Music, Computers and Interaction
Collected papers

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(Frisk, 2005)

Chapter 1

etherSound—an interactive sound installation

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Abstract

In this article the interactive instrument/sound installation *etherSound* and its artistic implications are discussed. *etherSound* is a work in progress and the main intention is to create a vehicle for audience participation through the use of SMS (Short Message Service) sent from a mobile phone. The two different contexts in which *etherSound* has been tried (in concert with performers and as a sound installation without performers) are discussed as well as the design of the system and the mapping between text and sound.

1.1 Introduction

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.

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" (Duchamp, 1959). The French curator and art critic Nicolas Bourriaud speaks of "*relational* art" (italics 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" (Bourriaud, 2002, p. 13).

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 (Adorno, 1962, p. 211). 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" (Ulyate & Bianciardi, 2002, p. 41). 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" (Machover, 1996, as cited in Rowe, 2001, p. 360). 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' (Wessel & Wright, 2002; Jordà, 2002. See also Rowe, 1993; Freeman, Ramakrishnan, Varnik, Neuhaus, Burk & Birchfield, 2004). With the recent technological advances there are innumerable tools that can be used for collaborative efforts (Barbosa & Kaltenbrunner, 2002), 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.

A project for which public participation is important must somehow deal with the aspect of access, and according to Pierre Bourdieu (1979) 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 (1990), 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 now 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* (Frisk & Östersjö, 2006a,b). 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*:

> 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. (Ascott, 1990, p. 242)

Though less centered on public participation and more on improvisation Guy E. Garnett (2001), 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 1.3. 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.[1] 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 of the educated listener—"the dominating class" (Bourdieu, 1979)—and makes room for new interpretations of the term 'understanding' in the arts. (This issue is also discussed in Frisk & Yoshida, 2005).

[1] 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.

1.2 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.[2] 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.

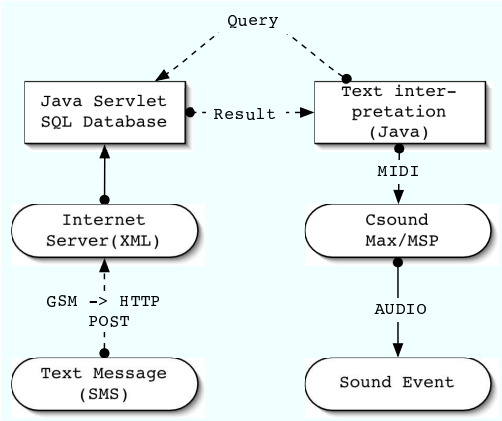

Figure 1.1: Communication in the first version.

Communication - first model

In the first version, realized in August 2003,[3] the communication between the participant and the system was accomplished according to Figure 1.1. 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 (in the Context of Interactive Sound Art: an empirical analysis, 2004) 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.

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.

[2] 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.

[3] See the audio and video recording *etherSound|etherSound 2003*.

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 1.2: Main GUI window for the *etherSound* program.

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 (Java Enterprise Edition, 1995) 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) (Wright, Freed & Momeni, 2003; of the Art 2003, 1997) for speed, reliability and flexibility, using the library JavaOSC (see `http://www.mat.ucsb.edu/~c.ramakr/illposed/javaosc.html`).

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 (J2SE 1.4.2, 2004) and features a simple but useful Graphical User Interface (GUI) for control and feedback about the status of the system (see Figure 1.2 and Figure 1.3). From the information extracted from the message control signals are generated which then influence (ordered from general to specific):

- 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:

$$i_1 = \frac{1}{(w(\frac{c}{w_c}) - w_l)^{1/2} + 1} \qquad i_2 = \frac{1}{(w(\frac{s}{w_c}) - s_l)^{1/2} + 1} \tag{1.2.1}$$

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

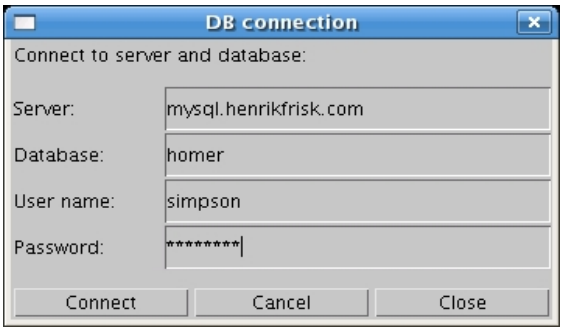

Figure 1.3: Panel for connecting to the database.

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 1.1: Life index for four different messages

defined by

$$w = \frac{1}{w_c - s_c + 0.5} \tag{1.2.2}$$

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[4] according to (1.2.3).

$$lifeIndex = \frac{i_1 + i_2}{2}\arctan(\frac{w_c}{o_w}) \tag{1.2.3}$$

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 1.1; 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.[5] If a message causes the global index to reach maximum, it stops the playback of the current message and begins playing back a precomposed 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.

The synthesis

The synthesis engine is written as a Csound orchestra (Boulanger, 2000) (For more information on Csound see also `http://www.csounds.com/`) included in Appendix A. In the first versions of *etherSound* Csound was running inside a Max/MSP (`http://www.cycling74.com/products/maxmsp.html`) 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

[4] Since a SMS is limited to 160 characters these constants are set according to what kind of message content should be rewarded.
[5] The rate is context dependent. In a performance with improvisation it would be shorter than in an installation.

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 1.2) and may be changed dynamically. The following discussion relates to the current version of *etherSound*.

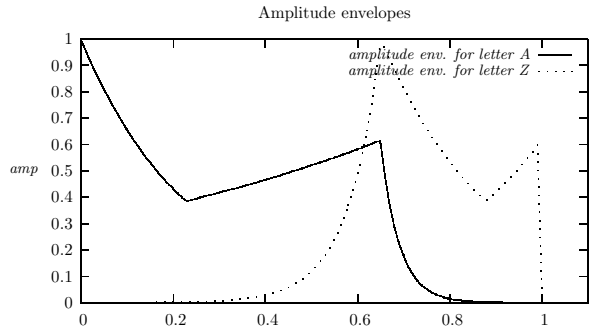

Figure 1.4: Amplitude envelopes for Instrument A. Linear interpolation between these two envelopes is performed for every character between A and Z.

All sounds heard in *etherSound* are generated with FOF (Fonction d'Onde Formantique) synthesis as this technique is implemented in Csound (Clarke, 2000; Byrne Villez, 2000), 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[6] 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 two notes and one pause, i.e. three (eight-note) triplets of which the last is silent (see Table 1.2). 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.

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

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 1.4). 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.

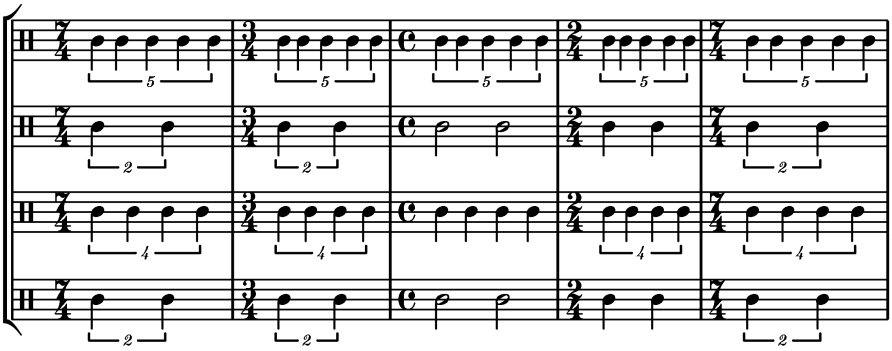

Figure 1.5: Rhythmic distribution of notes in Instrument B as a result of the message "*Hello, my name is Henrik.*".

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,[7] as many voices as there are words in the message. An example of the rhythmic mapping of notes is shown in Figure 1.5, the origin of which is the message in Table 1.2, 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 like character or of its inversion, and notes close to the beginning of a bar has a greater likelihood of being emphasized.

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

Figure 1.6: 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.[8] 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.[9] For each excitation of each voice, the instantaneous value of the corresponding glissando sets the pitch for that excitation. The message from Table 1.2 would result in the chord showed in Figure 1.6—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 1.3). 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.

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

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

[9] 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.

modeling the discrete words and characters as they appear in time, the objective flow of the components of 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.

1.3 Discussion and reflection

As has already been explained, the main issue for *etherSound* is to allow for unconditioned participation. It comes natural that unconditioned perception should similarly be allowed for. 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[10] with stochastic elements, methods which have been explored by many composers for many years. In his book *Formalized Music* composer Iannis Xenakis (1971) 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 (p. 8).

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

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

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 [..]" (Camurri, Richetti, and Trocca, 1999, as cited in Rowe, 2001, p. 373). 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?

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,[11] 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

[11] 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.

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 (2000): "interactivity has gradually become a metonym for information retrieval rather than dialogue" (p. 36). 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 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,[12] 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 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 (the 'gift' aspect is further discussed in Frisk & Yoshida, 2005 and Yoshida, 2006). 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,

[12] 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.

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 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.

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 (2002) 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" (p. 204). 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 music-making" (Evan Parker, as cited in Bailey, 1992, p. 81). 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: "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 [...]" (Cited in Bailey, 1992, p. 81).[13] 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" (Lewis, 1996, p. 108). 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. (Lewis, 1996, p. 117)

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.

[13] It should be pointed out that I make no comparison between *etherSound* as music and the music of Cecil Taylor.

1.4 End note

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 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 participant, especially were you to work with it on several occasions. 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 develop the participant control aspect of the interface without loosing the collaborative focus.

	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 1.2: 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 1.3: Influence of vowels on four consecutive voices of Instrument B.

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(Frisk & Yoshida, 2005; Yoshida, 2006)

Chapter 2

New communications technology in the context of interactive sound art: An empirical analysis

Authors: *Henrik Frisk & Miya Yoshida*

Abstract

In this article we discuss the notion of 'interaction' and 'participation' and 'the public' in artistic work, specifically within the context of the exhibition The Invisible Landscapes (curated by Miya Yoshida, Malmö Konstmuseum, 2003) and etherSound (created by Henrik Frisk), a sound installation displayed in that exhibition. In this work the audience is invited to participate in the creation of new sound events by sending text messages from their mobile phones. Thus, our discussion is focused on the space and the mode of participation opened up by new communication technology. Based on our experiences of that project, we introduce and explain what we believe are relations of creative production and a different kind of creativity that may emerge from active interaction. We also attempt to describe what we believe an implementation of active public participation can lead to.

We are combining two modes of thinking in this article - one is inspired by discourse of the cultural theories and the other is the reflection upon our experience of the event. The latter is by definition rather subject-centered and expansive based on individual observation. We examine and analyze the phenomenon of 'participation' whilst playing *etherSound* as a process of creative production, and seek to reflect upon the power of the co-operative practice and its relation to participation and creativity.

2.1 Introduction

The 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' (Bourriaud, 2002) 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 (DiMaggio & Useem, 1978; Bourdieu, 1979). 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' (Bourriaud, 2002), 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 to annihilate excess energy (Bataille, 1989). 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.

2.2 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 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' (Rudi, 2003). 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' (Ulyate & Bianciardi, 2002).

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' (Rudi, 2003). 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 (i.e. (Barbosa, 2003; Jordà, 1999; Duckworth, 1999)). 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

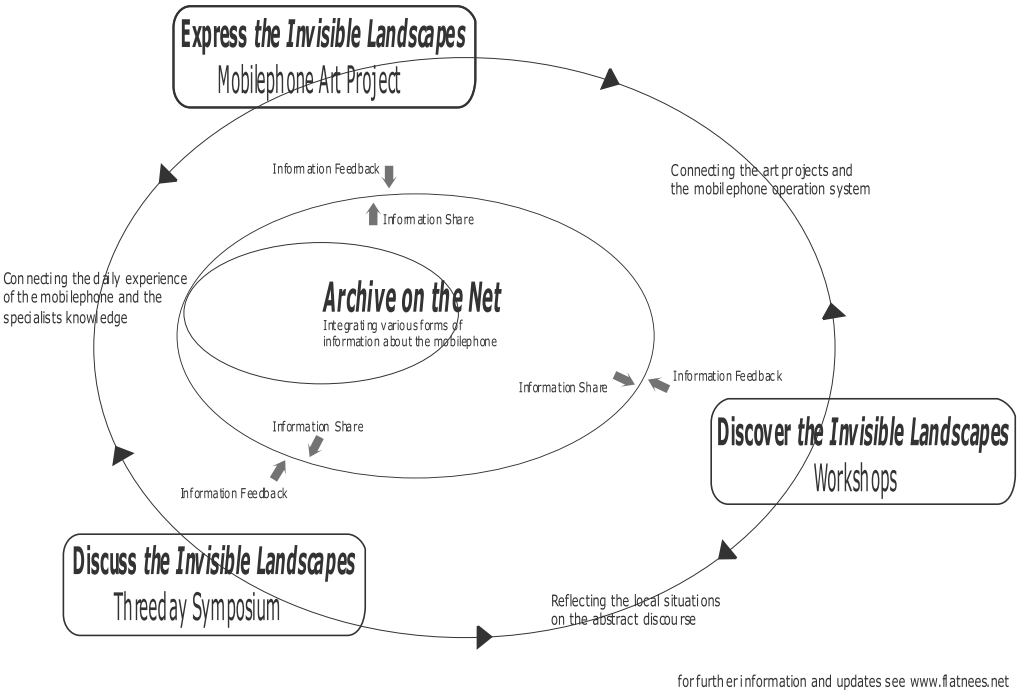

Figure 2.1: Map of events for the project *The Invisible Landscapes*.

understand and appreciate any discipline [...] is by "doing" and being part of' (Jordà, 2002). 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.

2.3 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 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 (J2SE 1.4.2, 2004; J2EE 1.4.1, 2004)) and the sound synthesis software (Max/MSP (Zicarelli, 2001) running a Csound orchestra (Boulanger, 2000)). 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 (Freeman et al., 2004). Although this last option was considered, such a solution would need a technical and finacial framework that was beyond our scope.

2.4 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' (Taylor & Harper, 2003) (see also (Mauss, 1990)). 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 and they are described here borrowing terms from Curtis Roads table of temporal hierarchies in music (Roads,

2001) (page 3): (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" (Barbosa, 2003) or the infinite musical form but it is the effect the indeterminate form has on the *understanding* and *interpretation*[1] 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 steals every experience and sell it back to us, but only symbolically'[2] (Martz, 1994), 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 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

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

[2] Martz uses the term 'the specatacle' with a reference to what Guy Debord and the situationists called 'the society of the spectacle' (Debord, 1967) which includes commodities, art-as-commodity, the mass media and the entertainment industry.

is indeed well suited as an interface for interactive art work where the creativity of the participant is the object.

2.5 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 (Jacob, 1995). 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. (Kiesler & Lee, 1992)

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 (Benjamin, 1968) 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' (DiMaggio & Useem, 1978). 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. (Benjamin, 1968)(chapter 1)

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 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

Figure 2.2: The space at Malmö Konstmuseum where *etherSound* was first realized.

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.

2.6 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.

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 (Taylor & Harper, 2003) 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. (Taylor & Harper, 2003) (p. 292)

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.

2.7 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[3] is testimony of the difficulty to achieve this and of the importance of context. Musical performance is surrounded by old and heavy traditions which

[3] *Elektrisk Helg*, arranged by Ars Nova, held in Malmö, Sweden in April 2004

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 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.(Garnett, 2001)

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 (Ascott, 1990).

2.8 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 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.

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(Frisk & Östersjö, 2006b)

Chapter 3

Negotiating the Musical Work: An empirical study on the inter-relation between composition, interpretation and performance

Authors: *Henrik Frisk & Stefan Östersjö*

3.1 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' (Wishart, 1985). 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.

3.2 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 constructive 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 3.1).

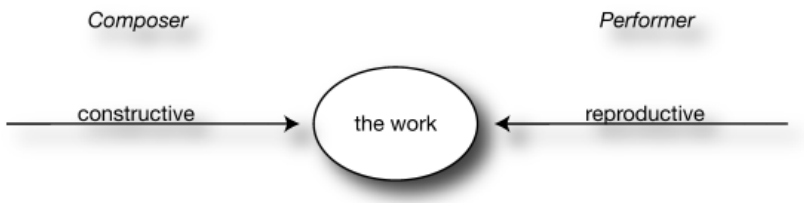

Figure 3.1: Within the Western art music tradition the score is commonly regarded as the primary source of information.

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 (Ricœur, 1991). 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. (Ricœur, 1991, p. 109-10)

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.

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.

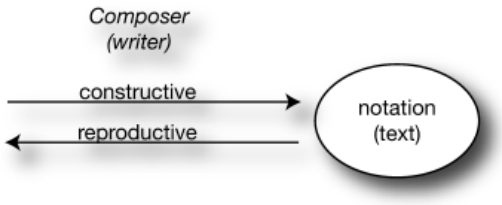

Figure 3.2: In the light of Ricœur we arrive at a modified scheme involving construction as well as interpretation in the composer's creative process.

Another aspect of the composer's practice is highlighted by Horacio Vaggione (Vaggione, 2001). 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. (Vaggione, 2001)

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'.[1]

[1] One important source for the notion of 'thinking through practice' is the thinking of Art historian and curator Sarat Maharaj. His

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.

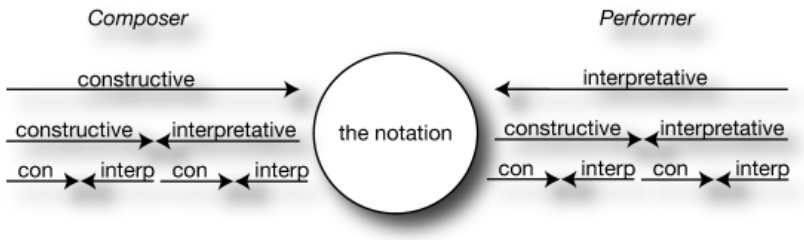

Figure 3.3: Our schematic model of the interaction between constructive and interpretative phases in performance and composition.

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 [...]" (Adorno, 1981, p. 144). 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' (Paddison, 1991). 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 guides the understanding of sentences. In the case of the narrative, these codes are

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 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*.

> 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. (Ricœur, 1991, p. 130)

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. (Meyer, 1973, p. 29)

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. (Stecker, 2003, p. 82)

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

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 (Levinson, 1993, 38-9). 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. (Levinson, 1993, p. 38-9)

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. (Stecker, 2003, p. 80)

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 part of it - a successful performance is an embodiment of the work[2]:

> 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.(Gadamer, 1960)

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.

3.3 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 (Nattiez, 1989, p. 30). 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" (Molino, 1990, p. 126-7). 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". (Eco, 1971, p. 61-6)

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 might try to approach this symbolic system in relation to a common context, or subculture created by the

[2]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.

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.

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." (Molino, 1990) 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 (Nattiez, 1990, p. 34). Molino argues for a three level symbolic analysis; "the poietic, the esthesic and the 'neutral' analysis of the object" (Molino, 1990). 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. (Nattiez, 1990, p. 92)

Leaving the problematic concept of the neutral level aside[3], a rudimentary definition of the two terms 'poietic' and 'esthesic' from a musicological point of view indicates that an analysis of the (external) poietics

[3] It has been extensively debated elsewhere, see footnote 8 of (Nattiez, 1989, p. 35) for a list of references

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 (Nattiez, 1990, p. 140-3). 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.
>
> (Nattiez, 1990, p. 15)

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. (Nattiez, 1990, p. 12-3)

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 (*ibid*, p. 72). 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 3.2, 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.

As we suggested in section 3.2, 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" (Nattiez, 1990, p. 92)), 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.

3.4 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. (Barthes, 1971)

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[4]:

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 3.3. 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. 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.

[4] For an in depth description of the empirical studies performed see (Frisk & Östersjö, 2006a).

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 (Eco, 1971, p. 154-5). 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 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.

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(Bullock & Frisk, 2007)

Chapter 4

libIntegra: a system for software-independent multimedia module description and storage

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Abstract

In this paper we describe a means of storing information about audio and message processing modules, which is not software specific. This information includes a module description, module instance data, and module implementation data. A novel XML file format and database schema are proposed, and we show how a newly developed library (libIntegra) can be used as a link between persistent storage on a networked server, and an existing software environment for audio. The library provides methods for instantiating and connecting modules in a given piece of software, and addressing them using Open Sound Control (OSC) messaging.

4.1 The Integra project

libIntegra is part of the Integra project, a 3-year project led by UCE Birmingham Conservatoire in the UK and part financed by Culture 2000.[1] The Integra library is being developed as a foundation for the software development aspect of the project.

4.2 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 a numeric addition, or a complex task like emulating a specific synthesiser. In this section, we will outline how Integra modules and module collections are constructed.

[1] `http://www.integralive.org`

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

Table 4.1: Integra Oscillator interface definition

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 does not 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 4.1.

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. 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 4.4).

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 automatically generated OSC address space. The OSC address space for a Sinus module is shown in table 4.2. The 'Sinus' class inherits the 'Oscillator' class interface, which in turn inherits the 'Module' class interface, so the attributes of these inherited classes must be reflected in the Sinus module's namespace. To keep addresses short, class names are omitted from the namespace unless there is a name clash.

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,

OSC address	Purpose
/<modulename>/freq <value>	Set the value of the 'freq' attribute
/<modulename>/phase <value>	Set the value of the 'phase' attribute
/<modulename>/active <value>	Set whether or not the module is active

Table 4.2: Integra Sinus module namespace

an implementation protocol must be devised for each software target. This protocol must then supported by the target-specific libIntegra bridge (see figure 4.1).

Integra currently provides implementation protocols for Max/MSP and Pure Data along with a growing selection of example module implementations and implementation templates. An eventual aim of Integra is to provide a protocol for constructing module implementations in a range of different software, and to develop a LADSPA/DSSI[2] host that wraps plugins in an Integra-compliant manner.

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. This data is stored in the Integra database in the module's instance table. However only one saved state can be associated with each module instance. If the user wishes to record state changes over time, then a separate 'Player' module must be used to store this data.

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.

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 numbers, each module has a globally unique symbolic name (e.g. 'sinus1'), and an implicitly determined, globally unique numeric identifier (UID). The Integra library can be used to address any module port using either its symbolic name and attribute name

[2] http://dssi.sourceforge.net/

(e.g. '/sinus1/freq'), or using a combination of its 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.

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. It is important to note that for audio connections, the software hosting the modules must support the required routings. This is because the library doesn't currently process audio-rate data.

4.3 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.

Rather than keeping all data needed to store an Integra collection in a single file we make use of the XML Linking language (XLink[3]) to link in relevant resources. This makes for more efficient parsing and helps to keep file sizes small.

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 4.2). 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>
   <className>Sinus</className>
   <classParent ...
        xlink:href="Oscillator.xml">
        Oscillator
   </classParent>
    ...
```

[3] http://www.w3.org/TR/xlink/

```
 </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. The module definition is specific to the notion of *modules* as defined in section 4.2.

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 a specific attribute or for the module itself. The link points to a file included in the local archive of module descriptions.

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'.

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 (pointing to definitions of individual addresses) in the module definition file pointed to by the locator. Finally, it also holds references to performance data files.

Serialization layer

To facilitate the conversion between flat XML files conforming to the IXD specification, and a memory-resident representation of the data, a serialization library component has been developed (see 4.4). The serialization layer is the link between the database and the local file system (see figure 4.1).

The serialization component provides functions for loading, saving and modifying XML, and is used by the instance host (see 4.4), the database (see 4.4) and/or any other application interfacing with the library. For example, on the database server, the serialization layer is made available to the python-based web interface via a SWIG-generated interface.

The IXD format is specified and documented in several XML Schemas.[4] The XML Schema for the module definition files is closely correlated to the database schema and they share the same versioning system. Any file conforming to the file format can be validated against a specific schema version and conditional actions may be performed on them as appropriate.

Finally, we are also working on an Integra specific XSL Transformation[5] specification for automatic generation of XHTML and/or PDF documentation of a given module or collection of modules. In practice this

[4] http://www.w3.org/XML/Schema
[5] http://www.w3.org/TR/xslt

means that once the user has created his or her own Integra collection for a project and uploaded it to the database, a documentation file for this collection is automatically generated.

4.4 (Integra)tion via the library

libIntegra 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. The library is hosted on Sourceforge.net[6] where source code and API documentation can be accessed.

Data persistence

For persistent storage of module data and other data relating to musical works we have designed and configured an on-line database. The only way in which users may add new, or edit existing module definitions is via a web-based interface to this database. The database makes use of the libIntegra serialization component to generate XML files on-the-fly, and these files are bundled into a gzipped archive to be downloaded and stored locally for potential offline use. Any program linked to libIntegra can then use the same XML handling functions to de-serialise the data, and form an in-memory representation of it.

Instance host

As well as a serialization component the library provides an instance host, which is responsible for keeping a record of each module's run-time state. This includes the values that any of its ports have, and any connections that are made between modules. The instance host acts as an OSC server (using the liblo library,[7]) and operations can be performed on modules by sending OSC messages to it. The instance host supports a condensed OSC syntax for loading, removing, connecting, disconnecting and addressing modules. For example two module ports can be connected with the following message:

```
/connect <module id> <port id>
         <module id> <port id>
```

Module instances can either communicate with each other through the instance host using OSC, or using an environment-specific messaging system. When messages pass through the Instance host, various operations can be performed on the data that passes through. These operations include type checking, range checking, unit conversion and type conversion. All of these can be validated against the module definition held in memory.

Library/target bridge

In order to instantiate modules in a target environment and to communicate directly with these modules, a target-specific 'bridge' is required. The 'bridge' is a dynamically loaded, binary shared object hosted 'inside'

[6] http://www.sourceforge.net/projects/integralive
[7] http://liblo.sourceforge.net/

the instance host. Its purpose is to facilitate bi-directional communication between the instance host and a given target module host (see 4.4). The library provides a very simple API that each target-specific bridge must conform to. The instance host has no knowledge of the software being used to host module instances so the bridge acts like a translator receiving function calls, and performing the relevant target-specific actions. These actions include instantiating modules, removing them and connecting them. Most OSC commands supported by the Instance host have a corresponding function in the bridge.

It is the bridge's software-specific communication mechanism that determines the protocol used to construct module implementations. It is possible, although not necessarily desirable to have several bridges for a given target, each of which elicits a different approach to module construction. This might be useful for compatibility with existing modularisation efforts, such as the Jamoma project or Faust's auto-generated PD abstractions.

Module host

The module host is any software that hosts Integra modules: it is not part of libIntegra. Typically, a module host will be dynamically linked to libIntegra at compile time. At run time the module host can make direct calls to functions in the instance host and also make use of the Instance host OSC interface. Typically the OSC interface is used for communication with modules or hosts that are running in a different program or operating system process. Communication from the Instance host to the module host and modules is always achieved through the 'bridge'.

It is also possible for the module host to be a standalone application that doesn't link to libIntegra. In this case the bridge will usually use a network-based protocol such as OSC to communicate with the module host. A Unix pipe or socket is another possibility for this type of setup.

Inter-library communication

An arbitrary number of libIntegra instances may be running on the same computer or on any number of networked computers. Each libIntegra instance can be running in a new instance of a common module host, or a completely different module host. A single computer setup is shown in Figure 4.1.

When multiple libIntegra instances are used, only one (the master), can make use of the serialization layer to load and save Integra module instance data and collections. This is to prevent several versions of the same collection being opened by different library instances, and becoming unsynchronised. If the user or developer knows that the serialization layer will not be required, the library can be compiled without it.

The Instance host contains mechanisms for inter-library communication and auto-discovery. This is mostly achieved through OSC messaging, and facilitates the loading of Integra collections across several module hosts, with transparent state saving.

4.5 Conclusion

We have outlined a robust, cross-platform, software-independent means of storing and loading module data. In addition we have discussed the facilities that the Integra library provides for loading, saving, instantiating

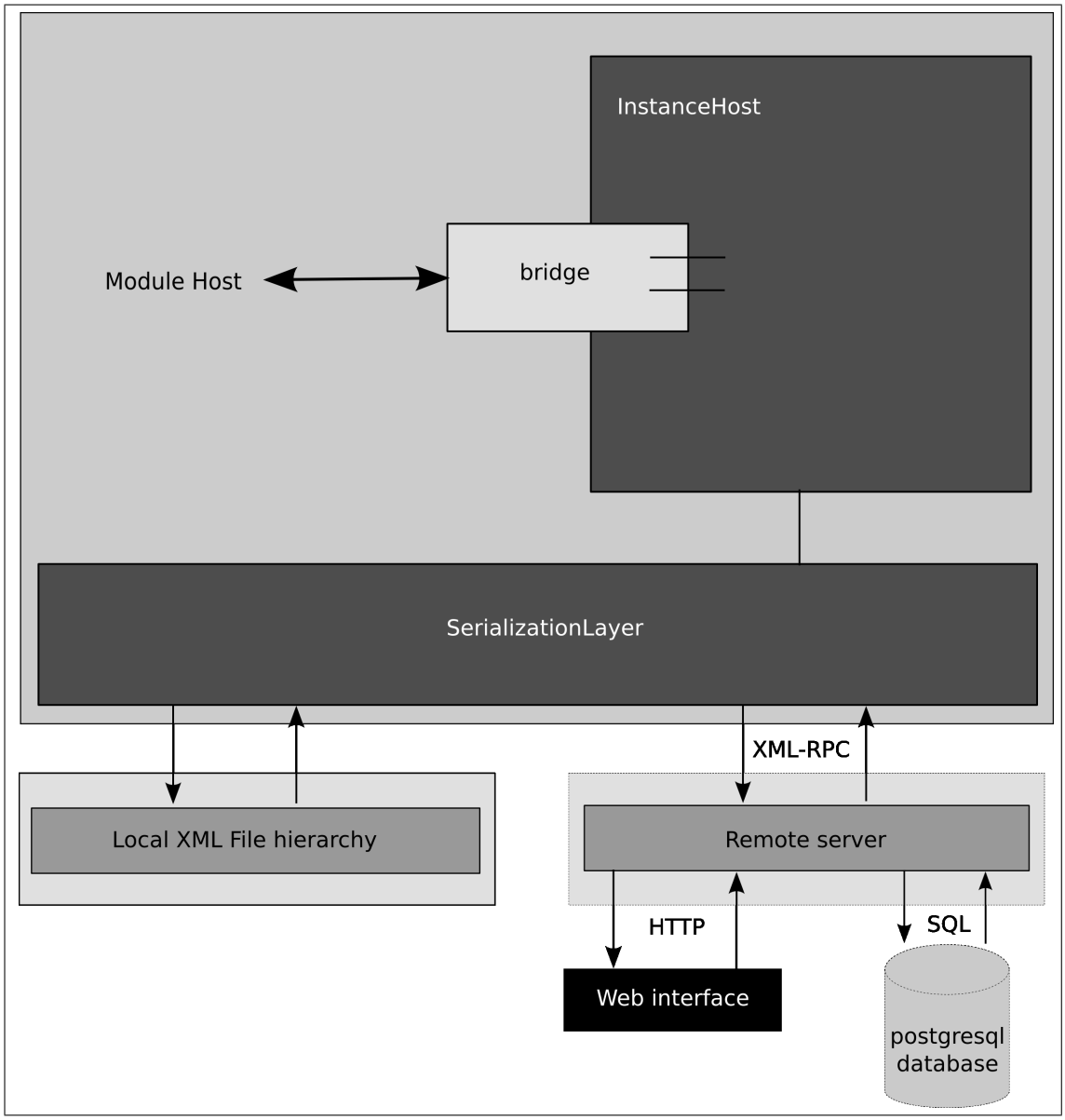

Figure 4.1: A model of the parts constituting libIntegra and how the library interfaces with other parts of the system.

and managing modules and collections of modules. 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 mechanism for the sustainability of the musical works it is used to create. libIntegra should ultimately provide a foundation for this.

Appendix A

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
```

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