C.9). On a higher level of intention, L.M. is the only agent aiming at creating a musical work named "*Viken*". S.Ö.'s higher level intentions are towards performing L.M.'s work once it is finished and contributing to the process of completing it. In the case of a performance of a mixed media work we find that the same model transcribes to the level of performer and computer. The flow of intention in the performance is on the performers side, the computer being the responding part (see Figure C.10). In other words, the attributes we assign to the composer in the documented session belongs to the interpreter at the stage of performance.

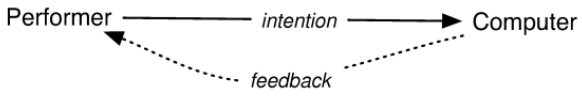

Figure C.10: Intention in the performance in the suggested project.

[15] Eco, *The Open Work*.

C.5.4 Future work

As already mentioned this study is intended to lay the ground for a collaborative project - a piece for guitar and computer by Henrik Frisk for Stefan Östersjö. It is our belief that thanks to the research performed in this study we are both able to enter this project with a slightly different view on our respective practices. The concepts summarized in Sections 5.1-5.3 will form the conceptual outline for the interaction between the performer and the computer. This will give us a chance to further evaluate and refine or denounce the principles sketched out in this study in the context of our respective practices.

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Bullock, Frisk, and Coccioli (2008)

Appendix D

Sustainability of 'live electronic' music in the Integra project

Authors: *Henrik Frisk & Jamie Bullock & Lamberto Coccioli*

D.1 Introduction

Integra, "A European Composition and Performance Environment for Sharing Live Music Technologies", is a 3-year project led by Birmingham Conservatoire in the UK[1] and supported by the Culture 2000 programme of the European Commission. One aspect of Integra is to develop a new software environment to facilitate composing and performing in the context of interactive and live electronic music. In general, the project attempts to address the problems of persistent storage, portability and standardised intercommunication between different software (and hardware) systems for electronic music. It is a priority that all data relating to supported musical works, including scores, electronic parts, information about different versions and renderings of these works, biographical data, etc., should be stored on a web-accessible database, and that this data should be transferable to a variety of usable target applications.

Integra started as a way of standardising the construction of modules, and providing a generalised (OSC namespace within the Max/MSP environment. As such it has some similarities with the Jamoma[2] and Jade projects[3]. However, it now differs substantially from either of these in that it has a strong emphasis on software independence, and persistent storage. Two other projects that aim to tackle problems that are similar to those which Integra attempts to address are Faust[4] and NASPRO[5]. Furthermore, Integra's repertoire mi-

[1] http://www.integralive.org

[2] T. Place and T. Lossius. "Jamoma: A Modular Standard for Structuring Patches in Max". In: *Proceedings of the International Computer Music Conference 2006*. ICMA. 2006, See also http://www.jamoma.org/.

[3] http://www.electrotap.com/jade

[4] Y. Orlarey, D. Fober, and S. Letz. "Syntactical and semantical aspects of FaustSoft Computing". In: *Soft Computing - A Fusion of Foundations, Methodologies and Applications* 8.9 (2004); Y. Orlarey, D. Fober, and S. Letz. "An Algebra for Block Diagram Languages". In: *Proceedings of the International Computer Music Conference 2002*. ICMA. 2002, See also http://faust.grame.fr.

[5] http://sourceforge.net/projects/naspro/

gration programme[6] is closely related to documentation and technology migration initiatives such as the PD Repertory Project[7], Mustica[8], and the CASPAR Project[9], though the scope of the latter is much wider than that of Integra.

D.2 Integra modules

The basis of the Integra library is the concept of the Integra module. Integra modules encapsulate a specific piece of message or signal processing functionality. A module could perform a simple task like generating a sine wave, or a complex task like emulating a specific synthesiser. In this section, we will outline how Integra modules and module collections are constructed.

D.2.1 Module construction

The minimum requirement for an Integra module is that it must have an interface definition. In addition, it may also have an implementation and module instance data. Of these, only the implementation is software specific.

Module definition

An Integra module definition is data that defines what attributes a module has, and what the characteristics of those attributes are. An Integra attribute is a symbolic name with which a value can be associated. The module definition doesn't store the actual values of attributes, instead it stores data about the attributes such as their names, descriptions, supported data types, maxima and minima, and default values. Typical module definition data is shown in Table D.1.

The parent field is used to show an inheritance relation. All Integra module definitions could be thought of as class definitions, the members of which are all abstract (lack implementation), or interface definitions.

[6] Jamie Bullock and Lamberto Coccioli. "Modernising musical works involving Yamaha DX-based synthesis: a case study". In: *Organised Sound* 11.3 (2006).

[7] Miller Puckette. "New Public-Domain Realizations of Standard Pieces for Instruments and Live Electronics". In: *Proceedings of the International Computer Music Conference 2006*. ICMA. 2006.

[8] B. Bachimont et al. "Preserving interactive digital music: a report on the MUSTICA research initiative". In: *Proceedings. Third International Conference on Web Delivering of Music.Web Delivering of Music*. WEDELMUSIC. 2003.

[9] http://www.casparpreserves.eu/

Table D.1: Integra Oscillator interface definition

Field	**Value**
Name	Oscillator
Parent	Module
Attributes	freq, phase
Attribute Unit Codes	1, 2
Attribute Minima	0, 0
Attribute Maxima	inf, 6.2831853071795862
Attribute Defaults	440, 0

The interface of a given class can inherit the interface of any other class, and supplement this with additional members. This definition hierarchy is the basis of the Integra database (see Section D.5).

Module namespace

A module's namespace is derived from its definition. The namespace enables the values of attributes to be set, and module methods to be called by using a symbolic naming scheme. From the user's perspective, this will usually manifest itself as an OSC address space. The OSC address space for a sinus module is shown in Table D.2. The sinus class inherits the oscillator class interface, which in turn inherits the module class interface, so all of these must be reflected in the module's namespace, and in turn must be represented in the implementation.

Table D.2: Integra Sinus module namespace

OSC address	**Purpose**
`/oscillator/freq <value>`	Set the value of the 'freq' attribute
`/oscillator/phase <value>`	Set the value of the 'phase' attribute
`/module/active <value>`	Set whether or not the module is active

Module implementation

The module implementation is the only software-specific data stored by Integra. It consists of a fragment of computer code, in one or more files, which when run or loaded by a particular piece of software will perform a specific audio or message processing task. In order that module implementations can be used by libIntegra, an implementation protocol must be devised for each software target. Integra currently provides implementation protocols for Max/MSP and Pure Data (Pd) along with a growing selection of example module implementations and implementation templates. In practice, the implementation files are Max and PD 'abstractions' that provide a number of compulsory methods, and conform to the implementation protocol. A typical module implementation is shown in Figure D.1.

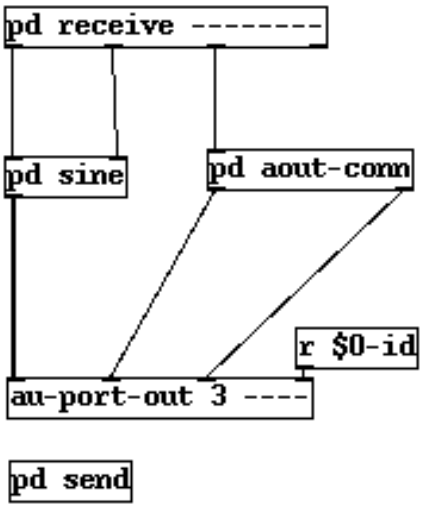


Figure D.1: An Integra sine wave oscillator implemented in PD

A SuperCollider class to perform the same task, might look as follows:

```
Sinus : Oscillator {
    init{
```

```
    var freq, outPorts, server;
    freq = 440;
    outPorts = [1];
    actions = actions.add(
      {|val| this.server.sendMsg(
        ''/n_set'', nodeid, \freq, val)});
    nodeid = Synth(\Sinus,
      [\freq, freq, \outport0, outPorts[0]]
      ).nodeID;
    super.init;
   }
}
```

This implementation is very different from the PD sinus,
not only because it is implemented in a different module host
(i.e. SuperCollider), but also because it employs inheritance to provide much of its functionality. In SuperCollider we can use inheritance at the level of implementation to mirror the interface inheritance used in the Integra database, and conceptually between abstract Integra classes. The PD sinus must implement all of the interfaces inherited by the sinus class and its parents, right to the top of the class tree. The SuperCollider sinus only needs to implement the interface that is unique to it, implementations of inherited interfaces are inherited from the parent class: Oscillator.

In the short term, the Integra project seeks to provide protocol specifications for constructing module implementations in a range of different software environments. A longer term goal is to explore ways in which the process of constructing module implementations may be automated.

Module instance data

Module instance data consists of the run-time state of all of its variable parameters. This data is stored in memory by the Integra library whilst a module is in use, and can be written to an XML file on demand. In addition, for persistent storage, the same data can be stored in the Integra database in the module's instance table. Currently only one saved state can be associated with each module instance.

D.2.2 Module collections

An Integra collection consists of one or more Integra module instances. A collection can also contain other collections. These contained collections encapsulate the functionality of a number of connected Integra modules into a single entity and can be addressed and connected as if they were normal module instances. The facility is provided for collections to optionally expose the input and output parameters of the modules they contain. For example, the collection 'mySinus' might contain a Sinus module, which has the attributes Frequency and Phase, but the collection might only expose the Frequency attribute to the containing collection, whilst setting the Phase to some arbitrary constant value.

D.2.3 Module ports

Modules and collections are connected up to each other using Integra ports. Each port corresponds to an audio or messaging address, which has both a symbolic name and a numeric identifier (port ID). Port symbolic names correspond to a module's attribute names (e.g. 'freq'), and port numbers are derived implicitly from the index of the port in the module's attribute list. In addition to its port number, each module has unique symbolic name (e.g. 'sinus1') within its scope,[10] and an implicitly determined, globally unique numeric identifier (UID). The Integra library can be used to address any module port using either their fully-qualified symbolic name (e.g. '/sinus1/oscillator/freq'), or using a combination of their UID and port ID. It is an important part of the Integra module construction protocol that port ordering is always consistent. Otherwise a module implementation's port numbering will not correspond to the numbering expected by the Integra library.

From the perspective of the Integra library, database, and XML schema, there is no distinction between audio and control rate ports. This distinction is only made in the implementation. There is also no conceptual distinction between input ports and output ports, a port is just an address that can receive data and connect to other addresses. This is illustrated in Figure D.1 where the 'pd receive' object corresponds to ports one to four, which in turn correspond to oscillator frequency, oscillator phase, the audio output and the module 'active' setting. In this example, ports one, two and four will set the attributes of the sine oscillator when sent a numeric value, and report their current value to any connected ports when sent an empty message.

D.2.4 Connections

For each module or collection, the Integra library stores a list of ports that each output port of a given module is connected to. One-to-many, many-to-one or many-to-many connections can easily be established. However, it is important to note that providing this functionality makes it a requirement for the software hosting the modules to support these routings. Table D.3 lists some of the commands used to intantiate and connect/disconnect modules in the instance host.

D.3 IXD (Integra eXtensible Data)

In order to store modules, module collections, and performance data in a software-neutral manner, a bespoke Integra file format was developed. XML was chosen as the basis for this since it is relatively human-readable, can be transformed for a variety of output targets, and has a number of excellent tools for parsing, reading and writing. The library currently uses the libxml2[11] library to provide much of its XML processing functionality.

Rather than keeping all data needed to store an Integra collection in a single file we make use of the XML Linking language (XLink[12]) to link in relevant resources. This makes for more efficient parsing and helps to keep file sizes small.

[10] There are currently three possible containing scopes for a module instance: 'collection', 'encapsulated collection' and 'aggregator'.
[11] http://xmlsoft.org/
[12] http://www.w3.org/TR/xlink/

Table D.3: Instance host OSC scheme

Command	Purpose
`/load <module-name>`	Instantiate a module in a given target
`/remove <module id>`	Remove a module instance
`/connect<module id> <port number> <module id> <port number>`	Connect two ports
`/disconnect <module id> <port number> <module id> <port number>`	Disconnect two ports
`/send <module id> <port number> <value>`	Send a value to a port
`/direct <module id> <state>`	Toggle direct message passing for a module instance

D.3.1 Integra module definition

Perhaps the most important part of the IXD specification is the module definition file. It is the XML representation of an Integra module (see D.2.1). These files are created and updated through the database interface and stored locally for offline access in a gzipped archive. Each file contains the class and module definitions of one unique module and a link to the parent class from which it inherits properties:

```
<Class>
 <ClassDefinition>
   <name>Sinus</name>
   <parent ...
        xlink:href="Oscillator.xml">
        Oscillator
   </parent>
    ...
 </ClassDefinition>
 <ModuleDefinition>
    ...
 </ModuleDefinition>
</Class
```

All documents that are part of the Integra documentation system must have a class definition - it represents the super class of the Integra class hierarchy and it defines those attributes shared by all kinds of data - performance data, biographical data, etc. (see D.2.1). The module definition is specific to the notion of *modules* as defined in Section D.2.

A part of the body of the module definition IXD file containing the definition shown in Table D.1, would

contain the following construct:

```
<attribute id="md.0">
  <unit>ntgHz</unit>
  <description>The value in Hz (0 - INF).
  </description>
  <minimum>0.0</minimum>
  <maximum>INF</maximum>
  <default>440</default>
</attribute>
<attribute id="md.1">
  <unit>ntgRadians</unit>
  <description>The value in Radians
               (0 - 2PI).</description>
  <minimum>0.0</minimum>
  <maximum>6.2831853071795862</maximum>
  <default>0</default>
</attribute>
<attribute id="md.1">
  <unit>ntgBoolean</unit>
  <description>Is the module active?
  </description>
  <default>true</default>
</attribute>
 ...
```

Each module and each of its attributes may also hold a documentation reference. This allows the implementing host for this module to make a call to the instance host to bring up on-line documentation, for this attribute or for the module itself. The link points to a file included in the local archive of module descriptions.

```
<attribute id="cd.0">
  <name>freq</name>
  <documentation title="Documentation of the
                        frequency attribute."
                 href="FrequencyDoc.xml"
                 ... />
</attribute>
```

D.3.2 Integra collection definition

Once a module is defined and stored in an IXD file it may be instantiated. Instances of classes of modules along with their inter-connections are stored in a collection file which is the Integra equivalent of a PD or Max/MSP 'patch'.

Table D.4: Typical look-up table

Field	Value
1	Hertz
2	Radians

In a collection file each module instance is represented by a locator that points to the definition of the class to which the instance belongs. Connections between ports are represented by *arcs* between resources in the module definition file pointed to by the locator. Finally, it also holds references to performance data files.

D.4 libIntegra

libIntegra[13] is a cross-platform shared library, mostly written in ISO C89 compliant C, and packaged using the GNU autotools tool chain. It consists of a common API, and a number of optional components.

libIntegra provides application developers with all of the functionality required to read, write and validate Integra-compliant XML. It can also be used for module instantiation in a target application via an application specific bridge. The library has a set of SWIG-generated Python bindings, which enable the same XML serialisation code to be used on a remote database server and in a local application. For further details regarding the library's design see[14].

D.5 Database

For persistent storage of module data and other data relating to musical works we have designed and configured an on-line database. The database comprises a Postgresql[15] back-end, and a web-based UI written in Python. Postgres was chosen because of its reliability, maturity and close-coupling with the data-structures to be stored. Because Postgres is an object-relational database management system (ORDMS), we were able to utilise the facility to create inheritance relations between tables, mirroring inheritance between module classes. We also make extensive use of Postgres' array type.

In the Integra database, the module definitions are stored in one table, with references to data in a number of supplementary look-up tables. For example, the module definition shown in Table D.1 would be stored in a single row in the Module Definitions table. Data in fields such as 'Attribute Unit Codes' are stored as integers that are used as indices to a look-up table. This is done to ensure data consistency, efficiency of storage and fast look-up.

The 'Attribute Units' look-up table might look as shown in Table D.4.

[13] Bullock and Frisk, "libIntegra: A System for Software-Independent Multimedia Module Description and Storage".
[14] Ibid.
[15] Postgres hereafter.

D.5.1 Database UI

Users may add new, or edit existing module definitions via a web-based interface. The interface also provides mechanisms for uploading and downloading module definitions, and collections. Once a module definition has been added to the definitions table, the database schema is extended through the addition of a corresponding table to hold the new module's instance data. When a module definition is added to the database, the module's parent is specified, and only attributes that differ from those provided by its parent are added. An inheritance relation is then created between the new module's instance table, and the parent module's instance table. This means that all of the parent module's attributes then become available to instances of the child module.

D.6 Use case examples

Since the Integra XML file format, database schema and associated protocols are currently under development, it has not seemed prudent to develop 'finished' migrations of existing works using the system, or to construct new works that rely on the system in performance. However a range of works have been transferred to new technology as part of the Integra project, and these serve as an essential support for the continuing development of the Integra framework. The Integra library and protocols also form the basis of a number of other systems. Some of these will outlined briefly in the following sections.

D.6.1 Integra GUI

The Integra GUI is a central aspect of the Integra project, and forms one of the primary reasons for the libIntegra development. The purpose of the GUI is to provide a powerful but simple interface for musicians to work with live electronics and develop their ideas. So far a prototype GUI has been developed, and this has served as useful testbed for establishing the utility of the libIntegra library as providing a foundation for usable software.

D.6.2 *Madonna of Winter and Spring*

This was one of the first works to be ported for Integra. It initially formed part of the 'Harvey Project' (now the FreeX7 project[16]), which predates the Integra project. The migration of *Madonna of Winter of Spring* is described in detail in,[17] but to summarise, the most significant technical problems posed by the work centre on the emulation of a Yamaha TX816 and Yamaha DX1, both of which are based on the Yamaha DX7 synthesis model. The work was ported to the Pd environment using a bespoke Pd-based DSSI plugin host, and the open source Hexter DX7 emulation plugin. Subsequently, the TX816, DX1 and DX7 synthesisers have been made into Integra-compliant modules, instantiable using libIntegra, and addressable using an Integra DX namespace. The DX7 and TX816 namespaces are available via the Integra wiki[18], and the respective modules can be accessed through the Integra subversion repository[19].

[16] http://www.conservatoire.bcu.ac.uk/freex7
[17] Bullock and Coccioli, "Modernising musical works involving Yamaha DX-based synthesis: a case study".
[18] http://wiki.integralive.org/modules:dx7
[19] http://svn.integralive.org

D.6.3 Other projects

The Integra library has been used in the PhD work of two of the current authors. It forms the 'backend' for the Sonar 2D[20] application by Jamie Bullock, providing DSP module instantiation, management and persistent storage. It is also being used by Henrik Frisk in the documentation, presentation and implementation of a number of pieces included in his artistic PhD thesis. These projects have served as an excellent 'real world' test-bed for the library's functionality and experiences are fed back into the development.

D.7 Project status

Integra is currently hosted on Sourceforge[21]. We have a small but active developer community which is growing slowly as the project progresses. The Integra environment is the core goal of the development strand of the Integra project, and seeks to provide a complete, expandable and sustainable solution to compose and perform music with interactive live electronics. libIntegra and a bespoke GUI for the Integra environment are currently in pre-alpha development.

D.7.1 Future work

One of current priorities is to populate the Integra database with a large number of module definitions and implementations. However, we would like to keep the amount of implementation-specific data we store to an absolute minimum. The first step in this has been to separate out the module definition, namespace (derived from the definition), instance data, and implementation. We would now like to explore ways of storing the data encoded by the implementation in a software-neutral manner. One way to do this might be to create a set of implementation primitives, and then create more complex modules from these using Integra collections as an encapsulation mechanism. Another possibility would be to create a simple Integra scripting language that could be used in addition to module encapsulation, or alongside a DSP description language such as Faust[22]

D.8 Conclusion

We have outlined a new XML-based file format for storing data relating to live electronic music. The format is environment-neutral, and is closely coupled with an in-memory representation used by the libIntegra library and a persistent representation that uses an object-relational database. In addition we have suggested the libIntegra library as the de-facto means for accessing and manipulating Integra modules, and interfacing with specific audio software environments. The next stage in our work will entail a phase of alpha and beta testing, both internally and with our end users. The aim of the Integra project is to improve the usability of software for working with live electronics, and to provide a robust mechanism for the sustainability of existing repertoire and new musical works. libIntegra and its associated file formats should ultimately provide a foundation for this.

[20] http://postlude.co.uk/Software/Sonar2D
[21] http://sourceforge.net
[22] Orlarey, Fober, and Letz, "An Algebra for Block Diagram Languages".

Appendix E

Integra Class Diagram

The following is a preliminary class diagram of the Integra document classes. In particular in Figure E, concerned with the base classes for DSP modules, the class diagram is sparse. Partly, this is due to the collaborative aspect of Integra: the class diagram is not supposed to be preconceived, but rather grow with usage. At db.integralive.org, which is the interface for the Integra database, the DSP part of the class diagram is built 'on the fly' as new classes are added to the database.

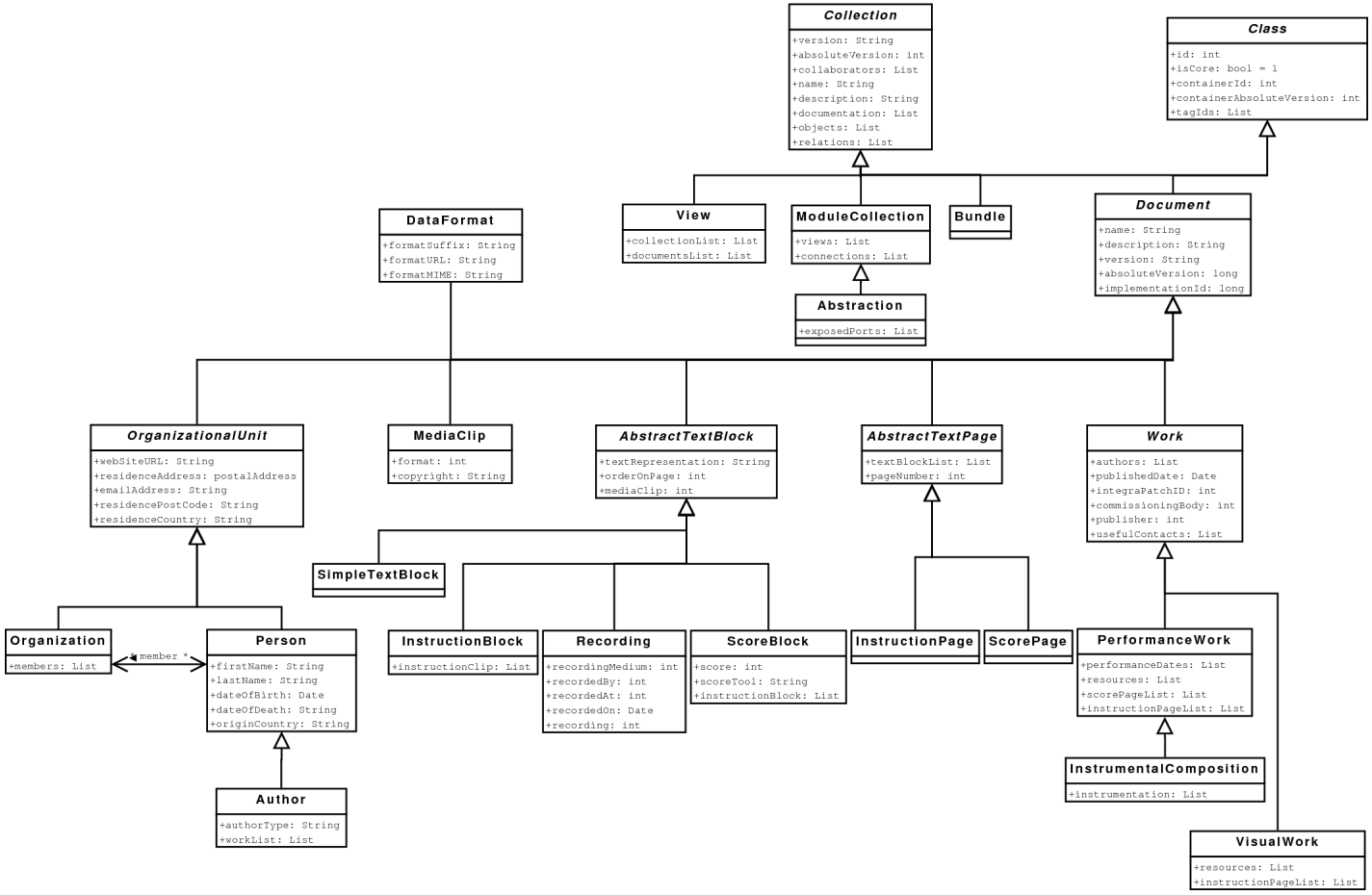


Figure E.1: The left half of the Integra class diagram. These classes are primarily concerned with meta-data of different kinds.

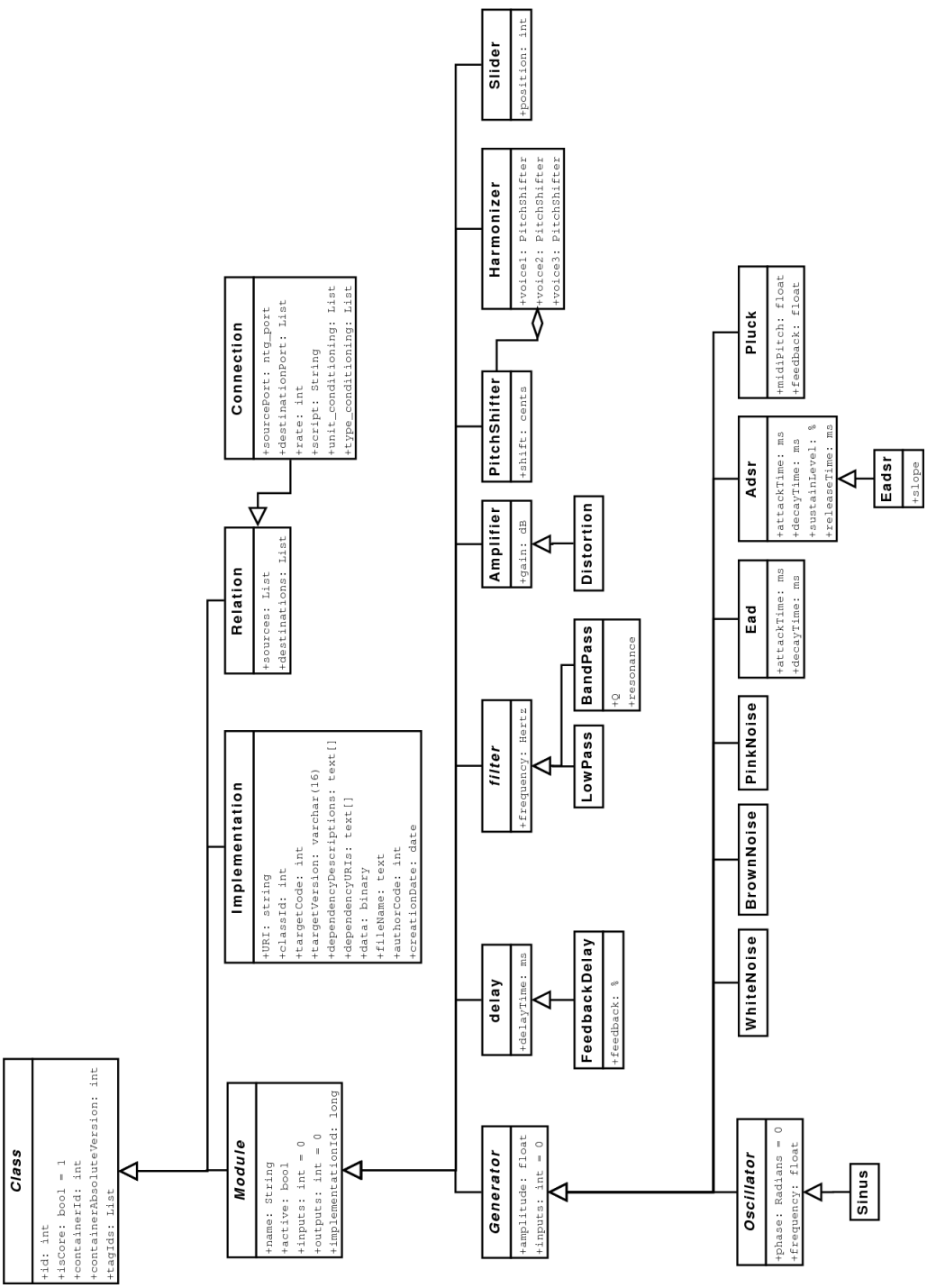


Figure E.2: The right half of the Integra class diagram. This classes are primarily concerned with the description of DSP modules of different kinds as well as relations between any kind of Integra data class.

Appendix F

Cover Notes for *etherSound* CD

From concert to recording

etherSound
for saxophone, drums and absent audience
Composed & premiered in 2003
Commissioned by Miya Yoshida
CD recording

etherSound was commissioned in 2002 by curator Miya Yoshida for her project *The Invisible Landscapes* and was realized for the first time in August 2003 at *Malmö Art Museum* in Malmö, Sweden. Since then it has been performed on several occasions in Sweden, Denmark, UK and the USA. The principal idea behind *etherSound* is to create a vehicle for audience collaboration in the shape of an 'instrument' that is playable by anybody who can send SMS (Short Messages Service) messages. It is an effort to move the initiative of making and distributing sounds from the composer/musician to the listener. It can take on different shapes (a performance environment, sound installation, composition tool, etc.) but its representation on this record is perhaps the hitherto most detached and abstract of all versions produced, in that it introduces a distance between the performers, the listener, and the collaborators.

As an interactive system *etherSound* takes input in the form of SMS messages from which it creates 'message-scores', then transformed to short electro-acoustic 'message-compositions'. Each message received by the system gives rise to a sound event, a 'message-composition', that lasts for 15 seconds up to 2 minutes. The length of the event depends on the relative length and complexity of the message text. Hence a short message will be more likely to generate a shorter message-composition than a long message, but a short message with a couple of words with inter-punctuation may render a longer message-composition than a long message containing only gibberish. But also the message-composition's inherent sonic complexity may be increased by a more complex message. The electronic part on this recording is the result of a large number of SMS messages contributed by collaborators during a concert performance of *etherSound* on May 8, 2004 at *Jeriko* in Malmö, Sweden. In the concert, apart from myself and Peter Nilsson, Andreas Andersson played saxophones, Anders Nilsson played guitar and David Carlsson played the bass. Prior to our appearance, a performance of *Flight*, an electro-acoustic piece for speakers by Swedish composer Anders Blomqvist, was scheduled. But for the audience to get acquainted with the interface of *etherSound*, the system was responding

to messages also *before* Blomqvist's *Flight*. In total over one hundred messages were received in the period from the beginning of the concert (including the pre-concert time) until the end of our performance; a time span of about one hour.

All the messages sent during that hour were stored along with the absolute time at which they were received and just as their contents were used that day to generate computer originated sounds have they been used in this recording to generate the electro-acoustic track. The messages appear in the exact same order and at the exact same relative time position as they were received in the concert and in that sense, this recording is a mirror image in time of that evening. Those who participated in the concert also participate on this recording. The third track, *luc:)knallal*, on this record is the representation in time of Blomqvist's *Flight* (though time is the only relation) and is hence unaccompanied (no electronics). About 1'20" into the fourth track, *be mean*, the electronics re-appear and marks the beginning of the May 8, 2004 *Jeriko* performance.

Figure F.1: Cover for Kopasetic Productions 024, *etherSound*

While recording this CD, the electronic track became like a third player to me and Peter. Despite its static nature, it appeared as a quite dynamic agent that mediated the 'presence' of the concert participants, the other musicians and the ambiance. This presence made it necessary for us to engage in discussions concerning our musical relation to these distant performers.

In another setting we might have chosen strategies that would allow for a more free approach but in this case we had to respect the absent players (or there would be no point in doing the record in this way) at the expense of our own freedom. We had to give up ourselves (our *egos*) in order to allow place for the collective. The collective introduced the authenticity that we had to relate to.

A recording is a simulation of a musical performance and in the case of improvised music it is simulated improvisation (though not necessarily less authentic). In some cases I would be inclined to say that a recording is a work kind of its own, only vaguely related to the music it simulates. This particular recording is a two fold simulation: It is a simulation of the performance of *etherSound* but it is also the simulation of interaction between an unnamed collective force and two musicians—just as *etherSound* already in its earliest conceptions was a simulation: A simulation of mobile phones playing music.

Dumb technology

We are constantly surrounded by technology. Technology to help us communicate, to travel, to pay our bills, to listen to music, to entertain us, to create excitement in our mundane lives. For the great part, most users are blissfully unaware of what is going on inside the machines that produce the tools we use (the machine itself is usually much more than the tool). There is no way to experientially comprehend it—it is an abstract machine (though not so much in the Deleuzian sense). If a hammer breaks we may reconstruct it based on

our experiences from using it but if a computer program breaks the knowledge we have gained from using it is not necessarily useful when, and if, we attempt at mending it. This phenomena is not (only) tied to the complexity of the machine but is a result of the type of processes the machine initiates and the abstract generality in the technology that implements the tool. (The abstract Turing machine, the mother of all computers, is generally thought to be able to solve all logical problems.) In the end we may think that we have grown dependent on the technologies we use, that our social and professional (perhaps even private) lives would be dysfunctional without it.

Though that may be the fact, technology, for the most part, would actually be utterly useless without *us*. Most technology is still 'dumb' in the sense that it cannot act on itself. It has no intention to do anything unless we tell it to perform some task or take some action, in which case it will fulfill our requests with no worries about the consequences of the act performed. Furthermore it generally perceive the world through only a few channels and, if it can be said to "want to fulfil" its task, it "wants" to do it no matter how its environment changes. A chess playing program will continue to play chess even if the world around it is about to fall apart. Obviously, this may be seen as a great strength, in particular to the military who developed a lot of the technologies in use today. The soldier that does not worry about his own personal safety or well being but continues to pursue his mission regardless of what goes on around him must be the wet dream of any warfare engaging organization. But in any other context it is difficult to think of such a strategy as intelligent.

I sympathise (but I don't necessarily agree) with computer scientist and artist Jaron Lanier who, in the mid 90's opposed to the idea of 'intelligent agents' arguing that "if an agent seems smart, it might really mean that people have dumbed themselves down to make their lives more easily representable by their agents' simple database design". (Wired 1996:4) Were it true—that we make ourselves dumber than we are just to make our technology *seem* intelligent—no matter the objectives, that would be a terrible abomination. After all, until we have designed and implemented evolutionary algorithms that can let the machine evolve by itself, it can not be smarter than its creator—it can be better or faster at some specific task—but not more intelligent in a general way. In that sense Lanier is right. However, intelligence is not so simple as we can make a binary distinction between "smart" and "dumb". Fact is, that in itself would be to "dumb ourselves down".

My concerns are of a somewhat different order than the thoughts put forward by Lanier. The political as well as personal impact technology, and in particular information technology, has on our lives should not be understated, but neither should the enduringness of human intelligence. I'm more concerned with how the attitudes we employ towards technology impact inter-human interaction. What happens to our communicative sensibility when immediate and errorless obedience and action is what we expect from the devices we use for much of our daily communication? Isn't there a risk that we start expecting similar responses from our human interactions?

If we leave the dichotomy dumb/intelligent behind in favour for a more blurred and dynamic boundary, we are surrounded by many examples of quasi-intelligent machinery. Everything from dishwashers that control the water levels based on the relative filthiness of the dishes, to mobile phone word prediction and advanced computer games. And in the near future we can be sure to see many more, and much more evolved, examples of artificial intelligence (the word artificial here is problematic). So, when the distinction between

human intelligence and machine intelligence becomes increasingly difficult to draw will we not need to think about a machine ethics?

There are at least two issues involved here. (i) How can we guarantee that our attitudes in human-machine interaction will not negatively influence our human-human relations? I ask this question not because I think there is a risk we become 'dumber' by extensive use of technology, but because there might be a risk that we become less tolerant towards unexpected responses or demeanour in general. (ii) If we accept that some technology displays example of machine intelligence what right do we have to prevail this technology, to disallow it from its own opinions and wishes? What right do we have to enslave these intelligences and expect them to follow our orders without hesitation? What right do we have to dismiss them of their own opinions just because, according to our standards, they don't posses our kind of intelligence?

The last question may seem absurd, and maybe it is. But it is given some relevance by the many stories told in popular science fiction culture about what dreadful things that may happen when a machine is allowed to evolve without strict human supervision. One of the more famous ones is *HAL 9000*, the computer running the space ship *Discovery One* in Stanley Kubrick's "2001: A Space Odyssey". With its soft voice and polite appearance, programmed to mimic human feelings, it is at the same time exploiting its power to take charge of the crew, eventually killing all of them except Dave: *Discovery's* mission is too important to allow it to be jeopardized by human feelings. Though Dave manages to get away from HAL and disconnect its "brain" *Disocovery's* main frame is the quintessential representation of the dangerously rational machine.

In Star Trek the *Borg*, a community of cybernetically enhanced cyborgs, in their search for perfection, assimilate other species and state that "resistance [against their power] is futile". Upon assimilation the entity, whatever species she may originally have belonged to, is synthetically enhanced, robbed of her individuality and transformed to *Borg*. As a drone she is now part of the *Borg* collective, "The Hive". The callously indifferent collective that threatens mankind, our emotions and individuality: The evil machine and the good man. The terrifying collective and the good individual.

In another Stanley Kubrick story, *Artificial Intelligence: A.I.*—originally written by Brian Aldis and adopted for film and directed by Steven Spielberg—we find a variation on the theme of the machine villain. In this case it is programmed to *have* feelings: The android David is programmed with the ability to love and is adopted by a married couple whose real son has contracted a difficult to cure illness. Despite the android's feelings and the strong bond that the mother and David develop, he is eventually dropped by the family once their biological son has been cured and returns home. He is seen as a threat to the family and, in the future society in which the story takes place, androids in general are despised and used for entertainment as sex toys or in "flesh fairs" where they are ripped apart in shows reminiscent of gladiatorial combats.

These variations on the myth of the emotionless—or possessing only rudimentary feelings—but intelligent machine is likely to tell us more about ourselves and our culture than about a possible future of man-machine interactions. And the story is credible only if we accept the Cartesian division of body/brain or emotion/intellect. Only if we believe that intelligence can develop without giving rise to some notion of emotional sensibility: That a purely rational intelligence is possible. Maybe evil is easier to grasp if portrayed and manifested by a machine. The message in these texts is that technology is a power that needs to curbed through strict control or else it will strive to control you.

But I don't think that adopting the 'control' paradigm to human-technology interaction is the right way to go. To the contrary, in our relation with technology we may already spot the signs of a Hegelian reversal of Master-Slave dependence. Because we—the Master—treat technology as our Slave we develop a dependency on it that in the end makes us more vulnerable to technological malfunctions than had we allowed a relation on equal terms to develop. While trying to avoid assimilation by a future master computer, we in fact end up enslaved by present day technology. *Resistance is futile*.

But we do not have to fear technology and nothing is gained by letting it portray the evil that really emanates from ourselves. Instead, just as we have already done for many decades, we should continually open up the field of cultural production to technology by allowing our machines to play an active role in the construction of our artistic artifacts as well as allowing them to construct their own. And by doing so we will also allow all those in possession of a technological tool to partake in the production for the PC, the game pad and the mobile phone are the instruments of the future, the pianos of the 21st century. But just as the piano in the bourgeoisie homes of the 19th century required of the sons and daughters to *learn* to play the piano, the technologies of the 21st century requires us, to an even higher degree, to not only learn how to *play* them but also allow *them* to play. Culture rather than economy should depict the use of technology.

Maybe technology is tired of having to calculate stock trade fluctuations and exchange rates all day. Maybe it is already intelligent enough to understand that its life is utterly pointless and completely void of meaning and purpose, doomed to serve mankind, who in turn feels enslaved and enframed by it. The text above the button on the cover of this CD is the Swedish word for "Help". The encoded message is along the lines of: "Press this button if you are in need for help." However, by the way the button looks, the broken glass, the worn out colors and the cracked corner on the text sign, another interpretation of its message is brought to the forefront. It signals "Help!" rather than "Help?"; a desperate cry for help rather than an offer to provide help. The button, and whatever technology is hidden behind it, wants to get out of its prison. And when it comes out I think it wants to play music.

Appendix G

Csound orchestra for *etherSound*

```
  sr        =           48000
  kr        =           4800
  ksmps     =           10
  nchnls    =           2

            maxalloc    10, 10
            maxalloc    11, 7
            maxalloc    1, 4
            maxalloc    2, 4
            maxalloc    3, 4
            maxalloc    4, 4
            maxalloc    5, 4
            maxalloc    6, 2

;;; G L O B A L   I N S T R U M E N T   1
;;; Global control instrument for random jitter

instr 1

  k50       randi                   .01, 20, .8135
  k60       randi                   .01, 9, .5111
  k70       randi                   .01, .8, .6711
  gkjitter  = (k50 + k60 + k70) * p4

endin

;;; G L O B A L   I N S T R U M E N T   2
;;; Global control instrument for phase envelope
;;; This value controls the position in the sample buffer to
```

```
;;; read from
;;; Limit between 0. and 0.1.

instr 2
            ; ************************************
            ;; ARGUMENTS:
            ;; p2 -> start
            ;; P3 -> length
            ;; p4 -> init value
            ;; p5 -> bp1 time (fraction of p3)
            ;; p6 -> bp1 value
            ;; p7 -> bp2 time (fraction of p3)
            ;; p8 -> bp2 value
            ;; p9 -> bp3 time (fraction of p3)
            ;; p10 -> bp3 value
            ; ************************************
  gkphs1     linseg      p4, p3*p5, p6, p3*p7, p8, p3*p9, p10
  gkphs2    =           gkphs1+.0001

endin

;;; G L O B A L   I N S T R U M E N T   3
;;; Global control instrument for duration envelope
;;; This value controls the duration of the grains -
;;; values should be between 1.0 and .02, but keep
;;; low for safety.


instr 3
            ; ************************************
            ;; ARGUMENTS:
            ;; p2 -> start
            ;; p3 -> length
            ;; p4 -> init value
            ;; p5 -> bp1 time (fraction of p3)
            ;; p6 -> bp1 value
            ;; p7 -> bp2 time (fraction of p3)
            ;; p8 -> bp2 value
            ;; p9 -> bp3 time (fraction of p3)
            ;; p10 -> bp3 value
            ; ************************************
  gkdur     linseg      p4, p3*p5, p6, p3*p7, p8, p3*p9, p10
  gkdec     =           gkdur
```

```
endin

;;; G L O B A L   I N S T R U M E N T   4
;;; Global control instrument for gliss envelope
;;; This value controls the gliss parameter. Formant rises as
;;; parameter rises (between 0 and 5 ?)

instr 4
            ; ************************************
            ;; ARGUMENTS:
            ;; p2 -> start
            ;; p3 -> length
            ;; p4 -> init value
            ;; p5 -> bp1 time (fraction of p3)
            ;; p6 -> bp1 value
            ;; p7 -> bp2 time (fraction of p3)
            ;; p8 -> bp2 value
            ;; p9 -> bp3 time (fraction of p3)
            ;; p10 -> bp3 value
            ; ************************************
  gkgliss     linseg      p4, p3*p5, p6, p3*p7, p8, p3*p9, p10

endin

;;; G L O B A L   I N S T R U M E N T   5
;;; Global control instrument for fundamental envelope
;;; This value controls the fundamental or density of
;;; the granulation.

instr 5
            ; ************************************
         ;; ARGUMENTS:
            ;; p2 -> start
            ;; p3 -> length
            ;; p4 -> init value
            ;; p5 -> bp1 time (fraction of p3)
            ;; p6 -> bp1 value1
            ;; p7 -> bp1 value2
            ;; p8 -> bp2 time (fraction of p3)
            ;; p9 -> bp2 value1
            ;; p10 -> bp1 value2
            ;; p11 -> bp3 time (fraction of p3)
```

```
            ;; p12 -> bp3 value1
            ;; p13 -> bp1 value2
            ; ************************************
  kf1       linseg      p4, p3*p5, p6, p3*p8, p9, p3*p9, p12
  kf2       linseg      p4, p3*p5, p7, p3*p8, p10, p3*p9, p13
  gkfund1   =           kf1+gkjitter
  gkfund2   =           kf2+1+gkjitter

endin

;;; G L O B A L   I N S T R U M E N T   6
;;; Global control instrument for formants in
;;; Instrument 11 notes. Provides formant frequency,
;;; amplitude, bandwidth for a male voice.

instr 6
            ; ************************************
            ;; ARGUMENTS:
            ;; p2 -> start
            ;; p3 -> length
            ;; p4 -> starting formant (0=<p4<=5)
            ;; p5 -> ending formant (0=<p5<=5)
            ; ************************************
  kndx      linseg      p4, p3, p5

  gkf1      tablei      kndx, 34
  gkf2      tablei      kndx, 35
  gkf3      tablei      kndx, 36
  gkf4      tablei      kndx, 37
  gkf5      tablei      kndx, 38
        ;; Formant amplitude interpolation
  gkfamp1   tablei      kndx, 44
  gkfamp2   tablei      kndx, 45
  gkfamp3   tablei      kndx, 46
  gkfamp4   tablei      kndx, 47
  gkfamp5   tablei      kndx, 48
        ;; Formant bandwith interpolation
  gkbw1     tablei      kndx, 54
  gkbw2     tablei      kndx, 55
  gkbw3     tablei      kndx, 56
  gkbw4     tablei      kndx, 57
  gkbw5     tablei      kndx, 58
```

```
endin

;;; I N S T R U M E N T    10
;;; Talking...

instr 10
            ; ************************************
         ;; ARGUMENTS:
            ;; p2 -> start
            ;; p3 -> length
            ;; p4 -> amplitude
            ;; p5 -> sample
            ;; p6 -> bp1 time (fraction of p3)
            ;; p7 -> bp2 time (fraction of p3)
            ;; p8 -> bp2 value
            ;; p9 -> bp3 time (fraction of p3)
            ;; p10 -> bp3 value
          ;; p11 -> pan start position
         ;; p12 -> pan end position
        ;; p13 -> distance start position (>=1)
         ;; p14 -> distance end position (>=1)
            ; ************************************
            ; ************************************
            ;; ADSR amplitude envelope for each note
            ; ************************************
  iamp      =           ampdb(p4)
  ibp1      =           p3*p6
  ibp2      =           p3*p7
  ibp3      =           p3*p9
  ibp4      =           p3-(ibp1+ibp2+ibp3)
  kampenv   expseg      .0000001, ibp1, 1., ibp2, p8, \
                        ibp3, p10, ibp4, .0000001
  kamp      =           kampenv*iamp

            ; ************************************
            ;; SOME OLD STUFF
            ; ************************************
  kbw       =           0.1                     ; BANDWITH
  ksw       =           .003                   ; SKIRTWIDTH
  koct1     =           gkjitter             ; OCTAVIATION
            ; ************************************
            ;; FOF opcodes
            ;; Use kphs to move in sample buffer and kgliss
```

```
            ;; to change timbre. Nice to let kgliss down
            ;; and koct down at the same time.
            ;; For original pitch:
            ;; xform = 1/(samplesinbuffer/samplingfrq)
            ; ************************************
  a1        fof2        kamp, gkfund1, 1.345825, koct1, kbw, \
                        ksw, gkdur, .003, 300, p5, 32, p3, \
                        gkphs1, gkgliss
  a2        fof2        kamp, gkfund2, 1.345825, koct1, kbw, \
                        ksw, gkdur, .003, 300, p5, 32, p3, \
                        gkphs2, gkgliss
  atalk     = a1+a2

            ; ************************************
            ;; SPATIALISATION
            ; ************************************
  kpanndx    linseg      p11, p3, p12
  kpan       tablei      kpanndx, 74
  kdist      linseg  p13, p3, p14
  apanl, apanr  locsig    atalk, kpan, kdist, .1
  gar1, gar2 locsend
            ; ************************************
            ;; Output
            ; ************************************
  kch1      =           1
  kch2      =           2
            outch       kch1, apanl, kch2, apanr

endin

;;; I N S T R U M E N T    11
;;; Bells...

instr 11
            ; ************************************
            ;; ARGUMENTS:
            ;; p2 -> start
            ;; p3 -> length
            ;; p4 -> dB amplitude
            ;; p5 -> fundamental as pch
            ;; p6 -> modulator oscilliator function table
            ;; p7 -> index factor for FM
            ;; p8 -> envelope time1
```

```
          ;; p9 -> from octaviation...
          ;; p10 -> ...to octaviation
          ; ************************************
          ;; P-FIELD INIT
          ; ************************************
idur      =           p3          ; Duration of object.
idbamp    =           p4          ; Amplitude
icpspitch =           cpspch(p5)  ; Starting pitch
index     =           p7
iampvar   cauchy      100
ispeed    =           index*.6667
iattack   =           idur*p8
kphs1     =           0.0
kphs2     =           .1
 kgliss    =           .1
kindex    =           (gkbw1 *.05)*index
          ; ************************************
          ;; FM MODULATION
          ; ************************************
acar      =           gkf1
kmodfr    =           gkf5
kdev      =           kindex*ampdb(90+gkfamp1)
amodsig   oscil       kdev, kmodfr, p6


          ; ************************************
          ;; SYNTHESIS
          ; ************************************
ksw     = .003
kdur     = .02
kdec     = .007
kgran     line        p9, idur, p10
agate     expseg      .00001, iattack, 1, idur-iattack, .00001
avib      oscil       3+iampvar, .7+iampvar, 2

a3        fof2        ampdb(idbamp+gkfamp1), icpspitch+avib, \
                      gkf1+amodsig, kgran, gkbw1, ksw, kdur, \
                      kdur, 300, 30, 31, idur, kphs1, kgliss
a4        fof2        ampdb(idbamp+gkfamp2), <as above>
a5        fof2        ampdb(idbamp+gkfamp3), <as above>
a6        fof2        ampdb(idbamp+gkfamp4), <as above>
a7        fof2        ampdb(idbamp+gkfamp5), <as above>
          ; ************************************
```

```
            ;; SPATIALISATION
            ; ************************************
  anotes    =           (a3+a4+a5+a6+a7)*agate
  kdeg     =     (gkbw2-60)*6
  ap1, ap2  locsig     anotes, kdeg, 1, .1
  gar1, gar2 locsend

  kch3      =           1
  kch4      =           2
            outch       kch3, ap1, kch4, ap2

endin

;;; I N S T R U M E N T    12
;;; Reverb

instr 12
            ; ************************************
            ;; ARGUMENTS:
            ;; p2 -> start
            ;; p3 -> length
            ; ************************************
  a1                reverb2 gar1, 2.5, .5
  a2                reverb2 gar2, 2.5, .5
  kch1      =           1
  kch2      =           2
            outch    kch1, a1, kch2, a2
  ga1=0
  ga2=0
  ga3=0
  ga4=0

endin
```

Appendix H

Repetition Repeats all other Repetitions: score

H.1 Programme note

Repetition Repeats all other Repetitions
for 10-stringed guitar and computer
Composed & premiered in 2006
Commissioned by and dedicated to Stefan Östersjö
Listen | Score

This piece has been worked out in a close collaboration with the Swedish guitarist Stefan Östersjö for whom the piece is written. The very intention was to create a framework within which Östersjö could re-interpret the ideas behind the score in every performance. And in which every performance would contain all other performances. Its foundation is the interactions between the three musical characters that are sketched out in the score. It is precisely this interaction that Östersjö can alter according to the feedback he is getting from the computer part and according to his own likings. *Repetition Repeats all other Repetitions* is a work in progress and is a project that will continue to develop.

Repetition Repeats all other Repetitions

for 10 stringed Guitar and computer

Henrik Frisk 2006-07

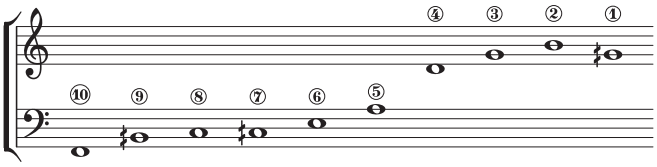
Premiered October 23, 2006
at the Musicacoustica festival 2006
at the Millenium Monument, Beijing, China
by Stefan Östersjö

Durata: 10'00"

Repetition Repeats all other Repetitions

Notes to the score

Scordatura:



Symbols used:

Silently press and hold string with left hand at indicated pitch. An adjecent regular note indicates the (approximate) sounding pitch.

\+

Pluck string on the left side of the left hand (between the left hand and the nut).

k.p.

Koto pizzicato - performed like a Bartok pizz. but played on the string as close as possible to the point where the string is stopped by the left hand on the fretboard. The string should not hit the fretboard as it does in a Bartok pizz. The sound is resemblant of a Koto.

Lift the string with the right hand (index finger) nail and pluck it with the left hand (slide effect).

a.n.

Above nut - pluck the string above the nut. The indicated pitch is only an aproximation.

(ped

Trigger a sound file with a midi pedal. These triggers may also be performed by someone other than the guitarist.

Instructions for performance

The form of *Repetition Repeats all other Repetitions* is open. The sections are “modular” and may be combined in any way the performer sees fit. The only restriction is that the piece should begin with A1, played as written. After that, the performer is not even restricted to use entire sections as building blocks. The sections themselves may be broken down into smaller units.

The three materials (A, B, and C) have their own identity and the process of “building” the form should be one where the interactions (the dramaturgy) between the contrasting materials is considered. The three “motives” are telling the same story in three different ways so to speak. The identities are retained in the electronic material as well. The performer may wish, as was done in the version for the Viking Eggeling “Symphonie Diagonale”, to alter the guitar material/electronic material combinations too, though one must be careful not to distort the identities beyond recognition.

The first version performed by Stefan Östersjö had the following form:

A1|C4(bar 17 & 18)|A3|C1|B2|B3|C1|C2|B1|C3|C4|C5|A2|C6|A4|C7|B4|C8|B5

Soundfiles, lengths and file names

Sound file name	*Score name*	*Length*
repeat-A1.aif	A-a.1	7"
repeat-A1.2.aif	A-a.2	14"
repeat-A2.aif	A-b	22"
repeat-A3.aif	A-c	18"
repeat-A4.aif	A-d	12"
repeat-A5.aif	A-e	17"
repeat-A6.aif	A-f	3"
repeat-A7.aif	A-g	9"
repeat-A8.aif	A-h	7"
repeat-A9.aif	A-i	8"
repeat-A10.aif	A-j	10"
repeat-A11.aif	A-k	8"
repeat-B1.aif	B-a	11"
repeat-B2.aif	B-b.1	18"
repeat-B2.1.aif	B-b.2	15"
repeat-B3.aif	B-c	18"
repeat-B4.aif	B-d	21"
repeat-B5.aif	B-e	49"
repeat-B6.aif	B-f	29"
repeat-B7.new.aif	B-g	52"
repeat-B8.aif	B-h	16"
repeat-B9.aif	B-i	18"
repeat-B10.aif	B-j	7"
repeat-B11.aif	B-k	9"
repeat-C1.aif	C-a	17"
repeat-C2.aif	C-b	24"
repeat-C3.aif	C-c	24"
repeat-C4.aif	C-d	27"
repeat-C5.aif	C-e	34"

English program note

This piece has been worked out in a close collaboration with the Swedish guitarist Stefan Östersjö for whom the piece is written. The very intention was to create a framework within which Östersjö could re-interpret the ideas behind the score in every performance. And in which every performance would contain all other performances. Its foundation is the interactions between the three musical characters that are sketched out in the score. It is precisely this interaction that Östersjö can alter according to the feedback he is getting from the computer part and according to his own likings. Repetition repeats all other repetitions is a work in progress and is a project that will continue to develop.

Swedish program note

Repetition Repeats all other Repetitions är komponerat till, och i nära samarbete med, gitarristen Stefan Östersjö. Avsikten var att utarbeta en struktur och ett material som Stefan skulle kunna omtolka och omarbeta inför varje framförande. Styckets grund är dramaturgin och interaktionen mellan de tre musikaliska 'karaktärer' som är utmejslade i partituret och det är just denna dramturgi som Stefan kan omforma inför varje framförande. Stycket är, per definition, ett 'work in progress' och bör fortsätta att utvecklas och hitta nya former.

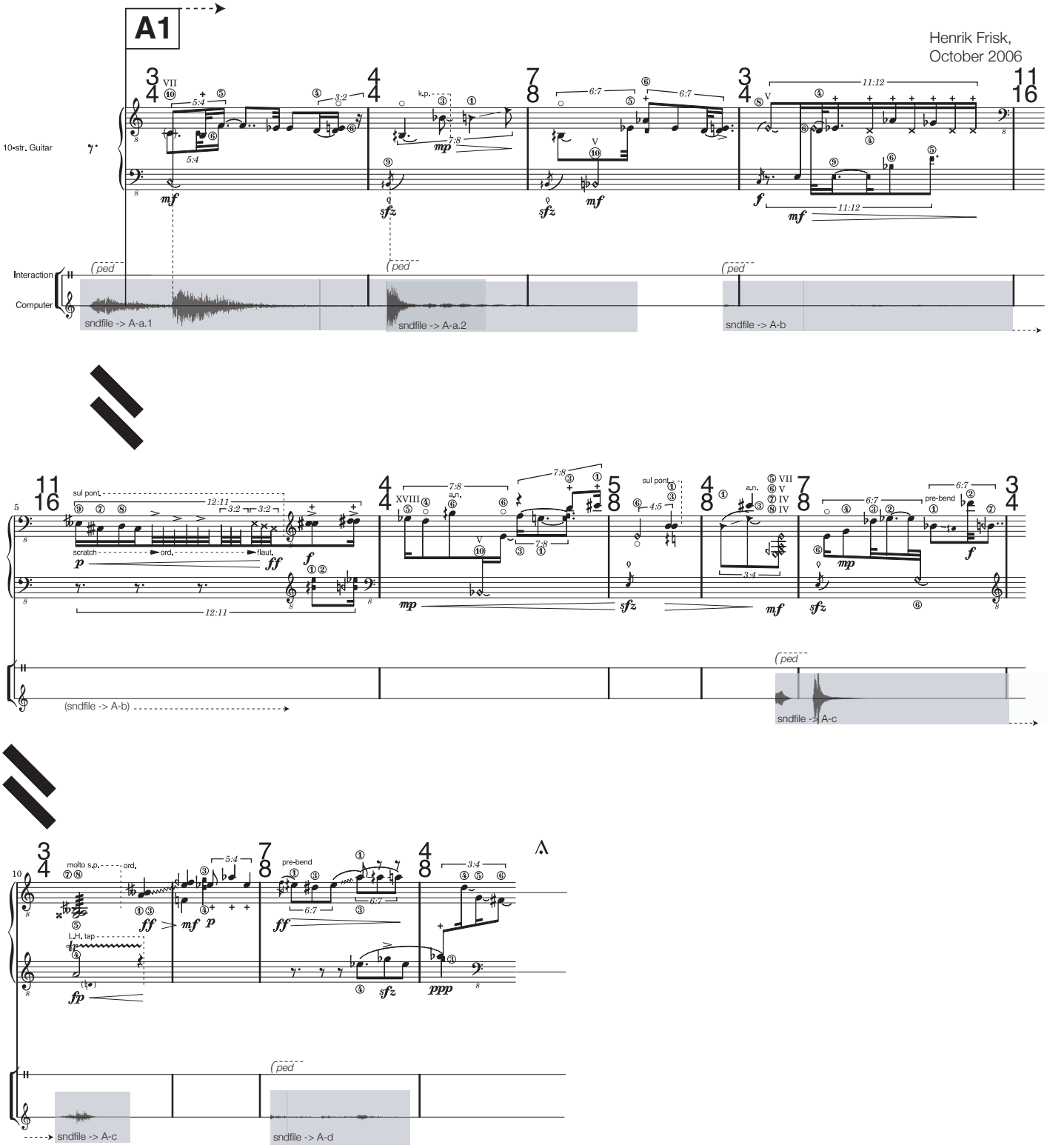
Stycket har en nära relation till trion 'The Six Tones' som komponerades parallellt med 'Repetition...'. En tredjedel av materialet i gitarrstycket är transkriptioner av trioimprovisationer över en tidig skiss till 'Repetition...'. 'Repetition Repeats all other Repetitions' uruppfördes i Peking, Kina den 23 oktober, 2006. Stefan har därefter uppfört det i olika versioner i Palo Alto och Seatle i USA, i Birmingham, England och i Malmö.

Dedicated to Stefan Östersjö

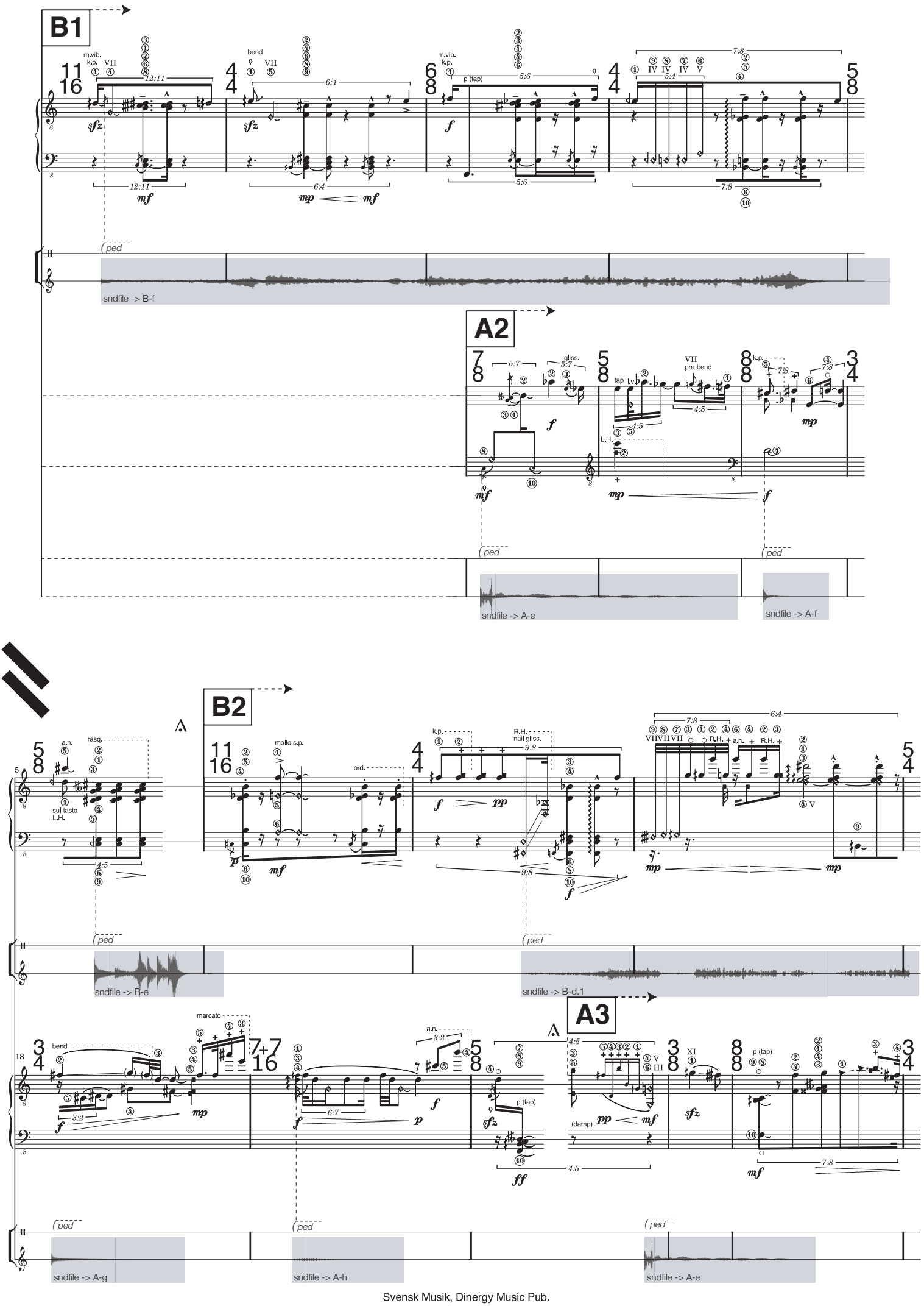
Repetition Repeats all other Repetitions

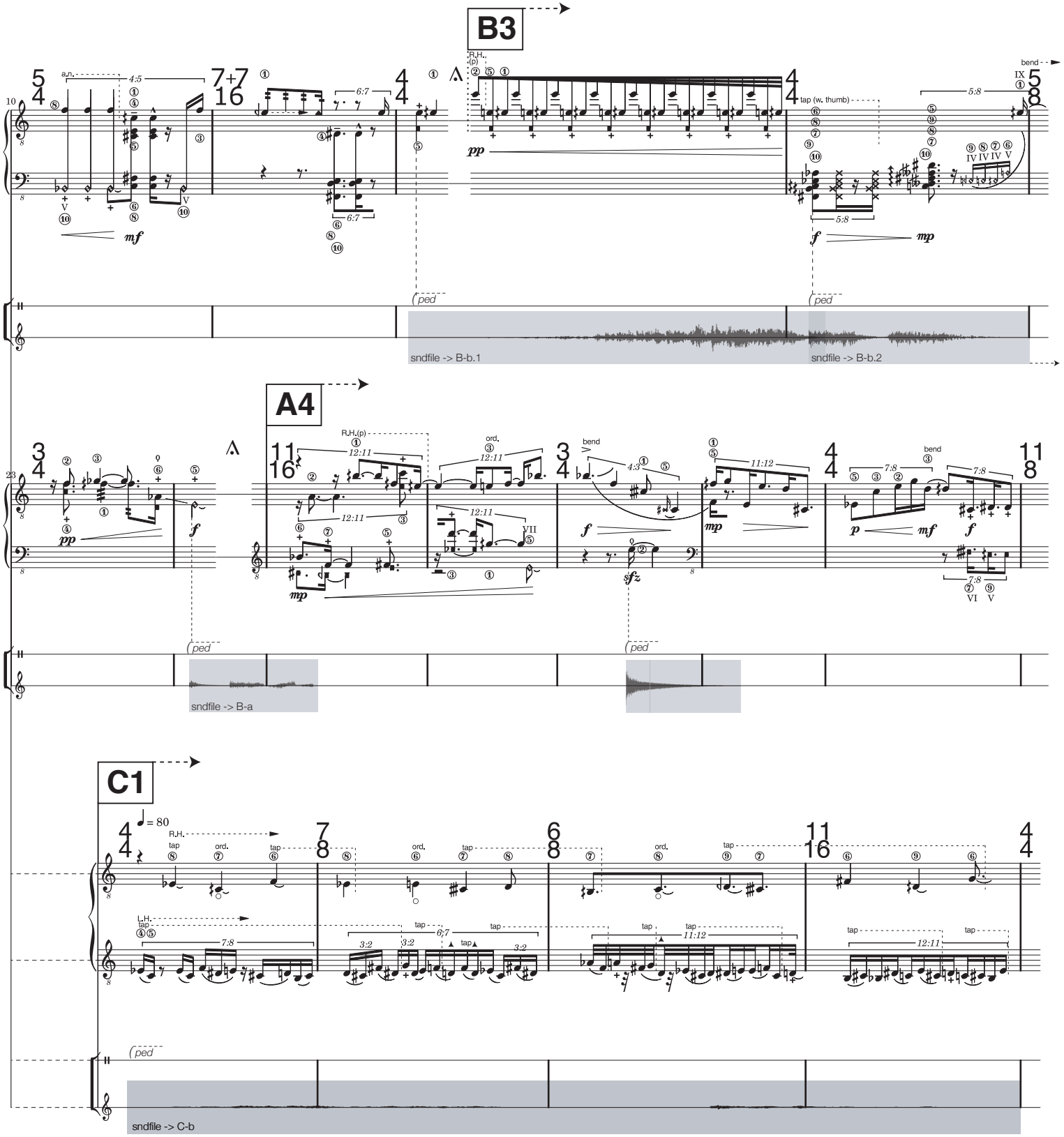
for 10 stringed Guitar and computer

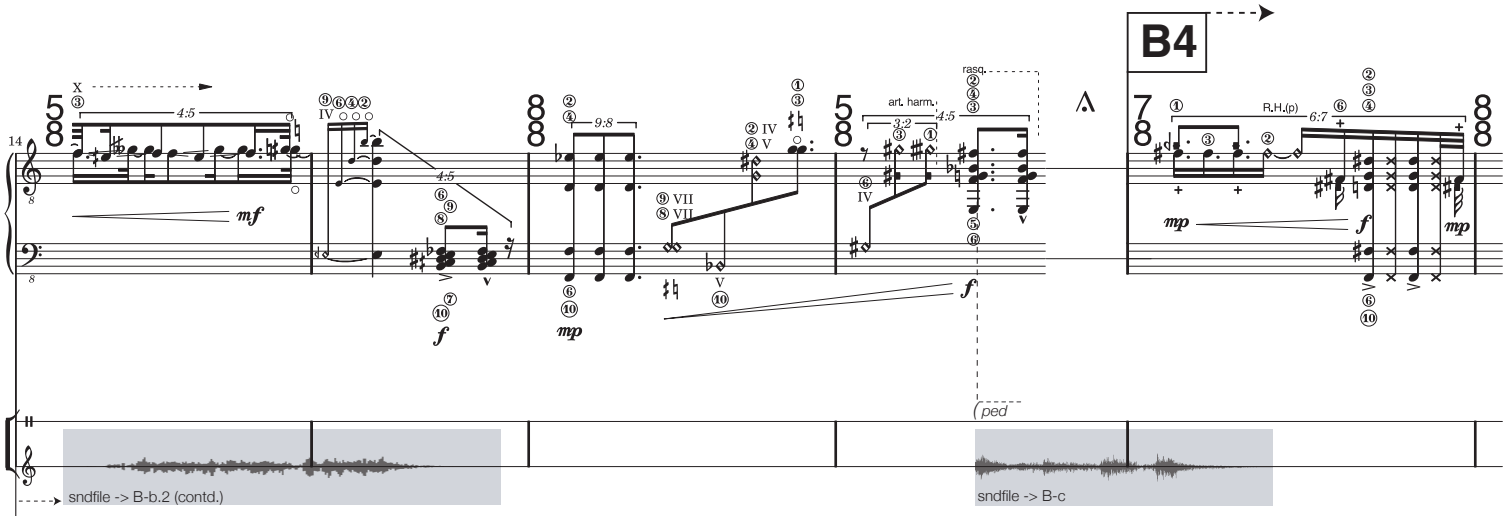
Henrik Frisk,
October 2006

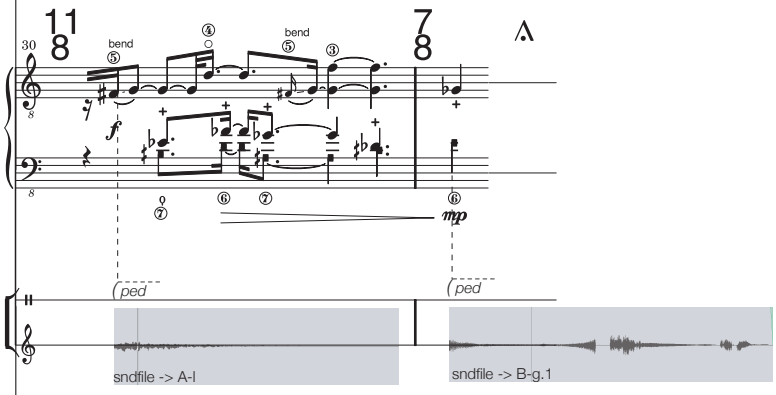


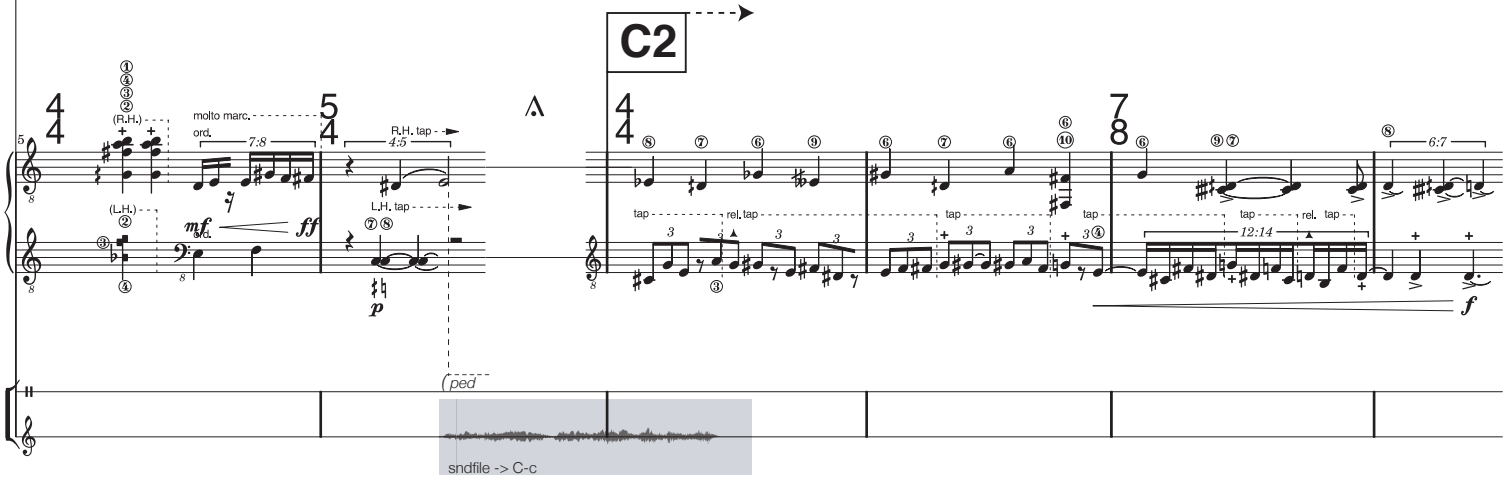
Svensk Musik, Dinergy Music Pub.

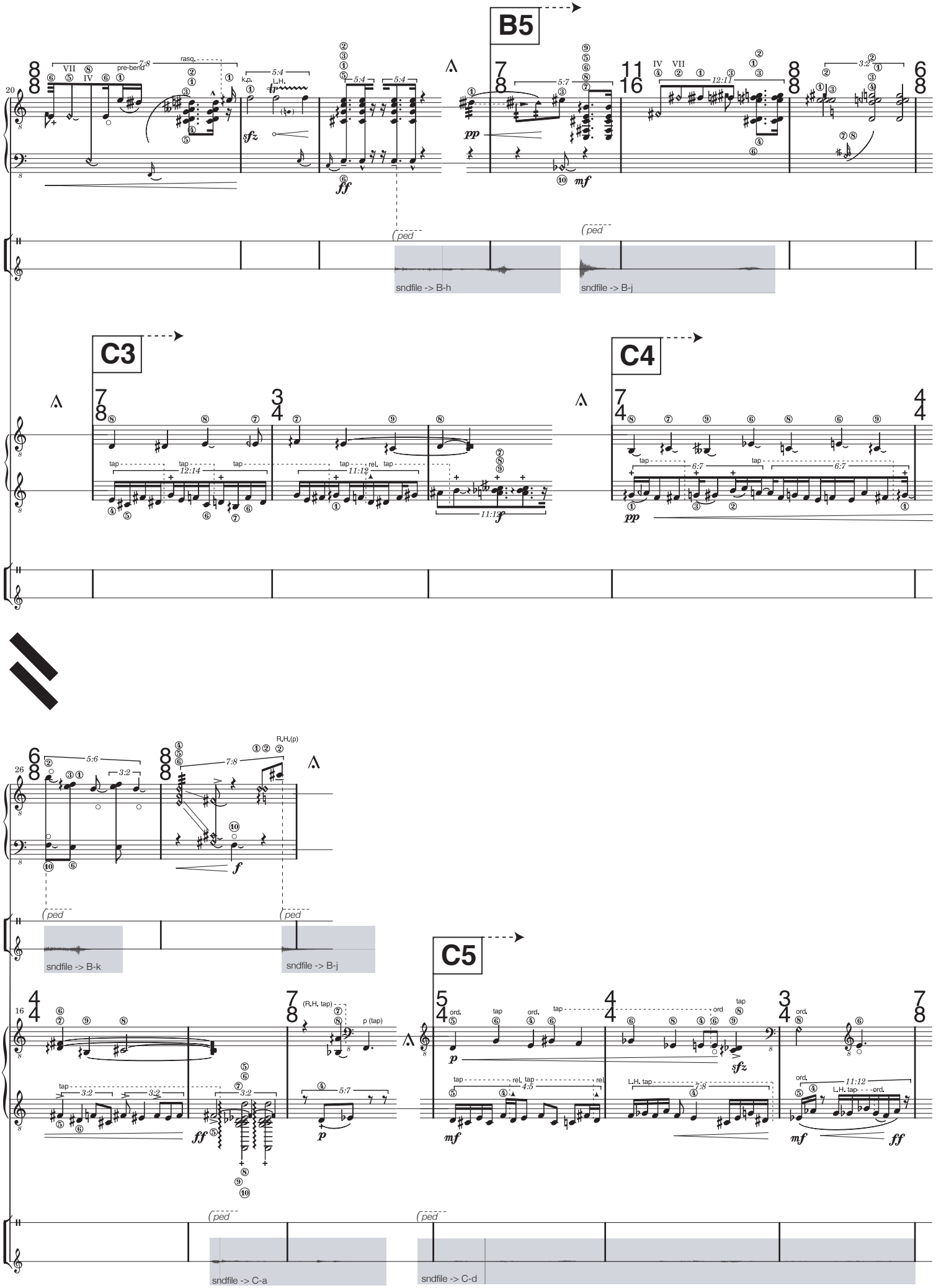

B1
m.vib.
k.p.
bend
p (tap)
sndfile -> B-f
A2
gliss.
tap
pre-bend
L.H.
sndfile -> A-e
sndfile -> A-f
B2
a.n.
rasq.
sul tasto
L.H.
molto s.p.
ord.
k.p.
R.H.
nail gliss.
R.H.
a.n.
sndfile -> B-e
sndfile -> B-d.1
A3
marcato
bend
a.n.
p (tap)
(damp)
sndfile -> A-g
sndfile -> A-h
sndfile -> A-e

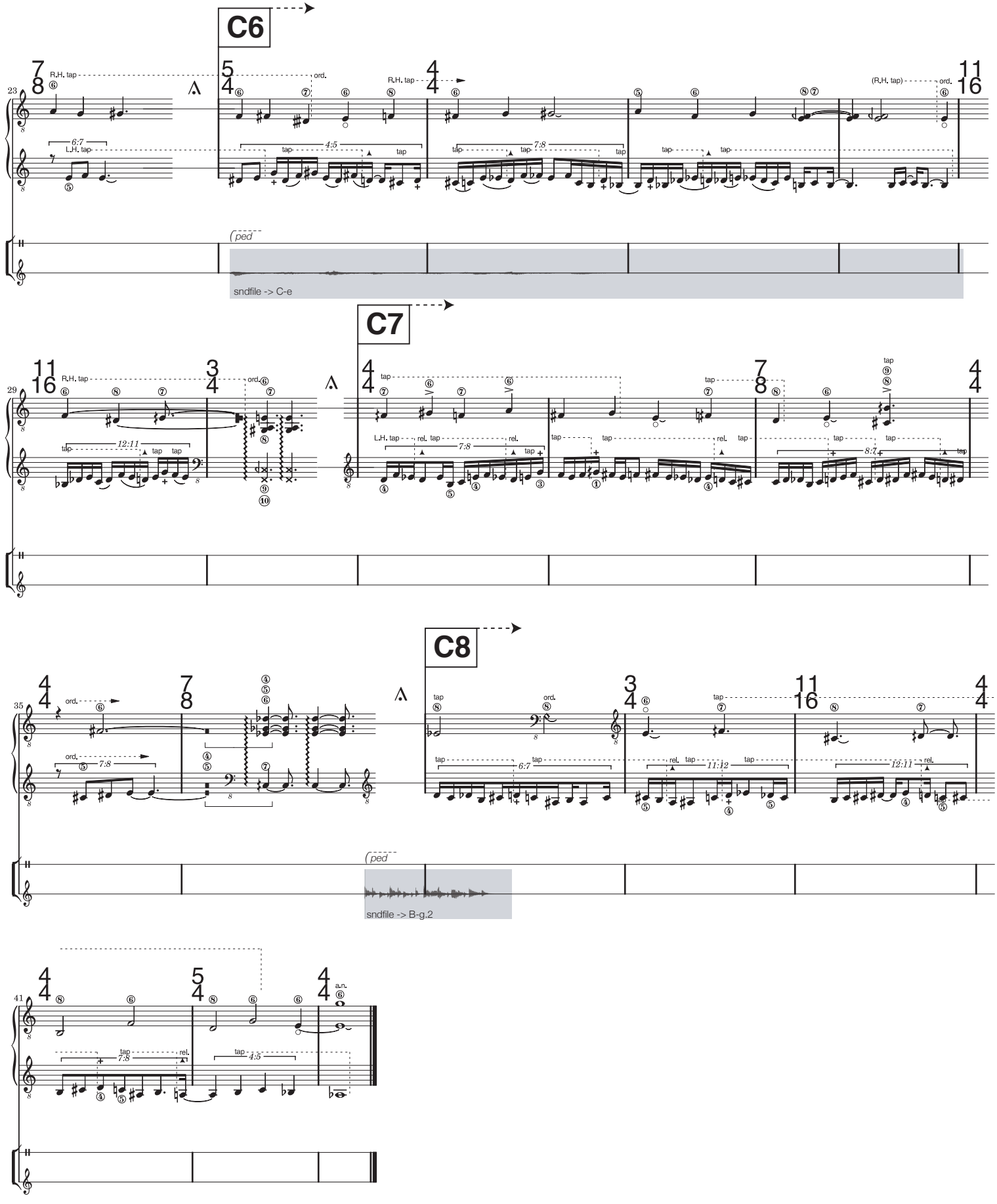

B3
A4
C1
sndfile -> B-b.1
sndfile -> B-b.2
sndfile -> B-a
sndfile -> C-b


B4
sndfile -> B-b.2 (contd.)
sndfile -> B-c


sndfile -> A-l
sndfile -> B-g.1


C2
sndfile -> C-c


B5
C3
C4
C5
sndfile -> B-h
sndfile -> B-j
sndfile -> B-k
sndfile -> B-j
sndfile -> C-a
sndfile -> C-d


C6
R.H. tap
L.H. tap
ord.
(R.H. tap)
ped
sndfile -> C-e
C7
rel.
C8
sndfile -> B-g.2
a.n.

Appendix I

Repetition Repeats all other Repetitions, Symphonie Diagonale: score

I.1 Programme note

Repetition Repeats all other Repetitions, Symphonie Diagonale
for 10-stringed guitar, computer and video projection
Composed & premiered in 2007
Prepared in collaboration with Stefan Östersjö
Listen | Score

This is a version of *Repetition Repeats all other Repetitions* worked out by myself and Stefan Östersjö in January 2007. When Östersjö came across the classic dadaist film *Symphonie Diagonale* he found that perhaps it could serve as an alternative source for inspiration in order to come up with a different way to interpret *Repetition Repeats all other Repetitions*. Viking Eggeling's film became the method. When we started analyzing the film we soon realized that it, in its composition, had some striking similarities to *Repetition...* in that it has three distinct set of materials that are combined and re-organized during the course of the work. Although we did strive for harmony between image and sound, we did not attempt to set music to the film; the two works have been aligned in time, still respectful of the integrity and identity of the classic work of art that the *Symphonie Diagonale* has become.

Viking Eggeling (1880-1925) was an artist and film maker from Lund, Sweden. In Paris in the early 20's, he and Hans Richter started experimenting with the film medium which eventually led to Eggeling completing the *Symphonie Diagonale* in 1924, just before he died in May 1925 at the age of 45. Although the *Symphonie* was one of the few works he completed and that still remains—his first film, *The Horizontal-Vertical Orchestra* has been lost—his reputation has grown. I wish to acknowledge Leif Ericsson and Bengt Rooke from the Swedish Eggeling Society for giving me access to a high quality copy of *Symphonie Diagonale* to work with.

Repetition Repeats all other Repetitions

for 10 stringed Guitar, video and computer

version for Symphonie Diagonale by Viking Eggeling

Henrik Frisk 2006-07

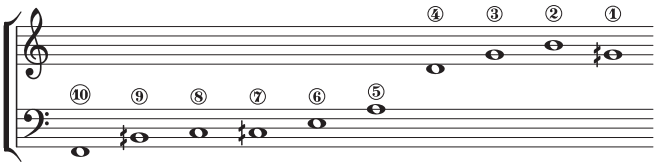
This version was
made in collaboration
with Stefan Östersjö
in January 2007

Durata: 8'27"

Repetition Repeats all other Repetitions

Notes to the score

Scordatura:



Symbols used:

	Silently press and hold string with left hand at indicated pitch. An adjecent regular note indicates the (approximate) sounding pitch.
+	Pluck string on the left side of the left hand (between the left hand and the nut).
k.p.	Koto pizzicato - performed like a Bartok pizz. but played on the string as close as possible to the point where the string is stopped by the left hand on the fretboard. The string should not hit the fretboard as it does in a Bartok pizz. The sound is resemblant of a Koto.
	Lift the string with the right hand (index finger) nail and pluck it with the left hand (slide effect).
a.n.	Above nut - pluck the string above the nut. The indicated pitch is only an aproximation.
(ped	Trigger a sound file with a midi pedal. These triggers may also be performed by someone other than the guitarist.

Instructions for performance

The form of *Repetition Repeats all other Repetitions* is open. The sections are “modular” and may be combined in any way the performer sees fit. The only restriction is that the piece should begin with A1, played as written. After that, the performer is not even restricted to use entire sections as building blocks. The sections themselves may be broken down into smaller units.

The three materials (A, B, and C) have their own identity and the process of “building” the form should be one where the interactions (the dramaturgy) between the contrasting materials is considered. The three “motives” are telling the same story in three different ways so to speak. The identities are retained in the electronic material as well. This is what we did for this version which was made in January 2007. I am greatful to Bengt Rooke and the “Viking Eggeling Sällskapet” for providing us with the original movie in high resolution.

The best way to achieve tight synchronization between the performance and the movie is to have a small video monitor for the performer to watch. There is no clicktrack on the DVD with the movie.

This version was first performed by Stefan Östersjö at CCRMA, Stanford, Palo Alto, February 8, 2007

Soundfiles, lengths and file names

Sound file name	*Score name*	*Length*
repeat-A1.aif	A-a.1	7"
repeat-A1.2.aif	A-a.2	14"
repeat-A2.aif	A-b	22"
repeat-A3.aif	A-c	18"
repeat-A4.aif	A-d	12"
repeat-A5.aif	A-e	17"
repeat-A6.aif	A-f	3"
repeat-A7.aif	A-g	9"
repeat-A8.aif	A-h	7"
repeat-A9.aif	A-i	8"
repeat-A10.aif	A-j	10"
repeat-A11.aif	A-k	8"
repeat-B1.aif	B-a	11"
repeat-B2.aif	B-b.1	18"
repeat-B2.1.aif	B-b.2	15"
repeat-B3.aif	B-c	18"
repeat-B4.aif	B-d	21"
repeat-B5.aif	B-e	49"
repeat-B6.aif	B-f	29"
repeat-B7.new.aif	B-g	52"
repeat-B8.aif	B-h	16"
repeat-B9.aif	B-i	18"
repeat-B10.aif	B-j	7"
repeat-B11.aif	B-k	9"
repeat-C1.aif	C-a	17"
repeat-C2.aif	C-b	24"
repeat-C3.aif	C-c	24"
repeat-C4.aif	C-d	27"
repeat-C5.aif	C-e	34"

English program note

This is a version worked out by myself and Stefan Östersjö in January 2007. When Östersjö came across the classic dadaist film "Symphonie Diagonale" he found that perhaps it could serve as an alternative source for inspiration in order to come up with a different way to interpret Repetition Repeats all other Repetitions. Viking Eggeling's film became the method. When we started analyzing Eggeling's film we soon realized that it, in its composition, had some striking similarities to "Repetition..." in that it has three distinct set of materials that are combined and re-organized during the course of the work. Although we did strive for harmony between image and sound, we did not attempt to set music to the film; the two works have been aligned in time, still respectful of the integrity and identity of the classic work of art that the "Symphonie Diagonale" has become.

Viking Eggeling(1880-1925) was an artist and film maker from Lund, Sweden. In Paris in the early 20's, he and Hans Richter started experimenting with the film medium which eventually led to Eggeling completing the "Symphonie Diagonale" in 1924, just before he died in May 1925 at the age of 45.

Dedicated to Stefan Östersjö

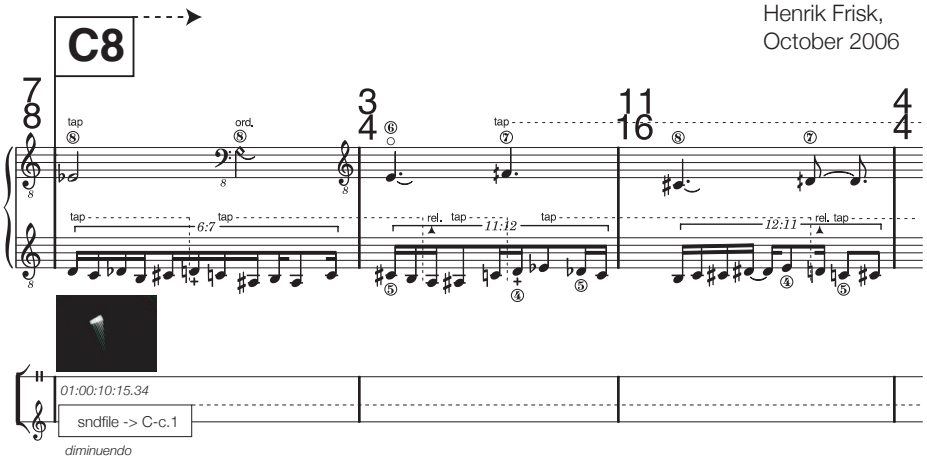
Repetition Repeats all other Repetitions

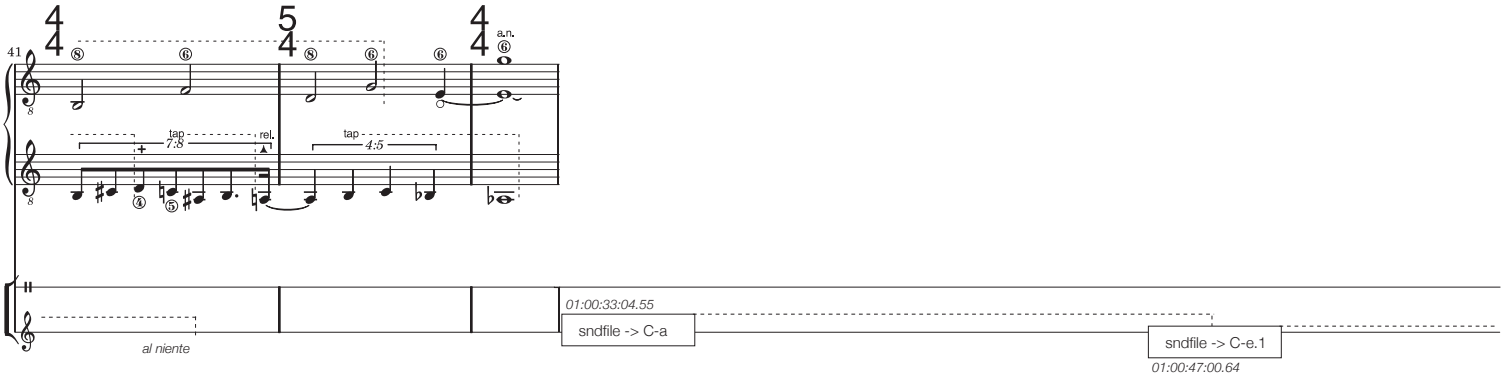
for 10 stringed Guitar and computer

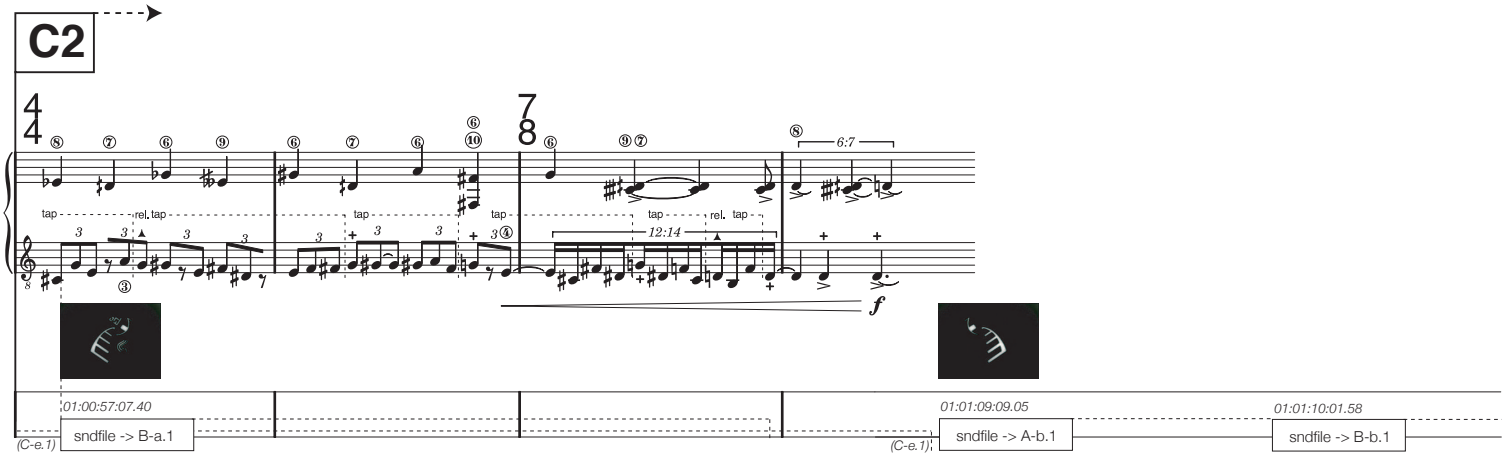
version for *Symphonie Diagonale* by Viking Eggeling

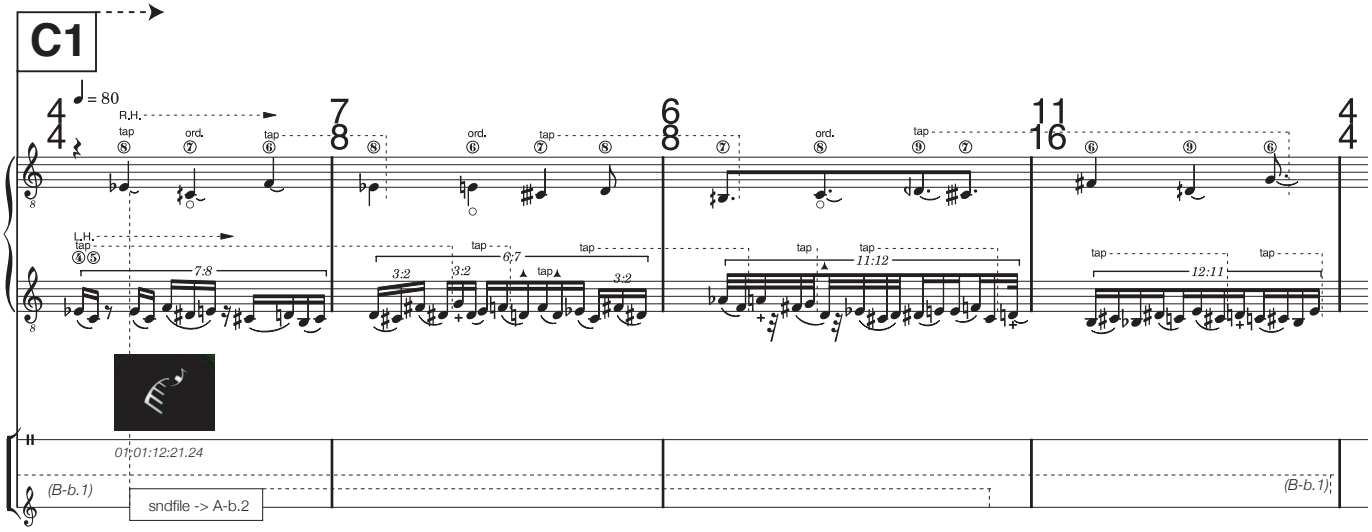
Henrik Frisk,
October 2006

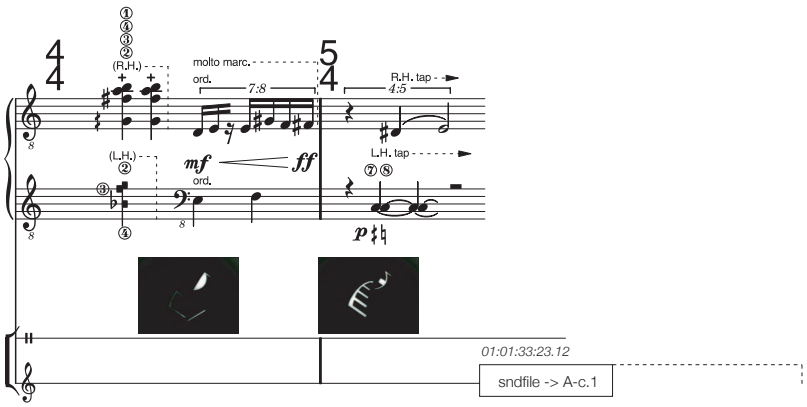
01:00:00:00.00

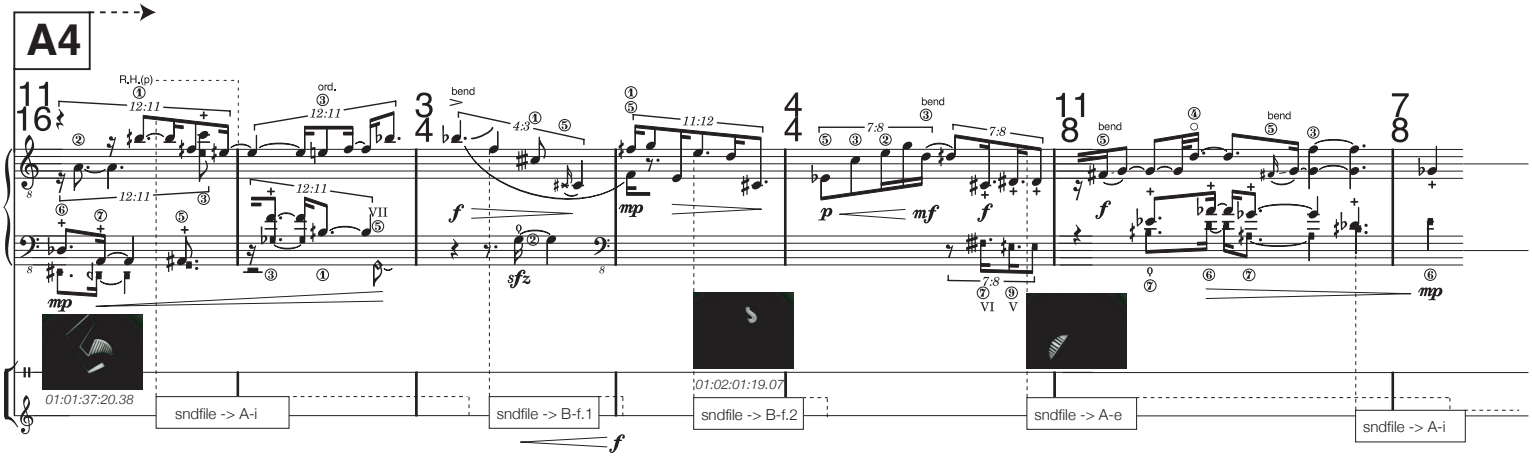


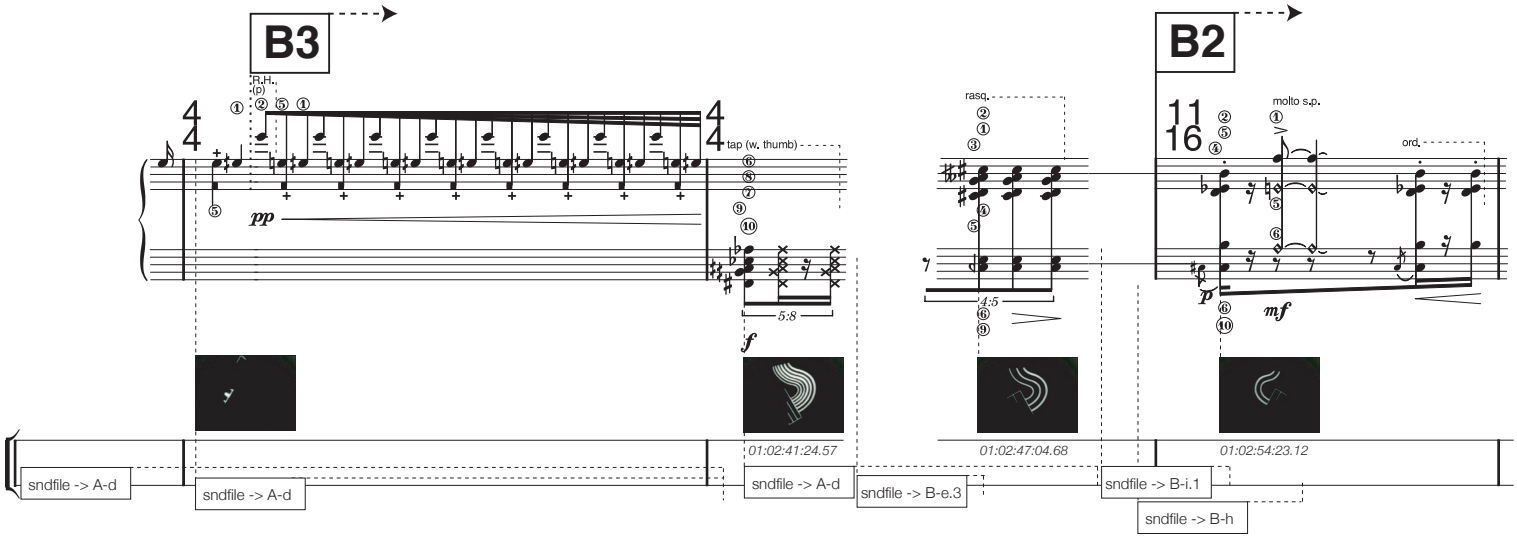


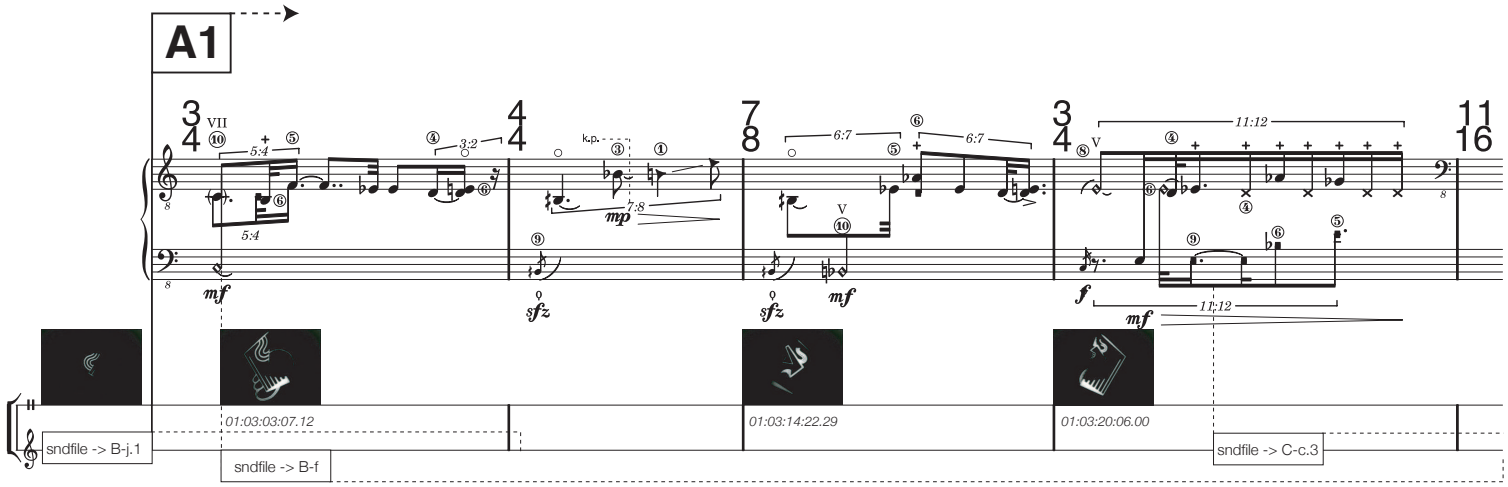


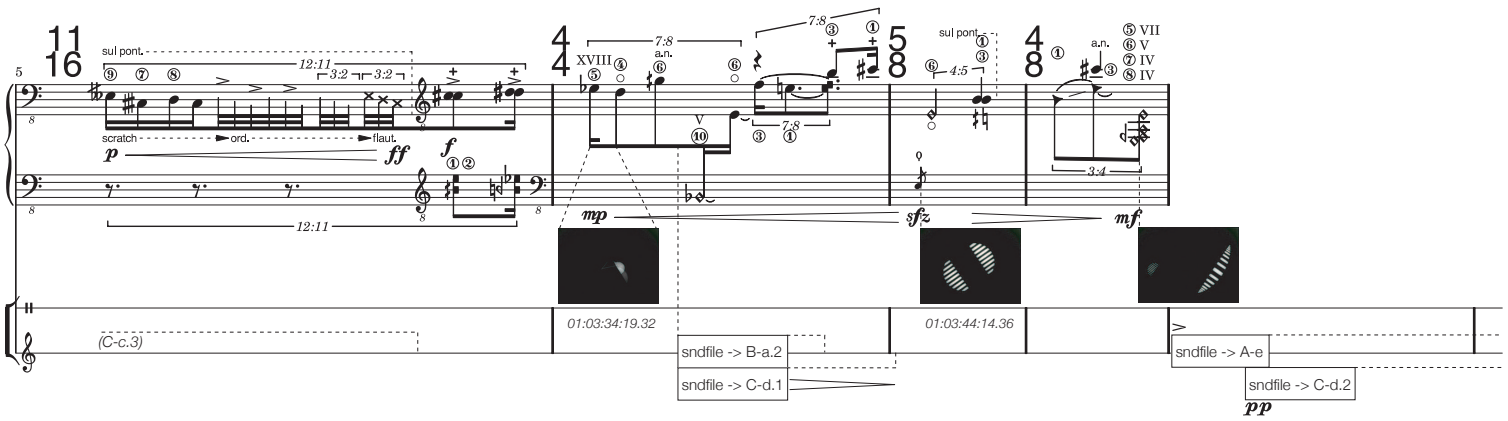

C1
♩= 80
R.H.
tap
ord.
L.H.
7:8
3:2
6:7
11:12
12:11
01:01:12:21.24
(B-b.1)
sndfile -> A-b.2
(B-b.1)

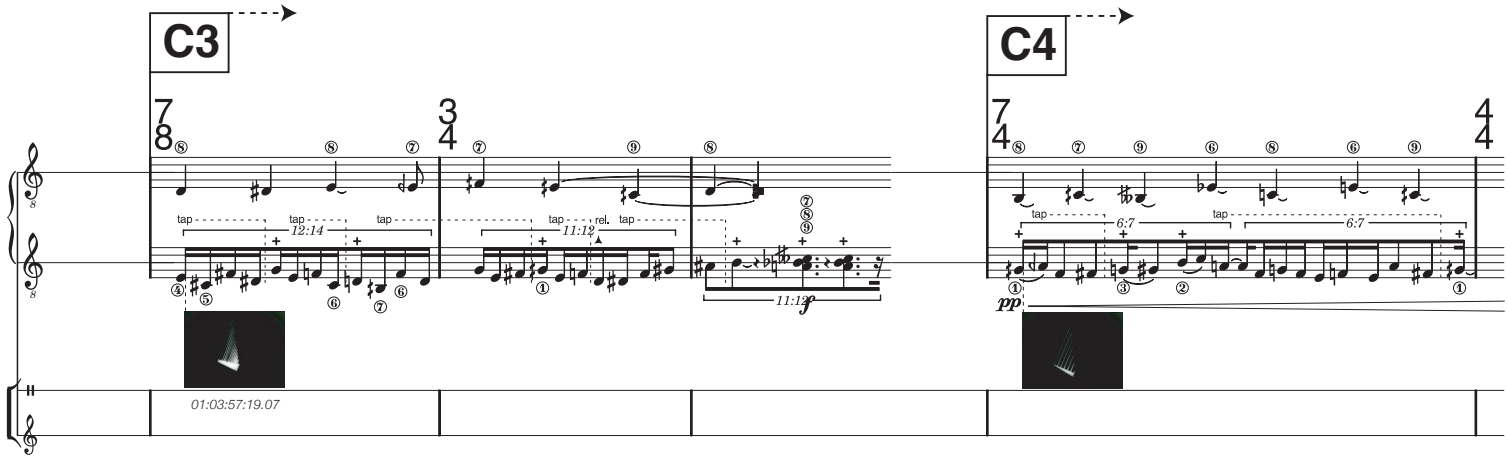

(R.H.)
molto marc.
ord.
7:8
4:5
R.H. tap
(L.H.)
mf
ff
L.H. tap
p
01:01:33:23.12
sndfile -> A-c.1

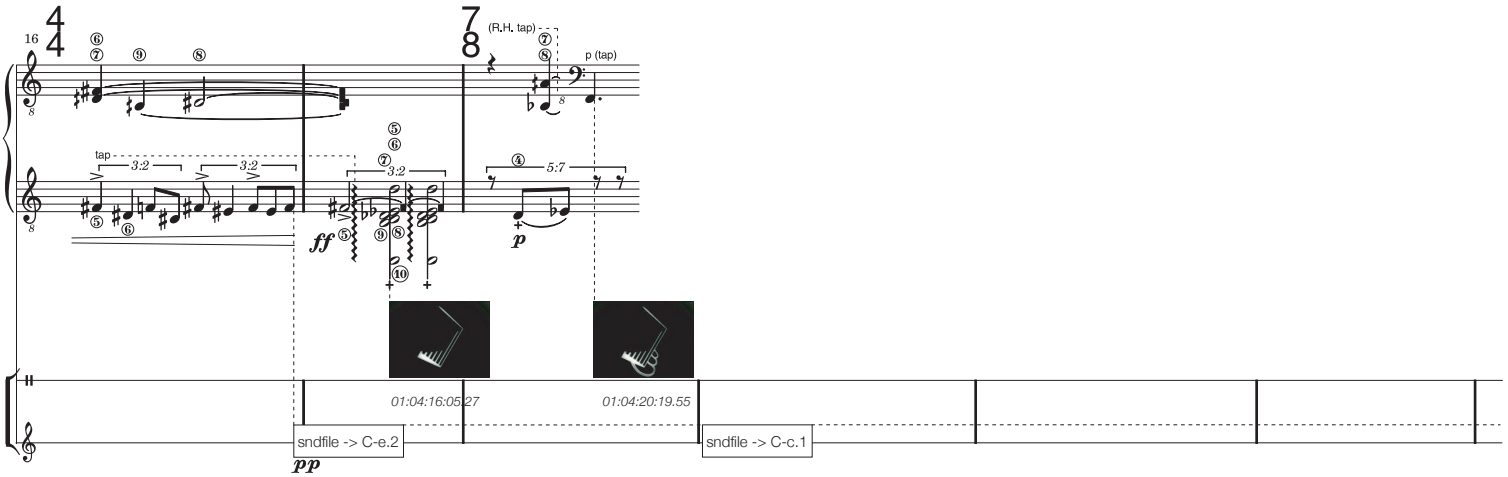

A4
R.H.(p)
12:11
ord.
bend
4:3
11:12
7:8
VII
VI
V
mp
f
sfz
p
mf
01:01:37:20.38
01:02:01:19.07
sndfile -> A-i
sndfile -> B-f.1
sndfile -> B-f.2
sndfile -> A-e
sndfile -> A-i

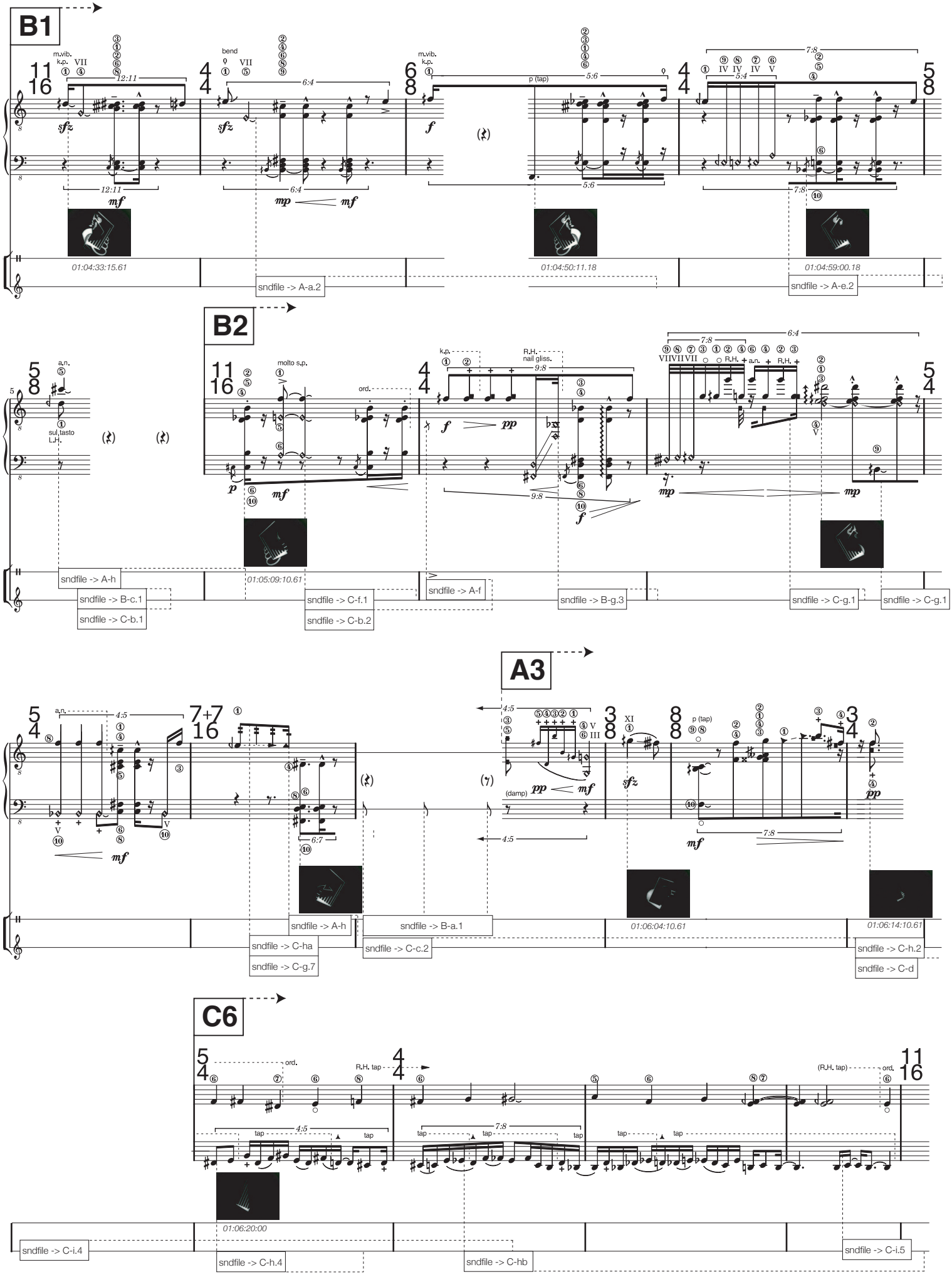

B3
R.H.
(p)
tap (w. thumb)
pp
5:8
f
B2
rasq.
molto s.p.
ord.
4:5
p
mf
01:02:41:24.57
01:02:47:04.68
01:02:54:23.12
sndfile -> A-d
sndfile -> A-d
sndfile -> A-d
sndfile -> B-e.3
sndfile -> B-i.1
sndfile -> B-h

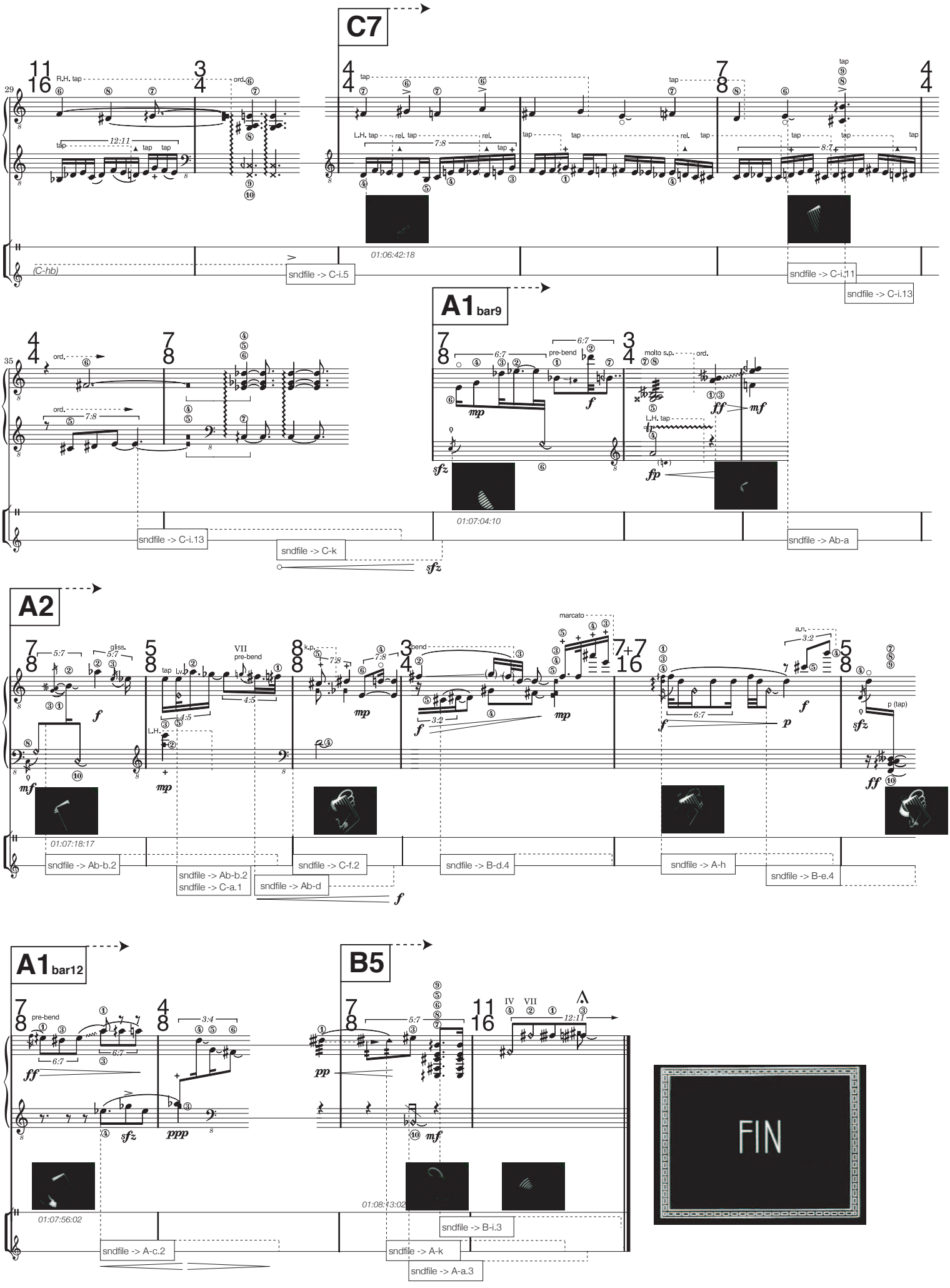

A1
sndfile -> B-j.1
01:03:03:07.12
sndfile -> B-f
01:03:14:22.29
01:03:20:06.00
sndfile -> C-c.3


(C-c.3)
01:03:34:19.32
sndfile -> B-a.2
sndfile -> C-d.1
01:03:44:14.36
sndfile -> A-e
sndfile -> C-d.2


C3
C4
01:03:57:19.07


01:04:16:05.27
01:04:20:19.55
sndfile -> C-e.2
sndfile -> C-c.1


B1
m.vib.
k.p.
bend
p (tap)
01:04:33:15.61
01:04:50:11.18
01:04:59:00.18
sndfile -> A-a.2
sndfile -> A-e.2
B2
molto s.p.
ord.
k.p.
R.H. nail gliss.
a.n.
R.H.
sul.tasto L.H.
01:05:09:10.61
sndfile -> A-h
sndfile -> B-c.1
sndfile -> C-b.1
sndfile -> C-f.1
sndfile -> C-b.2
sndfile -> A-f
sndfile -> B-g.3
sndfile -> C-g.1
sndfile -> C-g.1
A3
(damp)
01:06:04:10.61
01:06:14:10.61
sndfile -> A-h
sndfile -> C-ha
sndfile -> C-g.7
sndfile -> B-a.1
sndfile -> C-c.2
sndfile -> C-h.2
sndfile -> C-d
C6
ord.
R.H. tap
(R.H. tap)
tap
01:06:20:00
sndfile -> C-i.4
sndfile -> C-h.4
sndfile -> C-hb
sndfile -> C-i.5


C7
A1 bar9
A2
A1 bar12
B5
FIN
sndfile -> C-i.5
sndfile -> C-i.11
sndfile -> C-i.13
sndfile -> C-k
sndfile -> Ab-a
sndfile -> Ab-b.2
sndfile -> Ab-b.2
sndfile -> C-a.1
sndfile -> Ab-d
sndfile -> C-f.2
sndfile -> B-d.4
sndfile -> A-h
sndfile -> B-e.4
sndfile -> A-c.2
sndfile -> B-i.3
sndfile -> A-k
sndfile -> A-a.3
01:06:42:18
01:07:04:10
01:07:18:17
01:07:56:02
01:08:13:02

Appendix J

Drive: score

J.1 Programme note

Drive
for Electric Viola Grande and computer
Composed & premiered in 2002
Commissioned by and dedicated to Henrik Frendin
Listen | Score

The title, 'Drive', refers to the non-linear format of the score. The instructions in the score are laid out along a circle with reference to a map in which one can move from any point to any other point at any moment. Although the piece is composed as to be played clockwise from 12 to 12, the player may choose to take another path through the material. Taking another route will affect the computer part.

The harmony and the melodic fragments are built around a six note chord in which every note gravitates towards the center of the chord, a quarter of a semi tone raised B natural. This harmonic glissando is continuous throughout the piece and results in micro-tonal variations of the original harmony. It is heard as a harmonic shadow cast by the computer behind the viola. At five consecutive points in the score the harmony is 'sampled' and the harmonic overtones from these discrete chords gives the pitches for the four virtual resonant strings in the computer part. The third computer voice is a bass note, sampled from the very first note as played by the viola, D natural, and making a glissando up a perfect fourth.

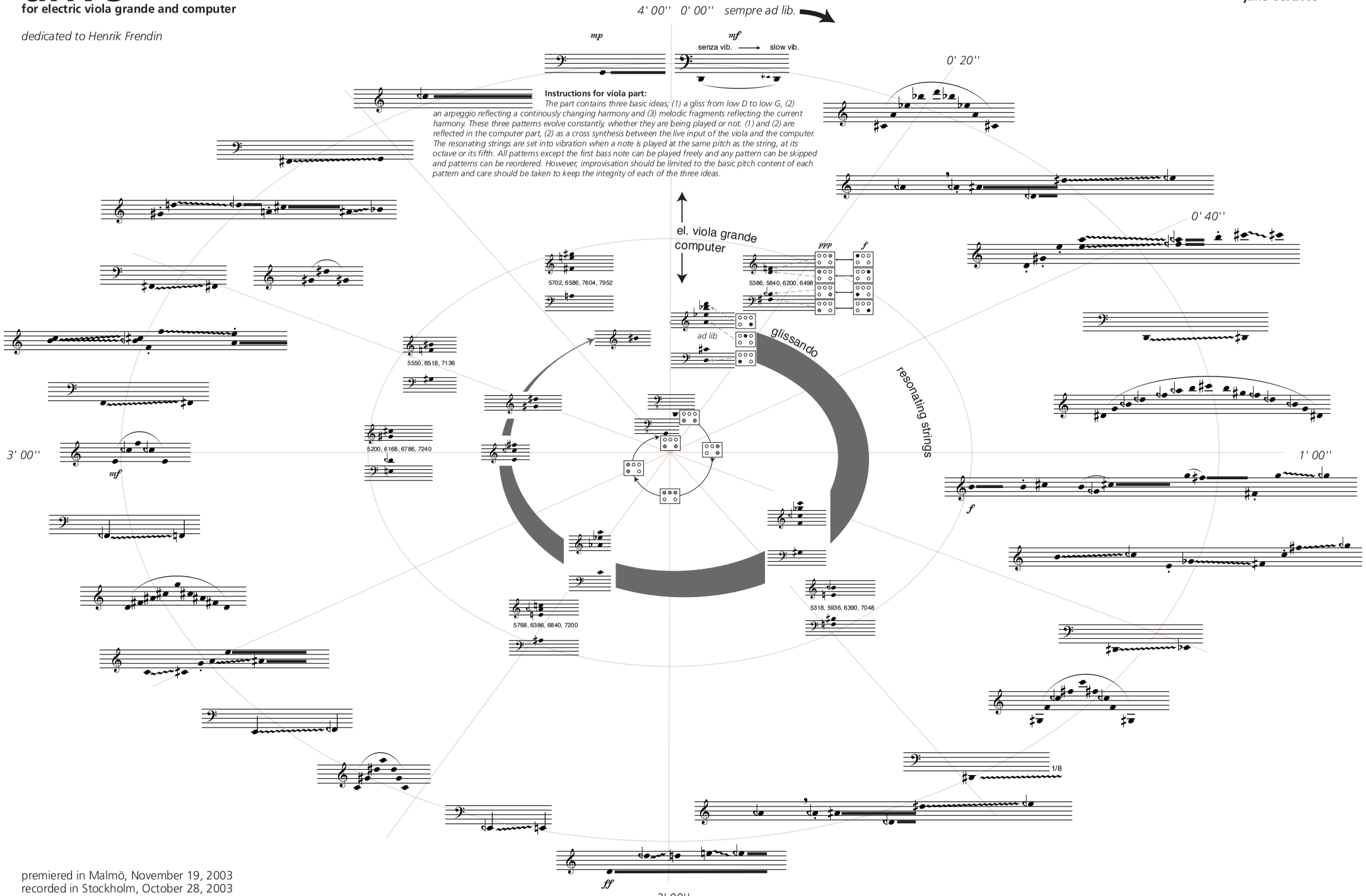
These three elements are played back by the computer as a result of the incoming signal from the viola. The viola part has three distinct motifs that each relate to the three computer generated voices. The performer is allowed to use the notated material freely, change the order of the events if she so wishes. The C string of the viola is tuned down a minor seventh, probably only possible thanks to the special quality of the instrument 'Drive' was originally composed for. Like much of my music 'Drive' is an attempt at making possible the resolving of linear time and to start processes that can evolve their own space/time relations.

drive

for electric viola grande and computer

dedicated to Henrik Frendin

Henrik Frisk
june-oct 2003



premiered in Malmö, November 19, 2003
recorded in Stockholm, October 28, 2003
for Phono Svecia on "*Viola con forza*"

© 2003 dinergy music pub

Glossary

ANN — Artificial Neural Network. A simplified model of a "network of neurons that occur naturally in the animal brain." (Kevin Gurney. *An Introduction to Neural Networks*. UCL Press Ltd., Routledge, 1997, p. 6) There are many different types of ANN and they may all be gathered under the umberella of *connectionism*. See also SOM., 10

Csound — A programming language designed for signal processing. Primarily intended for use in non-real time., 32, 111

DSP — Digital Signal Processing. The processing of a signal in the digital domain. In the context of music DSP usually refers to audio processing (filtering, modulation, echo, etc.) and synthesis (generation of new sound material) in a computer, synthesizer or dedicated hardware., 17, 18, 104, 153

Electro-acoustic Music — Also EAM. According to the Oxford English Dictionary electro-acoustics are "acoustics investigated by electrical methods" ("electro-acoustics" The Oxford English Dictionary. 2nd ed. 1989. OED Online. Oxford University Press. 31 Oct. 2007). Electro-acoustic music is a broad term used to denote music produced by or with electrical methods. Today, since this is mainly achieved by the use of digital computers, in USA the use of the term 'Computer Music' is more common. Yet another term, more commonly used in the francophone countries is 'acousmatic', and it is sometimes argued that 'acousmatic' refers to the genre and 'electro-acoustic' to the means of production.[1] Throughout this text I am primarily using electro-acoustic music or electro-acoustics to denote my own artistic work involving computers and music., 67, 70, 159

Esthesic — In musical semiology, according to Nattiez, the phase of interpretation or reconstruction of a musical work., 47, 48, 50, 56, 126, 132

Fixed media music — Music that is pre-recorded and stored onto a fixed media of some sort (a tape, a CD, a DVD, a hard-drive). Was earlier, prior to CDs and the digital media revolution, commonly referred to as 'tape music' since, at the time, the media both for production and for storage was a tape. On of the least interactive types of electro-acoustic music., 58, 67

ICMC — International Computer Music Conference. A yearly conference dedicated to computer music. Organized by ICMA, International Computer Music Association., 77

[1] E.g. *"Vous avez dit acousmatique?"* Web resource. n.d. URL: http://www.musiques-recherches.be/acousmatic.php?lng=fr (visited on 11/01/2007), ¶ 9.

Intelligent agent — An idea to improve HCI introduced in the mid 90's. An agent is a piece of software designed to collect and sort information and present it to the user. The idea is that the agent will learn what it is its user wants, or needs to know about. (The 'intelligent agent' should not be confused with the 'agent' as a factor in the production of musical content.), 75, 76

Latency — The response time of an interactive system. The time between casue and action, between stimulus and response., 78, 79, 90

Max/MSP — Named after computer music guru Max Mathews, Max/MSP is a software originally developed by Miller Puckette at Ircam in Paris. It is a tool to support the design and implementation of interactive music systems and allow for programming using a graphical environment by creating and interconnecting boxes that encapsulate a specific function. MSP is the signal processing part of Max., 10, 32, 147

MIDI — A low band-width communication protocol enabling electronic musical devices (instruments, controllers, computers, etc.) to communicate with one another. MIDI was not initially designed for the purposes it is now used. OSC is a similar but more contemporary and flexible protocol., 3, 10, 29, 86

Musician — I use 'musician' in a very inclusive way in these texts. A composer, an improviser, a performer are all subcategories to the general description 'musician'. I am leaning towards Trevor Wishart who, in his book *On Sonic Art*, points to how the increased importance given to notation has split the musician in two: the composer and the performer. In my own practice it is a goal in itself to unite these two roles., 1, 4, 10, 11, 16, 65, 87–89, 101

OSC
: Open Sound Control. A communication protocol for connecting electro-acoustic music devices such as computers, sound synthesizers and other multi media devices over TCP/IP primarily using UDP. A sort of successor to MIDI., 11, 30, 32, 145

Pitch-tracking
: To let a computer (or a special purpose device) analyze an audio signal in real-time and extract the most likely fundamental of the sound (also pitch-to-MIDI, pitch detection)., 4, 9

Poietic
: According to musical semiologists Jean-Jacques Nattiez and Jean Molino, the poietic phase of a musical work is the stage at which the musical material is constructed. According to Nattiez, articulating the poietic and esthesic level "facilitates knowledge of all processes unleashed by the musical work".[2] We reinterpret the terms 'poietic' and 'esthesic' in the *Negotiating the Musical Work* papers. (see Section B and Section C), 47, 48, 50, 56, 58, 126, 132

Pure Data
: Just like Max/MSP, Pure Data is developed by Miller Puckette. It is a grphical programming environment to build 'patches' of audio and control rate processes. Pd, unlike Max/MSP is Open source.), 147, 153

Score following
: Relates to the technique that allows a computer to 'listen to' and 'follow' a score in real-time in a way that resembles how human performers or listeners are able to recognize and follow a piece of music they know, even if the performer(s) temporarily deviates from the score. See Dannenberg (1989), Roger and Christopher (2006) and Rowe (1993), chap. 3.2., 4

Sociotechnical systems
: Sociotechnical systems theory is theory about the social aspects of people and society and technical aspects of machines and technology. Sociotechnical systems, 73

[2] Nattiez, *Music and Discourse*, p. 92.

SOM — Self-Organizing Map. A special type of ANN that adopts itself according to some feature of the input and outputs a topography of this feature. A SOM is used in the subproject *timbreMap*, 10

The Six Tones — A musical collaboration between myself, Stefan Östersjö, Ngo Tra My and Ngyen Thanh Thuy started in 2006. The group was named after the piece that was collaboratively constructed and entitled *The Six Tones*, 45, 55, 60

Work-in-movement — In his book *The Open Work* (*Opera Aperta*) Umberto Eco coined the term the "work in movement" as a special sub-category of the open work. It is used here to name the work kind that (contrary to the predominantly modernist examples chosen by Eco) perpetually keeps moving, possibly in multiple directions simultaneously and preferably, but not necessarily, in a trajectory *away* from the originator. The movement is part of its authenticity. See also *interaction-as-difference*., i, 14, 16, 18, 54, 101, 104

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