Proximity, intimacy & network design in Internet streaming media related distributed improvisation

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Introduction

There has been a recent profusion of streaming media based musical activities occurring in or around Internet related network environments[1]. Musicians and researchers are exploring the potential of both Internet and next generation Internet (Internet 2) platforms for musical performance[2]. A number of such explorations are designed to connect and/ or host multiple points of improvised musical performance activities in a modularly distributed organisation. Positioning improvised musical performance in relationship to the Internet proposes a number of issues, which include geo-spatial configuration and temporal acoustic ecology. Formulating a common environment for musical activity around this infrastructure exposes inherent relationships between spatial and acoustic concerns in network design and notions of proximity and intimacy within musical performance practices. This paper will compare issues found in Internet based streaming media network design with frameworks for distributed improvised musical performance. Three specific improvised performances, which were conducted in such network spaces, are used as models to discuss relationships between relative sites of musical performers (or sites of musical activity) and aesthetic considerations of intimacy within distributed musical improvisation. The paper concludes with a proposition that proximity relationships in this type of musical performance can be

[1] See http://transition.turbulence.org/blog/ for examples of the current diversity of networked practices
[2] See *Soundwire* project at the Stanford University Center for Computer Research in Music and Acoustics for further details of Internet 2 projects http://ccrma.stanford.edu/groups/soundwire/

more acutely aesthetically described in terms of intimacy between performers, expressed through the distribution of media streams.

Internet related streaming media network design issues in distributed musical improvisation.

Amongst other factors, the recent acceleration in the availability of network bandwidth and the increasingly efficient operation of Internet software and hardware has provided fertile ground for contemporary artistic exploration. While established considerations of physical and metaphorical networks within art practice continue to underpin the development of an abundance of artistic network strategies, specific modes of enquiry brought about by the operational structure of the Internet and the distribution of streaming media present radically different artistic and collaborative potential. Within the plethora of special or unique networks[3] and point-to-point connections that have been developed for specific artistic creations, the decentralised infrastructure in which the Internet has developed provides within itself an intriguing model for musical improvisation. Potentially limitless numbers of computers connected over a seemingly anarchic collection of networks, using a variety of interchanges, regulations and transport methods to facilitate global media transfer can readily be shaped, by artists, into a mechanism for distributed musical collaboration. A musical configuration of an Internet related network space presents computers as tools for digitisation, sound synthesis and transformation; compression, packet loss and jitter approximating a sort of acoustic envelope and latency, a method of shaping temporal periodic structure. The flexibility of such a network, with performers positioned to send, receive or host media and to select the time and method of participation within a performance reflects to an extent, the ad-hoc nature of the Internet itself.

Internet streaming media technologies propose two methods of data distribution. Uni-cast media streams are directed from one point to another using the Internet as a transport mechanism and are useful for relaying a media stream between two computers in a closed or metaphorically private fashion. Multi-cast media streams are generally made publicly available and offer potential for multiple connections to a single media

[3] The *Marcel* network is one example http://www.mmmarcel.org/intro.htm

server. Anyone with a computer and Internet connection of relevant capacity can access a multi-cast media stream from its point of distribution. Multi-cast streaming media technologies are inherently public. This binary division between media distribution models provides a useful framework for acknowledging public and private models of improviser activities. It is possible to use Internet streaming media technologies to appropriate a range of media production relationships within established models of group based improvised musical practice[4].

The current technological state of Internet streaming media and the real-time streaming protocol[5] demand the compression of data into formats that can readily be transferred between computers over the Internet. Such compression formats, which are commonly based within guidelines developed by the MPEG[6] organisation, have resulted in a range of open source and proprietary frameworks including various QuickTime[7], Windows Media[8], Real Media[9] & Unix based streaming servers and media players. MP3[10] and MPEG4[11] have become common formats for distributing streaming media over the Internet using these frameworks. Applications of digital audio compression usually result in some form of perceptible change in 'sound quality' in comparison to analogue sources. Compression formats used with streaming media applications represent audio signals in far less detail than file formats used in CD and higher quality digital audio production. Packet loss and network jitter, introduced to Internet media streams through inefficient network bottle-necks usually found near routers, firewalls or network exchanges further affect the potential sound quality of distributed media streams. Directions within which media streams are distributed around the Internet and the number of network bottle-necks which are encountered en-route, are two factors which are likely to alter potential sound qualities throughout the duration of distribution. The exact nature of this sound quality is difficult to determine, as many of these network factors are temporally varied between the different connected users (performers, audiences) during a performance. The unregulated manner in which Internet audio

[4] See the *webjam* and *decentred* | *distributed improvisation* projects for specific examples http://www.n0media.net
[5] See http://www.ietf.org/rfc/rfc2326.txt
[6] See the Moving Picture Experts Group http://www.chiariglione.org/mpeg/ for further details
[7] See http://www.apple.com/quicktime/
[8] See http://www.microsoft.com/windows/windowsmedia/default.mspx
[9] See http://www.real.com
[10] See the Moving Picture Experts Group http://www.chiariglione.org/mpeg/ for further details
[11] Ibid.

streams are amplified and diffused into both performer and audience based physical performance and listening spaces further complicates musical resolutions of media production within Internet based distributed improvisation.

In the three examples described in the next section of this paper, open source multi-cast streaming media technologies were used to facilitate Internet related improvised musical performances. Two of the examples demonstrate relationships between solo performers and webcast media streams. In both of these performances multi-cast media streams were webcast from streaming servers sited in the same physical space as the performers. These streams were received and diffused back into the improvisation in the physical performance space as audio feedback or delay mechanisms using the same network connection for transmission and reception. The third example demonstrates relationships between geo-spatially remote located performers engaged in a group-based improvisation. During this improvisation, individual audio performances were webcast from several discrete multi-cast streaming servers. The resulting media streams were received and combined in one physical space and then webcast in a composite form to online performers and audiences. Individual inter-site webcasts used in each of the three improvisations were made available to all of the participating performers.

Proximity based relationships in three examples of Internet streaming media related distributed musical improvisation.

Amy Cunningham *Green Blues* decentred | distributed improvisation
Norwich Gallery & Online, Thursday 25th March 2004[12]

> Amy Cunningham is an artist who often deals directly with her own singing voice, particularly with how the voice relates to and responds to different media and contexts that are contrary to the conventions of vocal performance. Her approach to the specificity of each medium or architectural space determines the sound she sets for her voice as well as the

[12] See the *decentred* | *distributed improvisation* project for audio-video documentation http://www.n0media.net

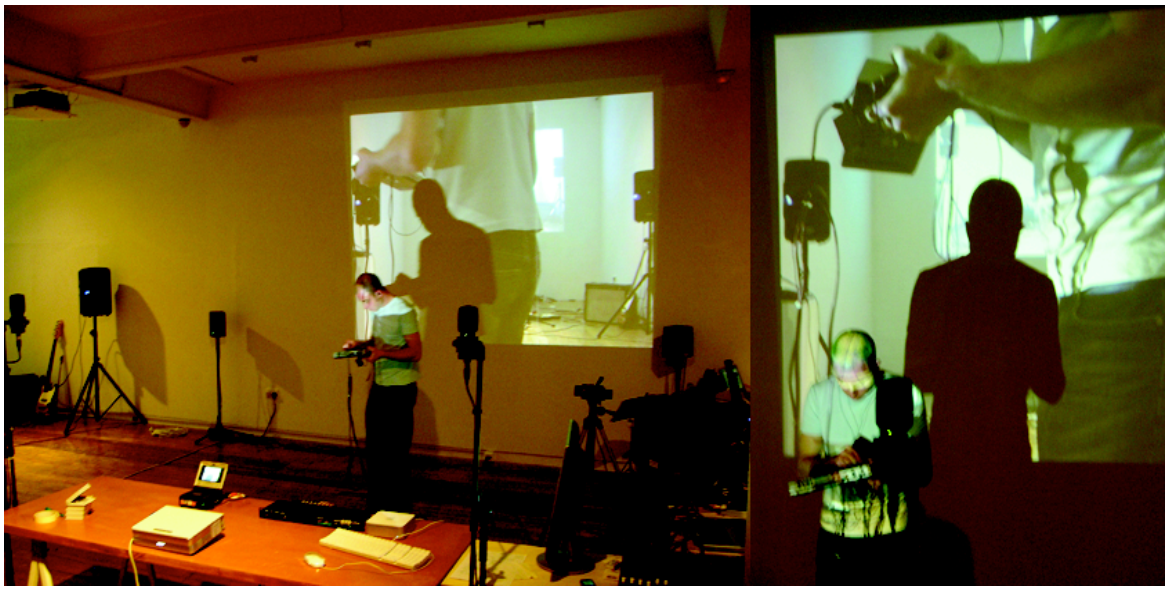
choreography of the performance or installation. Cunningham is concerned with the various states of vocal mediation, ranging from the acoustic delay found in a bathroom, amphitheatre or garden, to the electronic mediation existing in 'video opera' or the live webcast. (Cunningham, 2004)

Images of Amy Cunningham during the performance

Green Blues (Cunningham, Simmons & Wells 2004 *decentred | distributed improvisation* Norwich Gallery & Online) was a two-hour solo performance within which the artist developed a sculptural montage from cut-out pieces of coloured paper whilst singing words following simple melodies to herself. A video camera and microphone were positioned close to the performance from which media streams were webcast. The webcast audio stream was received back into the performance space using a secondary computer and mixed with the audio feed picked up by the microphone. Both audio signals were mixed and diffused into the performance space, forming the catalyst for a delay based audio-visual performance. Both outgoing (send) and incoming (receive) audio signals were distributed using the same Internet access network, router and firewall. Throughout the performance the Internet delayed audio stream was variably audible between delay cycles of approximately 0.5 to 12 seconds. As the performance developed, longer periodic cycles emerged, which could be attributed to the accrued re-introduction of compressed audio streams into the performance space becoming degraded to a point at which, ultimately they became perceptibly silent. Internet delay mechanisms were affected by the amount of other network traffic using the same network access infrastructure as the performer. The number of online viewers accessing the webcast media stream created a direct relationship between the amount of traffic being directed through the Internet access framework and the latency and sound quality of the media stream. Greater numbers of people watching the stream resulted with increased packet loss, longer time lags and ultimately, a reduction in sound quality. As

such, potential relationships between performer and audio material were developed within an inherently indeterminate framework, established within the relationship between the performer and the Internet related performance space. While proximity between performer and voice was physically consistent, proximity relationships between performer and Internet delayed audio material were structurally variable over the course of the performance. The resulting sound structures were ambient, with vocal material being layered alongside webcast material in cyclical periods.

Tom Simmons *Untitled (mp3-compressed feedback)* WebJam 9
Norwich Gallery & Online, Saturday 29th October 2005[13]



Images of Tom Simmons during the performance

Untitled (mp3-compressed feedback) (Simmons 2005 *WebJam 09* Norwich Gallery & Online) was a twenty-minute solo performance within which the artist used four software oscillators as catalysts to develop an improvisation based around Internet regulated feedback. The four oscillators were used for an initial period during which they were webcast, received back into the performance space and independently routed to four loudspeakers. After this initial period the oscillators were turned off. The performer used a pair of head-worn binaural microphones to collect audio information from the

[13] See the *webjam* project for audio-video documentation http://www.n0media.net

diffused audio streams by walking around the performance space and positioning his head in relationship to one or more selected loudspeakers. The stereo audio streams collected using the binaural microphones were then webcast and subjected to the same diffusion mechanism. As the performance developed the feedback generated between the binaural microphones and the received/ diffused webcast became slowly degraded until the webcast audio faded out all together. At this point the performance ended. During the performance spatial relationships were formed between the variable latency's of each webcast audio stream and the loudspeakers from which the streams were collected for further webcasting. In this framework it became possible to modulate received webcast streams being diffused in one or more loudspeakers with those collected from other loudspeakers. A pair of room microphones were used to webcast a documentary stream to a streaming server, which was located on a different network backbone, from where it was multi-cast to an online audience. Two network backbones were used (an 8MB DIA from NTL and a 155MB Janet link) in order to spread Internet traffic between Internet access networks in order to minimise the impact of Internet traffic generated by an online audience on the performance itself. As a result, the individual latency of the media streams was reliably consistent at around 4 seconds per delay cycle.

Braxton Ensemble, Nick Melia, Tom Simmons, Anne Wellmer & Liam Wells *Group Improvisation* decentred | distributed improvisation
Wesleyan University Concert Room & Recording Studio, Norwich Gallery & Online, Monday 22nd March 2004[14]

Images of Anthony Braxton, Nick Melia, Tom Simmons, Anne Wellmer & Liam Wells during the performance

[14] See the *decentred | distributed improvisation* project for audio-video documentation http://www.n0media.net

During this two-hour distributed improvisation performers based in the concert room and recording studio at Wesleyan University, Connecticut USA were connected with performers based in the Norwich Gallery UK, using Internet related streaming media technologies. A variety of instruments and sound sources were used including the numerous instruments of the Braxton Ensemble, Nick Melia's modified guitar, digital sound processing provided by Anne Wellmer's laptop based distortion and Liam Wells & Tom Simmons' video driven sound synthesis. Two Internet access networks were used; a high bandwidth connection at Wesleyan University and a 10MB LES circuit connected to the Janet network in Norwich. Various microphones were used to produce a mix of the Braxton Ensemble, which was either webcast without intervention or processed by Anne Wellmer prior to being webcast using the Wesleyan Internet connection. A second mix was produced from Nick Melia and Tom Simmons' audio outputs in the Norwich Gallery and webcast using the Norwich connection. A third sound mix, consisting of the combined webcasts from Wesleyan and Norwich, was uni-cast using the Norwich connection and relayed to another server where it was multi-cast to an online audience. Online audiences were also directed to the media stream being webcast from Wesleyan University. As performers became familiar with the immediate effects of the distributed infrastructure and began to recognise the geo-spatially distributed sources of the webcast sounds, a framework began to develop for exploring relationships between sound sources in a musical fashion. Compression, latency, packet loss and jitter frequently disrupted webcast media streams, resulting in intermittent and unpredictable media presence and quality. Latency varied between 1 and 12 seconds at the Norwich site. During the two-hour period, the performers experimented with a number of structures, some clearly layered in relationship to the original sound sources and pertaining to a sense of horizontal improvised strategy, others more intricately mixed, combining processed material in more complex sound structures.

Problems with proximity in Internet streaming media related distributed improvisation

A number of proximity related issues have arisen as a result of the performances described above, some of which are generic to conducting distributed improvisation in a

framework that includes the Internet, others which are possibly more specific to the composition of individual performances. Prior knowledge of the geo-spatial distances between performers involved in an Internet based distributed improvisation informs certain parameters of the framework within which the performance develops. The complication or removal of the physical closeness between performers and audiences, which is regularly associated with improvised musical practices, complicates immediate musical and social interaction. The use of body language, gesture, touch and immediate relationship with acoustics and diffusion are required to be re-thought within this framework. Inherent factors, which are specific to the Internet, bring about another set of dominant themes. The relative connection between performers and audiences is always subject to a degree of latency, audio (data) compression and network degradation. Proximity between performers becomes normalised within a variable (four second or greater) time difference, which to an extent, pushes considerations of physical geo-spatial distance to a secondary position. Proximity between performers, or between a solo performer and the material they are generating or manipulating within a distributed improvisation becomes more readily assessable in relationship to the distribution of media streams themselves. In a distributed improvisation, performers are more likely to feel a proximate relationship between each other when a mutual understanding of the principals that have been developed during the opening section of a performance become established in media terms. Proximity relationships and intimate transactions between performers become developed through the exchange of streaming media. The common thread between performers and audiences becomes the distribution of the audio-visual materials produced during a performance within these media streams. It is within this framework that both performers and audience begin to interpret an improvised performance, which becomes constructed from the reception of such audio-visual material. From this point, it becomes plausible to offer a proposition that ‘intimacy with media’ could be a useful method for understanding aesthetic decision making in Internet related distributed improvisation.