ADDRESSING THE NETWORK: PERFORMATIVE STRATEGIES FOR PLAYING APART

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ABSTRACT

This paper describes a recent network music performance (NMP) study that was carried out at the Sonic Arts Research Centre in Belfast in March 2007. We refer to this study as the "Apart Project". This study is unique in that a wide variety of novel network scenarios were tested. A vast database of movie and sound files has been created as a result of this work. For this study, three professional musicians, a pianist, a saxophonist and a percussionist, were placed in three separate studios at the Sonic Arts Research Centre (SARC) and were asked to perform two pieces under different conditions. These conditions simulate geographically displaced network performance through, for example, the introduction of differing latencies. One of the scenarios, in which computer-generated graphics (Avatars) were introduced for testing the performer interactions, will be described in more detail. This paper provides an insight into the cultural implications of the network as a site for performance. It also describes the various set-ups of the "Apart Project", the use of graphics for performers' communication and highlights some important musical issues inherent to network music environments.

1. INTRODUCTION

In the age of technological omnipotence, digital connectivity and apparently unlimited possibilities, being 'networked' has become a fashionable state, being in the 'network' a favored place of existence.

However, the idea of a 'network' has existed for a long time; the etymology of the word attesting to this. The 'network' can be traced back to at least the 1560's, where one finds the network posited as "net-like arrangement of threads, wires, etc" [19]. In the 1840's the word tended to refer to "any complex, interlocking system", often used in reference to transportation channels such as rivers, railways, and canals [19]. Roughly sixty years ago, the network came to signify the interconnection of groups of people, and in the early 90's, the nowadays frequently used socio-political term of the "network society" was coined by the Dutch author Jan van Dijk in his 'De Netwerkmaatschappij' (1991, translation: "The Network Society") [28]. Five years later Manuel Castells referred to this term in the first part of his trilogy "The Information Age" [4].

Castells examined the ways in which a network society reconfigures itself; the ways in which it can constantly change. At the end of the 1970's, the extension of digital networks was understood as a way to revive democracy, as a way to facilitate communication which is free from class and ethnicity; a way to forming a "global" village, as Marshall McLuhan had termed it in 1962. [20]; [11] ,p1]

The 'network' took on extended meaning in Deleuze and Guattari's (D&G) "A Thousand Plateaus" [13], where they entangled the network with the metaphor of the rhizome. Coyne convincingly argues that a rhizomatic system should not be seen as the same as the network system: networks suggest circulation, repeating and looping, and indeed Coyne suggests the loop as the basic unit of the network [11], p12+17] The loop reveals interdependence, it not only recalls Nietzsche's emphasis of repetition, of the "eternal return" as the defining element of human beings, but also, the loop counters any arboreal, tree-like or hierarchical ideas [13], p5]. Networks flow and consist of interconnected entities; however, as Coyne points out [10], we too easily conceive of this technology as an idealized way of connectivity, of the ability to revitalize democracy, of a unity of all things, of a new holism, of things being able to flow without disruption. Networks may seduce us into thinking that we have access to the infinite, whereas in fact the network functions more in the manner of D&G's notion of the "surface", where nothing exists above nor underneath. A surface, according to D&G is always one against which other surfaces may resist. It is indeed Deleuze's rhizome metaphor and its alignment with the notion of fragmentation and disconnection that counters these idealizing ways of thinking about the network, what Coyne refer to as the "inflated authority of the network" [11], p.10]. D&G very much argue against seeing networks as a globalizing way of explaining everything.

Not only writers but also artists have come to understand the network as being in the company of such metaphors as 'the disturbant', 'the irritant', 'a machine running amok', 'subversion', or interruptions of flows or breaks, what D&G title *coupures*, [12], p36].

Much of the recent work of performing musically in a network has addressed such notions of the fragmented or the asynchronous. [One could argue that the notion of communicating/working *over* a network, has gradually transformed into the notion being *in* the network. This means that there is a move from humans looking *at* the network as a sort of onlooker, towards seeing themselves as involved entities *within* the network that shape and indeed constitute the network itself. The network now is

the place, a space for being, a locus for dwelling. This is attested by performance environments, such as Second Life [29], which not only acts as a platform for communication, but establishes itself as places to be inhabited. Having said this, there also exists, even more recently, a trend towards technological escapism, a wish for a return to non-technological practices and research topics, a turn towards being "connected a little less", as Shaviro calls it [26]; p5]. These kinds of practices emphasize body-centered works, site-specificity, 'liveness', as well as audience interaction (see the research topics of groupings such as the Centre for Contemporary and Digital Performance [30]).

A general consensus seems to have appeared at the recent Two Thousand + SEVEN symposium on networked performance environments [31], in which musicians/digital artists/performers emphasized the wish to embrace what some computer programmers consider 'problematic', 'disturbing', or 'irritating'. Thus, artists are turning towards these inherent idiosyncrasies of the network, such as 'loops', 'latencies' and 'disruptions', and are developing strategies for addressing what can be considered crucial characteristics of the network as a medium.

In the last few years some works already have explored these kinds of a-synchronicities inherent in all current network technologies. For example, Chris Chafe's site-specific sound installation "Ping" made audible the delay existing when data of networked computers was transferred between different sites [5]. In 2005, the duo l a u t performed a work entitled "A-Synk", a piece for percussion, saxophone, live-electronics and internet audio chat client that explores the improvisational content between two groups of musicians in two different locations (Belfast, UK and Lisbon, Portugal). The performance is informed by the inherent behavior and misbehavior of the group's low bandwidth audio chat link. In this way, the music's development is shaped by the limitations of bandwidth, unpredictable delays and interruptions, which are inherent in such technology, where the live-electronic's role is "that of an extrapolation of the types of down-sampling, filtering, delays and interruptions presented by the audio link itself while the instrumental parts are based on close response to (delayed) events created by each of the performers" [24].

2. BACKGROUND

The "Apart Project" builds on a year-long journey of networked music performances that have been carried out at SARC. Theses performances started in 2005 and consisted of various ensemble formations: a traditional Irish Jam Session (with CCRMA, Stanford/US, SARC and the University of Washington); a two-site Christmas concert in 2005, as well as a three-site Christmas concert in 2006, with the participation of CCRMA, Stanford/US and UEA Norwich, UK.

From having carried out these performances and after carefully examining a vast variety of other networked performances over the last years, we felt the need to address specific musical issues in a field in which technological complexity shifts considerations of musicianship and remote performativity into second place. The "Apart Project" thus wanted to carefully examine these complex cues and intricate ways in a network environment. We are particularly interested in how the network might suggest strategies for ensemble playing which might differ from those commonly used on the traditional stage.

We will first turn to a more detailed technical description of the "Apart Project" before analyzing one of the scenarios in more detail.

3. PLAYING APART – A STUDY

3.1. Design

The "Apart Project" builds on previous work that addresses the analysis of musical interaction under network conditions. Elaine Chew's study on user-centered experiments in network performance is a purely quantitative study, which examines the effects of latency on musical ensemble accuracy. The study proposes two ways of measuring that accuracy by analyzing the 'segmental tempo difference and the segmental tempo ratio from a baseline performance' [8]. The study is based on the analysis of MIDI data collected from two geographically displaced pianists playing in a variety of latency conditions. Another study, led by Chris Chafe [6] looked at a latency threshold beyond which music is getting too difficult to play over the network. The study is commonly known as the "Clapping Experiment" as musicians were placed in separate rooms and asked to clap a rhythm together.

Our particular study was developed with view to promoting situated types of musicianship rather than to formalise the thresholds of playability in a network performance situation. The study's aim is to better understand conditions for performance that are created, facilitated and suggested by geographically displaced network performance environments. The musicians involved (Pedro Rebelo - Piano, Franziska Schroeder - Saxophone and Steve Davis - Drums) have worked together in the context of free improvised music [16]. They chose two pieces to perform under a number of different scenarios that emulate a variety of network conditions and introduce approaches to audio monitoring and video exchange. The selected repertoire (Ornette Coleman's "Bird Food" and Pedro Rebelo's "One Note") provides two contrasting musical situations with Coleman's work requiring a high degree of synchronisation and Rebelo's piece requiring an acute type of listening for the realisation of instructions through improvisation. The work "Bird Food" requires precise unison playing for the tune and also includes a short free improvised section. This piece thus allowed the performers to test issues of timing, precision as well as free playing.

The piece "One Note" is based on a simple improvisational idea described through verbal

instructions (see Fig.1). It was conceived as a structured improvisation developed with the inherent aspects of the network in mind. In "One Note" the saxophonist and the pianist musically follow each other towards a unison sound: one of the players chooses a note which in the course of the musical play should be matched by the other player. Both players then explore this unison sound through beatings, trills, bisbigliandos etc. The player who reaches the note last then moves onto a different note, which becomes matched by the former player and so on. The percussionist provides a musical counterpoint in that his most active playing occurs during the time when the other players are exploring the unison sound.

It was important for this study that such a free piece was included since intense listening is demanded while at the same time the performers are not required to follow a score nor to be in metric synchronicity. This parameter was important since a score-based work, such as "Bird Food" requires the performers' eyes to be focused on the material in front and thus makes it harder, and at times impossible, to focus on any other visuals that may be introduced.

The "Apart Project" was divided into 5 types of scenarios, which allowed us to explore the following conditions: 1. Latency 2. Use of standard video conferencing technologies 3. Enhanced audio monitoring 4. Avatars and 5 Traditional shared stage performance setting. The scenarios are briefly described in section 3.2.

ONE NOTE
Pedro Rebelo 2007

One player begins a long note on a chosen pitch
Other players slowly join in and approach the same pitch
Once the whole ensemble is playing the same pitch as long sustained notes....
Player begin to deviating from the pitch slightly
Players gradually stop, leaving one player sustaining the resulting pitch
Repeat from line 2

Figure 1. One Note Score

3.2. Scenarios

The first scenario consisted of both stable latency (150ms) and variable latency (random variations between 90ms and 185ms). These values were deliberately high in order to challenge synchronicity and to complement studies which define the ensemble performance threshold (EPT) as the maximum delay with which musicians can play in synchronization.

The second scenario makes use of standard video conferencing technologies, in this case three-way iChat [1], to add video feedback to performance both with and without latency. The latency introduced by iChat had no impact on the audio latency simulated for the study as these were independent systems.

The third scenario introduces the notion of enhanced audio monitoring in which monitoring in each of the studios is mixed according to pre-assigned virtual positions for each instrument and panned according. This strategy attempts to position each musician within a stereo image, which is akin to that on a shared traditional stage. Another kind of enhanced monitoring consisted of the sharing of ancillary cues such as breathing. This was achieved by installing a headset microphone on each player with the signal being monitored by the other performers through an ear-piece. These types of monitoring were tested both with and without latency.

The fourth scenario introduces the idea of 'avatars' (described in more detail in section 5). These graphics assume the presence of each musician in the remote locations as displayed on a computer screen. The avatars attempt to capture gesture information from each player which is then modulated by audio-based analysis to render graphic entities which can potentially introduce a parallel type of interaction and serve as a way of displaying remote presence for an audience as discussed below.

Figure 2. Video still from the three studios

4. TECHNICAL INFRASTRUCTURE

The infrastructure behind the study has been developed to provide two kinds of modalities: a 'comfortable' playing situation for geographically displaced musicians and a high quality audio and video capture of each musicians for later analysis and archiving. The 'comfortable' playing situation for each musician was achieved by using high-quality open monitoring of remote signals, rather than using wired components such as headphones. The high quality video capture was achieved by placing a camera in each room capturing the gestures and interactions between musicians[1].

The setup included three studios in the SARC building. Each studio had a performer in it sending audio and video signal to a fourth studio that was used as a control room. The control room was redistributing the signals back to the three studios after some processing. This setup could also have easily been achieved on a Wide Area Network (WAN), providing sufficient bandwidth availability. Recent tests and performances between SARC and the CCRMA at Stanford University

[1] The technical infrastructure used in the simulation is now being used as a reference framework for real-world network performances such *disparate bodies* [14], a three-site performance at NIME 2007 and a two site piano duo between Pedro Rebelo (SARC) and Mark Applebaum (CCRMA).

have allowed the bi-directional communication of non-compressed high quality audio between the two sites with up to 16 channels as well as compressed video.

4.1. Audio Set-up

4.1.1. Performance spaces

Each of the three performance spaces was sending two channels of high quality audio to the control room using high-quality microphones. A third auxiliary channel of audio was used in certain scenarios to send ancillary cues, which were used in some cases as an independent stream of audio for potential enhancement of ensemble playing. The capture of these ancillary cues was achieved through the use of headset microphones. A fourth channel of audio was used to send the independent signals to audio analysis devices located in the control room. The audio channel used for audio analysis was either decoupled at the control room level or captured directly as a third microphone in the performance space depending on the type of instrument used. The audio signal originating from each studio was routed through the control room to a pair of loudspeakers in each studio. This allowed for the processing of signals prior to sending them through depending on the scenarios chosen.

In each studio the speakers were strategically placed in relation to the microphones to minimize bleedthrough and feedback loops. The speakers were located as far as possible from the microphones at a minimum of two meters. The polar patterns chosen on the microphones were as directional as possible in order to capture the sound from the instrument rather than the speakers.

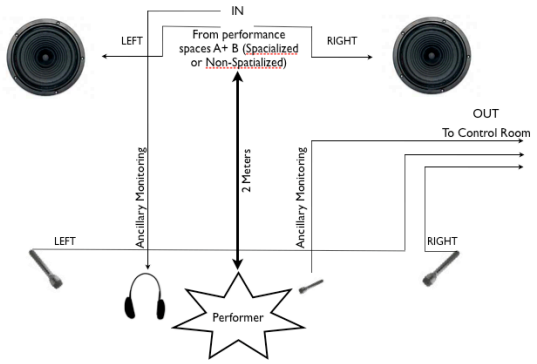

Figure 3. Studio connectivity and routing

4.1.2. Control Room

The control room was the hub of the overall system. It is important to specify that in the case of a real-world network performance the control room can be part of one of the performance spaces. For practical reason and due to the analytic nature of the study, a separate studio was used for the control room.

In order to provide documentation for later analysis, each individual audio stream was recorded into a Digidesign ProTools [15] digital audio workstation (DAW). Every stream was captured at 44.1KhZ with a 24 bit resolution.

Using a DAW to capture the incoming audio streams was convenient as it allowed for the artificial inclusion of fixed and variable latency by using simple delay lines with delays corresponding to those found on standard IP WAN networks. In the case of this study a fixed delay of 125ms was applied on independent incoming signals from each performance space to simulate stable but distant network conditions. In some other scenarios, a variable delay ranging randomly from 90ms to 185ms was inserted to simulate ”worse case” network conditions with large amounts of jitter, which has a negative impact on latency stability.

The control room was also broadcasting a SMPTE signal to the cameras in the three studios so that the individual non-synchronous video streams could be matched to the audio streams at a later time. The control room further included a set of computer dedicated to audio analysis of each signal. The audio analysis was used in certain cases to modulate a set of avatars rendered in individual computers in the studios. A talkback microphone was installed in the control room in order to facilitate communication with the musicians.

A video link was used in some of the scenarios to link the studios. The video was not transmitted to the control room and was broadcast bi-directionally in a peer-to-peer fashion. For full quality video the Apple iChat AV [1] application was used. iChat provides a surprisingly low level of latency and high video quality despite the usage of video compression codecs. iChat was chosen for the simulation because it is currently the most commonly used application in real world NMPs.

For other scenarios, a MAX/MSP/Jitter patch capturing the gestures of musicians was used and sent via the network to the other performance spaces. In return, each performer was able to view rendered gestures from the two other performers on a screen. This method is very bandwidth efficient, as the video stream is not sent over the network directly but rather an openGL Jitter matrix which is rendered locally at each of the studios.

The patch was, in certain cases, also responding to the audio analysis system located in the control room. The process was very light in terms of bandwidth utilisation as the machine located in the performance spaces were only reading a set of messages originating from the audio analysis system rather than from the actual audio data.

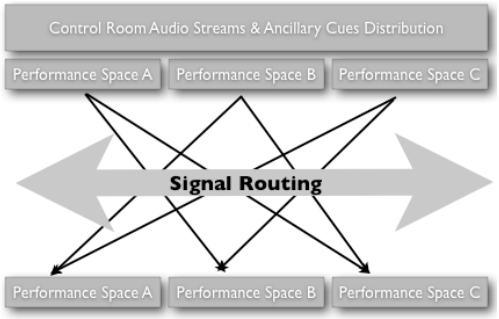

Figure 4 Control room connectivity

4.2. Real-time Audio Analysis

A stand-alone software application, developed specifically for the study, analyzed signals from performers in real-time, generating data, which consisted of estimations of onset detection density, spectral shift, and inharmonicity. Using our adaptation of OSCpack (originally by [2]) data was continuously sent as OSC packets to the avatar servers at 30 fps. Although the application of Constant Q Transform [3] would probably be preferred, signal analysis was achieved by using only overlapped Fast Fourier Transforms (FFT) in different window lengths (as discussed in [17]). For a general comparison of Time-Frequency analysis methods, refer to [22]. Using Blackman spectral window, power of partials were calculated using coherence gain factor of narrowband signals (piano and saxophone) and of broadband signals (drums) [21]. FFTs were zero-padded in order to obtain a finer "frequency resolution" (higher number of DFT bins) of the discrete-time Fourier transform.

Changes in power and frequency were weighted according to the following adaptive, heuristic method: threshold of power-raise detection laid between +3dB and +6dB in the same DFT bin, and in relation to a previous frame (at 30 fps); onset detection happened when power ceased increasing over that threshold; changes in frequency were interpreted as local maxima of the interpolations of the weighted bins; detection of changes in frequency depended on power detection, and bin bandwidth; at the beginning of each musical work, thresholds were reset to a minimum, near the background noise level; maxima and minima were adapted during rehearsal time, but never at recording time. Onset detection density was defined as an average of 2 seconds window of detections of partials. Spectral shifts were defined as power weighted bins' bandwidth converted into (musical) cents in absolute values; and inharmonicity was understood as instantaneous, fractional relations of partials (in the case of narrowband signals).

5. NETWORK PERFORMANCE AVATARS

Although the study of visual cues in music performance is beyond the scope of this paper, the design of avatars used in the "Apart Project" is informed by notions of gesture anticipation, movement and to a certain extent of duration as applicable to particular music materials. These notions are derived from a wider performative context that can be described as free improvisation, in which gesture and bodily presence can be reflected directly into musical decision making, and in particular from the performance practice of this particular trio.

Traditional avatars as used in gaming and online environments such as Second Life are designed to reflect character and identity through representational graphics which, more or less, tend to emulate characteristics of the human body while acquiring artifacts and idiosyncrasies of virtual environments (such as walking through walls, flying, constant reconfiguration and costumization). The avatars used for the "Apart Project" are not self contained characters as viewed by a virtual camera arranged in Cartesian environments which 3D graphic technologies rely on to communicate scale, distance, movement and relationship between objects/bodies. Rather, they are designed as close-up and detailed yet abstract renditions of performance gesture. The all encompassing god-like camera view which situates one and one's avatar in a 3D environment is here replaced by an almost haptic condition which plays on the local and embodied rather than on the observed or the perspectival. The "Apart Project" avatars emerge from the understanding that one's notion of one's own body is never optically complete; it is made of fragments, glances, suppositions, sometimes fantasies. There is an element of the incomplete, the fragmented and an inherent engagement in low-bandwidth, which is potentially better suited for the kind of interactions at play in ensemble performance. As will be argued in the next section frontal full body video capture does not provide an ideal visual connection to performers in remote locations and the generic nature of conventional video conference imagery seems too impose too much emphasis on the notion of being there whilst impeding the exploration of being apart. The "Apart Project" avatars attempt to address both a level of interaction between performers as well as a type of visualization that can be used to render the telematic body in a way that invites exploration from an audience (i.e. interpretation and ambiguity rather than the simulation of "being there").

The avatars consist of OpenGL 3D graphics that render simple 3D primitives (cubes, cylinders, planes…) modulated by multimodal inputs. In our case the input consisted of video cameras positioned according to the axis of highest degree of movement for each instrument (bell – mouthpiece for the saxophone, allowing for the capturing of finger movement as well as relative movement of the instrument in relation to the body of the performer, along the piano keyboard allowing for the capturing of finger movements from the low to the high register, and over the drum kit allowing for the capturing of action through the space defined by the configuration of drums and cymbals). Under some of the scenarios describe here the avatars were further modulated by the real-time audio analysis described in 4.2 which provided an opportunity to visualize aspects of musical material, such as density, shifts in spectrum and inharmonicity.

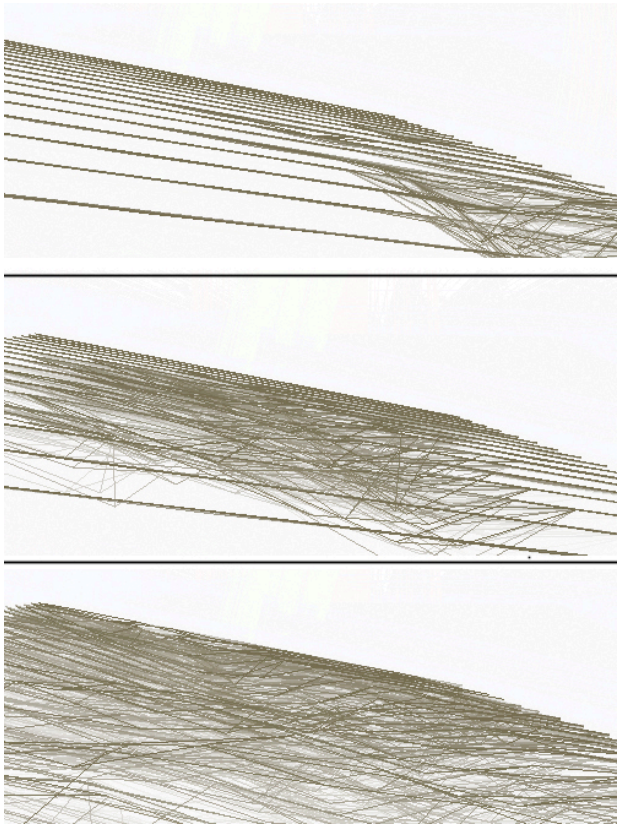

Figure 5: Stills from Avatars showing increasing density in piano playing

6. ANALYSIS AND RESULTS

Although the "Apart Project" yielded many different results, some of which we are still in the process of detailing, we are concentrating here on the analysis of the "avatar"/video scenarios.

In order to derive meaningful results from the "Apart Project", we used "Content Analysis" methodologies that are often employed in the social sciences. Content Analysis (also referred to as textual analysis) is defined as "the study of recorded human communications, such as books, web sites, paintings and laws", where the core questions are thought to be "Who says what, to whom, why, to what extent and with what effect?" [9]. According to Weber, content analysis is a research method that infers from texts or transcripts of human communication [27].

In the "Apart Project", the musicians were asked to fill in a questionnaire after the performance of each piece under each scenario. [1] The questionnaire consisted of 6 continuums that intend to address different aspects of ensemble performance. For each of these continuums performers were asked to mark what best describes the performance of each piece under each scenario as follows:

- Sense of Space (Shared - Dispersed)
- Anticipation (Critical - Flexible)
- Timing (Micro - Macro)
- Relationship between Piece and Performance Scenario (Aligned - Disjunct)
- Ensemble Sound: Intonation, Balance, Dynamics etc. (Homophony - Heterophony)
- Performance Participation (Immersed - Disengaged)

In addition to these continuums, each questionnaire included a narrative section for comparing two different scenarios. Observation was carried out by two other musicians who were asked to fill in the same questionnaire but had no connection to the project. Also, an anthropologist was asked to observe the study after being provided with only minimal information on how the performance would unfold. All answers were transcribed afterwards and evaluated according to the principles of content analysis methodologies. In this way we were able to ensure that spontaneous feedback of the performers pertaining to each individual network scenario was recorded and could be analyzed objectively after the study.

Further, the "Apart Project" was recorded in both multi-channel audio and video, where one camera per location was used for documentation and analysis. Afterwards the footage from each site was composited into a widescreen format movie (Figure 2 shows a still from this movie format), which allowed for the visual comparison of the performances at each site while being able to hear a mix of the audio recording. After consulting the video footage in combination with the answers the performers had provided on the questionnaire, it became clear that the network avatars were not particularly useful for playing a score-based work, such as "Birdfood". This is evidently due to the fact that the musicians needed to concentrate on the score and were not able to look sideways at a computer screen at the same time.

For a work, such as "One Note" it was noted that the performers constantly looked at the 3D avatars. Judging by the answers that the content analysis provided, it can be concluded that the performers enjoyed looking at the avatars as a means for visual interaction and potentially for enhancing sonic interaction; though, in the first instance, improvising musicians *listen* to each before *looking* at each other.

When consulting the recorded movie files one can see that as soon as an improvised section starts, the performers turn towards the screens on which the audio modulated avatars were displayed. The pianist for example exclusively looked at the computer screen towards the avatar, using the computer-generated graphics as a way to interact with the remote others.

It was interesting to note that when the performers were playing with an iChat video link providing the performers with a full frontal body perspective of the two remote players, there were remarkably few glances towards the screen in both pieces. One reason for this may be that there was a delay of the video in relation to the audio. A further reason for this, and this is possibly more interesting, is the fact that when playing in the same physical space performers also would not stare at each other. The ways in which performers communicate

is far more subtle; they do not require a full representational presence of another player in order to make music with each other. Performers tend to glance, often simply out of the corner of their eye, at the other players while intently listening to the performance at each present moment. In the same way that you cannot stare the network "straight in the eye",… that "[y]ou can never directly confront the network […], [f]or it is always somewhere else from wherever you may be looking", [26], p5], performers never stare at other players. There are always musical cues that are not 'see-able'. Playing music is always a multi-tasking experience.

This implies that performers tend to have a much more abstract reading of another human being's presence. An aspect of this abstraction of bodily presence was attempted in the "Apart Project" in the form of the 3D avatars. These graphics, by being one level removed from a full bodily representation, ask for interpretation in the same way that a performer's glance during a performance does.

It is conceivable that the full representation of the performers' presence as provided by the iChat link can be aligned with above-mentioned idea that we tend to have this idealized view of connectivity when working in a network. The network seduces us into this new holism where our expectation is one of unlimited, undisrupted access to the infinite. However, as argued above, the network functions much more in the manner of D&G's notion of the "surface", one against which other surfaces are able to resist. The network is not a graspable thing; it is something you can never directly confront, as Shaviro argues [26], p5. In this line of thinking, the avatars in the "Apart project" provide the performers with such space of possible resistance. They allow a space for interpretation, and ultimately render one a little less connected; they give you what Shaviro calls "a kind of ironically distanced, self-conscious asceticism" [26], p5].

The real concern for performers' interaction in remote spaces may lie in the way that bodies interact in general, in the intricate ways of musician's communication processes.

7. FUTURE WORK AND CONCLUSION

The audio-visual documentation from the "Apart Project" will further be analyzed and catalogued so it can serve as a shared resource for addressing both results and the design of studies of this sort. This study has provided insights into possible explorations of network musicianship and network performance practice, which will inform an upcoming composition by Pedro Rebelo for six instrumentalists distributed in three different sites. Further work on the avatars includes the design of dynamic projection systems in which reflections from the rendered graphics can be fragmented and projected outside the frame of a formal screen.

The design of the "Apart Project" as a study for better understanding the conditions of ensemble musicianship under a variety of simulated network conditions represented a step towards the study of new performance environments. Network Music Performance suggests a new type of musicianship which can only be understood and developed through the creation of conditions that are not about emulating the traditional stage, but rather take advantage of the network itself as a medium for performance. These conditions are certainly modulated and informed by technologies but it seems that the current challenges for NMPs are of musical and performative nature. This study demonstrated an inherent capacity for musicians to address specific performance contexts when repertoire and musical materials are specifically created for those contexts.

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