VISUALIZATION OF NETWORK BASED MULTI-USER INSTRUMENTS

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1. ABSTRACT

This paper presents several strategies for visualization of networked based multi-user instruments that are geographically dispersed. These strategies are formulated through practice based research as conducted by the authors' intercontinental band Glitch Lich. Anecdotal evidence of each strategies' strengths and weaknesses are covered, as well as example pieces that highlight these methods and how they may be applied. The paper concludes with a consideration for possible future work, and how this information may be used by other network musicians.

2. INTRODUCTION

This paper presents strategies for the aesthetic visual presentation of a subset of network music performance scenarios in which multiple performers are controlling the same virtual instrument via networking technologies while being geographically displaced. These network based multi-user instruments (or NMI's) provide interesting capabilities for performers, such as the ability to perform with others remotely, the ability to form dynamic hierarchical musical relationships, and the ability to create real-time music that is the realization of a close-knit collaborative improvisation [10]. Just as many other electronic music instruments, NMI's may suffer issues stemming from their lack of a physical corporeality, which may impede their sense of liveness. However NMI's provide ample opportunity to overcome this in the form of visual presentation of the various network and musical interactions that occur during performance to produce a virtual representation of the instrument. This virtual representation may serve to inform the audience of the technical workings of the instrument, as well as to provide a further aestheticization of the musical soundscape being produced and to increase the feeling of liveness in the performance.

A series of specific strategies for visual presentation that have been pursued in practice based research by the authors as part of the intercontinental laptop quarter Glitch Lich will be covered, as well as anecdotal impressions and results of these strategies impact on performance. These strategies include: basic graphical user interface (GUI's) presentation, alternative aestheticized GUI's for audience presentation, visualization of individual musical parameters, purpose built 3D graphical interfaces, textual communications, and performer embodiment.

These techniques and approaches are informed by many other's works such as *Faust Music Online*, a network music program created Sergi Jordà which facilitates collaboration utilizing unique interfaces[6]. Another important example is *nebula.m81*; a highly aestheticized web browser developed by Netochka Nezvanova that turned internet surfing into a data driven visual experience[8]. Network music sites such as Max Neuhaus' Audicle, John Bischoff's Aperture, and Jason Freeman's Graph Theory utilize web technologies to create engaging experiences[7, 1, 5]. Ge Wang and Perry Cook's experiments with visualization using in the *Audicle* sound engine shows the scope of possibility for using visuals in a local are networked ensemble [9].

The previously mentioned strategies are by no means considered exhaustive, nor are they necessarily exclusive of each other, as these individual strategies may easily be combined. Instead this paper is presented as an overview of several attempts at addressing the issue of visual embodiment and the lessons that the ensemble feels it has learned about the advantages, disadvantages, and idiosyncratic aspects of several methods for addressing visual presentation that the ensemble has attempted. As well, a series of possible alternative strategies that may be explored in future work will be given.

3. VISUALIZATION TECHNIQUES

When Glitch Lich, comprised of Cole Ingraham, Chad McKinney, Curtis McKinney, and Ben O'Brien, began creating network based musical pieces there was initially no attempts at creating a visual presence for the ensemble [4]. This lack of corporeality, a general concern for all electronic music performances, was especially poignant in Glitch Lich's case as the ensemble performed geographically dispersed. Thus from the audience stand point all they understood of the performance was that a person was onstage and theoretically several people were being piped in from some far off land. After gigging for a time with exclusively sound based pieces, feedback from the audience informed the ensemble that the lack of a physical embodiment and visual presentation of the music left some of the audience members disinterested or confused. Glitch Lich's first attempts to address this were extremely simple: the ensemble began to project its performance GUI's to the audience.

3.1. GUI Presentation

Visual presentation of performance GUI's, while basic, does give some advantages over presenting nothing at all. Firstly, the presentation of a GUI gives the audience a sense of the performance gestures being utilized by the ensemble to achieve certain musical effects. While seeing sliders and knobs associated with certain aspects of the music is not the most visually tantalizing, at least the audience can more clearly understand the connections between performer actions and sonic results, giving some sense of an elusive embodiment of liveness. Furthermore, presenting a performance GUI can let the audience in on the structural aspects of a piece. In Glitch Lich, each individual piece attempts to use the network in a novel way. By presenting the GUI to the audience they come to a closer understanding of how the piece is constructed and the rules for musical engagement. This draws the audience in and gives more meaning to the individual sounds that they hear. While not the most artistic of options, the audience feedback the ensemble received at this time was that the presentation of the performance GUIs helped the audience gain a deeper understanding of the music, and thus appreciate it more.

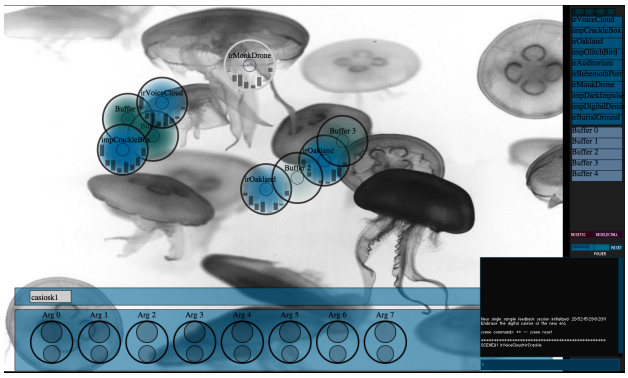

Figure 1. GUI for Neuromedusae I and II.

An example of this methodology in action is the group's pieces *Neuromedusae I* and *Neuromedusae II*, two pieces that utilize audio feedback loops and recursive modulation synthesis techniques extensively. For these pieces a GUI system entitled *Medusa* was created in Java/Processing to facilitate control of the individual feedback synthesis engines. These feedback synths were symbolically represented as ellipses placed on a two-dimensional plane. These ellipses could be moved about and their proximity to other ellipses would cause the associated feedback synths to couple and recursively influence each other. Presenting this GUI to the audience gave them a very clear understanding of how four individuals are manipulating this interface and creating music together, despite the vast distance and lack of physical corporeality of the ensemble.

However, there are some clear disadvantages to using this strategy. The primary problem with this method is that associating your music with simple knobs, sliders, and ellipses is not the most aesthetically pleasing, and may actually be detrimental to the emotional and aesthetic impact that you would like for your piece to have. It is for this reason that some ensemble such as The Hub refrain from visuals almost completely [2]. As well, this strategy requires that the piece you wish to present has some kind of GUI to present in the first place. Some groups, such as live coders, may present a textual interfaces as code based alternative to this approach.

3.2. Aestheticized GUI's

An alternative approach to the strategy of projecting performance GUI's for audience presentation is the technique of actually creating a separate aestheticized version of the performance GUI made specifically for audience consumption. In this case there would actually be two different versions of the same GUI, one utilized by the performers to control the music, and another created to give the audience a visual embodiment of the music. This aestheticized GUI attempts to address the shortcomings of the previous method by attempting to present the same general elements of the performance GUI that are useful for the audience to see, while stripping those things that are unnecessary, and attempting to visually present everything in a way that is appropriate to the music and gives some sense of visual beauty.

This is in some ways the best of both worlds as the audience can still have a deeper understanding of the fundamental structures of a piece and the performance gestures being utilized, while still being presented with something that was created specifically for visual consumption. Audience feedback for this method has been positive, with many not realizing that the ensembles was using a separate interface tooled for performance internally. Another significant advantage of this technique is that it makes creating the visual aspects of the piece more obvious and less time consuming, as there is already a road map laid out for how the visuals should be constructed. In Glitch Lich's case this is significant, as each piece can take as long as 6 months or more to construct, and thus cutting down the amount of time required to compose a piece is extremely beneficial.

Figure 2. Screen shot of Yig, the Father of Serpents (Performer GUI).

Figure 3. Aestheticized GUI used for Yig, Father of Serpents.

An example of this method is Glitch Lich's piece *The Curse of Yig*. This piece is a spiritual successor to *Neuromedusae I* and *Neuromedusae II* in that relies on a similar control interface based on manipulating feedback synths represented by ellipses on a two-dimensional plane. However, the foil here is that the piece places a significant emphasis on rhythmic interactions in the ensemble and rhythmic feedback. For this piece a performance GUI was constructed using C++ and the Qt GUI framework, and a separate aestheticized version of the same GUI was constructed in C++ with the Cinder opengl framework for audience presentation. To present a visual interface that was more closely aligned with the aesthetics of the piece, the visuals were constructed so that they produced visual feedback.

Into this recursive visual system is placed a series of visual elements that symbolically reference the feedback synths that reside on the two-dimensional plane in the performance GUI. These elements however are designed to be visually dynamic, as opposed to the static elements they represented in the performance GUI, and are manipulated by the audio signals derived from the synthesis being produced. The oscillations of the sound, and the placement of the different feedback engine have a cascading and visual stimulating effect on the visuals. Furthermore, the interconnections of these feedback synths are highlighted by creating visual symbols that connect interacting ellipses. This symbolically informs the audience that a relation between the two elements is occurring. Several different versions of the GUI have been created to mirror the different musical sections of the piece, more clearly delineating the structure to the audience as the piece is performed, and providing visual variety to the piece.

This method however does suffer from the fact that at least some form of performance GUI must be constructed for this to be viable. As well, this method aesthetically enslaves the visuals to an artistic presentation of GUI elements that were not necessarily constructed or organized with visual presentation in mind.

3.3. Visualization of Individual Musical Parameters

Another approach to visually presenting network based multi-user instruments is through visualization of individual musical parameters in a more abstract fashion. This method has several advantages. As opposed to the previous two strategies, the visuals are not slavishly tied to some GUI system whose construction was not created with visual presentation in mind. This allows for more overall freedom of visual aesthetics. However, by focusing on visualization of musical parameters, you can still deliver a structural understanding of the music to the audience.

Figure 4. Visualization of musical parameters in Simulacra 1

There are many different musical parameters that may be visualized, and the ones you choose to visually embody will significantly depend upon the piece and the musical and performance characteristics you would like to emphasize. Some possible parameters for visualization include various sonic analyses (amplitude, frequency, transient detection, tempo detection, noisiness, etc), tapping into various control information sources (manipulations of control parameters, signal chain ordering, construction processes of algorithmic structures, etc), or the interactions of the ensemble (such as geographic placement, information sharing/stealing, and object ownership). By narrowing down the visuals to embodying specific elements of the performance, the visuals can serve to focus the piece to an even finer point, and deliver a more focused impression of the music to the audience.

An example of this strategy is Glitch Lich's piece *Simulacra 1* (which will be performed at Live Interfaces 2012). *Simulacra 1* attempts to strip down the aspects of network music and network based multi-user instruments to its most basic aspects. Each individual of the ensemble is assigned a single control parameter for which they are responsible. The performers may then manipulate this control element over time by using a custom made network based step sequencer. The ensemble collectively manipulates an algorithmically generated soundscape that is derived out of the combinations of the individual parameters that the members are controlling, thus the music arises as a shared sum of the individual inputs. To visualize this a three-dimensional graphical environment is constructed

that plots the vectors of these parameters as the paths of floating glowing serpentine shapes. Furthermore, a kind of algorithmic terrain over which these shapes floats is generated based on the summation of these parameters. The serpentine shapes are further visually modulated but the amplitude of the various sound sources in the music. While more abstract than previous strategies, the overall graphical presentation and its intended aesthetic impact is more visually focused, while still communicating to the audience fundamental aspects about the construction and performance of the piece.

3.4. Purpose built 3D Graphical Interfaces

Recently Glitch Lich has been exploring the use of 3D interfaces for network music performance. Designing these interfaces has required more work than usual, however future projects will likely take less development time now that the group has become acquainted with many of the difficulties in 3D programming. While their creation is often more difficult, the inclusion of another dimension presents some interesting benefits, but also some challenges. There is much more room in the environment to place information that can often become crowded in a 2D plane. Instead of faking depth using opacity or shading, objects can have more natural relationships in space. On the other hand, because these interfaces are often meant to be projected to an audience, sometimes design choices are made which can sacrifice some legibility or clarity on the part of the performer to allow for a more interesting visual display. For example, the use of lighting and shaders can help create a more dramatic scene, but can also be distracting or make differentiating parts of the interface more difficult at times.

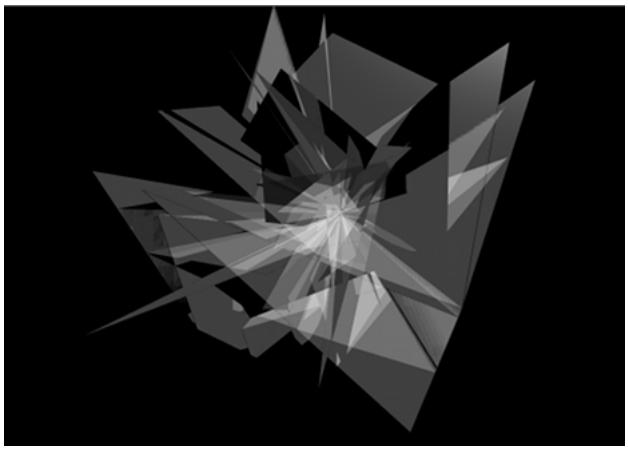

Figure 5. Screen shot of The Blackness From The Stars.

Our initial draw to 3D graphics was to design these kinds of aesthetic interfaces for display during a performance, however it also presents an opportunity to create very different types of control systems. *The Blackness From The Stars* is a new piece for Glitch Lich that utilizes an interface where the performers collaborate to construct and manipulate one giant feedback mesh. The concept was to create a truly massive collection of points in the audio chain in order to explore how the feedback evolves over such an extensive structure. The Performers create and manipulate points in an ever growing polygon mesh. Each point represents a running audio synthesizer and their position in the mesh determines their placement in the feedback chain. The 3 dimensional coordinates are used to modulate delay and filter parameters in real-time. As the shape grows and transforms the audio changes as well, mirroring the graphics. The interface is simple and easy to use while rendering a clear yet aesthetically informed presentation of the performer's actions and how they effect each other and the music.

3.5. Textual Communication and Performer Embodiment

A final consideration is the usage of textual communications in network music visualizations, which speaks to a deeper topic of performer embodiment. While electronic music as a whole may experience issues with audience impressions (or lack thereof) of performance gestures, network music that is geographically dislocated is particularly susceptible to these issues.

In what might be thought of as a default state, each performer using a laptop and/or controller communicating over a network with no visualization, the audience only sees one performer and hears a stream of sound by which they have no mean to identify the source from whom these sounds are being generated. This lack of performer embodiment may be an impediment to some individuals aesthetic enjoyment of the music, as they feel a visceral disconnection between the physical and ethereal (i.e. music over a network) realms. Visuals which embody GUI's or performance parameters go a long ways towards solving these issues, however another more straightforward, and perhaps transparent, way of accomplishing this is through the usage of textual communications.

Often times network music ensembles rely on text based communications to organize a performance. By projecting these communications for the audience to see, the ensemble can give a sense of the background organization of the performers, as well insight into the minds and personalities of the individuals participating in the performance. This gives more weight to each individual musical event, as well as humanizing the electronic soundscape. It may also be a means of communicating with the audience itself, breaking down the fourth wall and disarming the audience from a passive state. This is a technique that has been extensively used by The Hub since performing in the early 80's [2]. In Glitch Lich's experience, this has been a very successful technique, and is something that is consciously worked into every GUI and/or visualization system that the ensemble constructs.

Glitch Lich has also attempted to go beyond this, to give the audience an even deeper impression of performer embodiment. A simple example of this is to use a color coded highlighting system that informs the audience which member is manipulating which element of a performance

GUI. The audience then may associate the turn of a knob, with a filter sweep, with a certain performer, cross referencing this with things that performer has said during performance. These elements build up giving the audience a fuller picture of the music and the musicians. A more extreme example may be used in 3D graphical interfaces. In these environments virtual avatars that represent the individual performers may be constructed. These avatars can give the impression of where a performer is in the virtual space and of the actions that performer is undertaking. It also serves to very clearly delineate each of the performers from each other, reducing confusion from the audience's perspective. For Glitch Lich, this is a new technique that has only recently been adopted for the future piece *Shuggoth*.

4. FUTURE WORK: TOWARDS A NETWORK MUSIC ENGINE

One major consideration for all of these techniques and pieces is the sheer man hours required to construct these systems. Glitch Lich has repeatedly spent considerable time on what may be deemed "boiler plate code" (general code that must be constructed as the basis for a system that is often recreated at the beginning of each new project). In an attempt to increase the efficiency of the ensemble, Glitch Lich will be undertaking the construction of a Network Music Engine, that will be similar to and influenced by video game engines. Portions of this engine are already in place as the ensemble has constructed tools for networking, using OSCthulhu, sound, using SC++, and converged on a single visuals platform, Cinder [3]. Thus, the major work for this engine will be to stitch these elements together, to provide as much of the repeated boiler plate code as possible, and to provide convenience classes and methods that serve to reduce the time it takes to start and finish a network music piece.

5. CONCLUSION

Several techniques for the visual presentation of network based music instruments have been covered, including presentation of performance GUI's, aestheticized GUI's, visualization of individual musical parameters, purpose built 3D graphical interfaces, textual communications, and performer embodiment. Each of these strategies attempts to solve specific problems and produce specific aesthetic goals, though each has its own concerns. There is no perfect solution or one-size-fits-all approach to these issues, which in some ways makes the attempt to address them more a more interesting and creative endeavor. Instead, this paper hopes to give the reader an impression of how certain strategies may be used and their individual idiosyncrasies, as well as to perhaps inspire the reader to attempt their own solutions to these issues, taking into account the lessons presented here.

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