AUKSALAQ, A TELEMATIC OPERA

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ABSTRACT

Auksalaq, the Inupiaq Eskimo word for "melting snow", is a large telematic work performed simultaneously in select venues worldwide. Using distance technology, live music, dance, movement, visual arts and commentary, the work creates a rich counterpoint of media linking great distances. *Auksalaq* integrates artistic expression, scientific information and social/political commentary to present an interactive, multi-dimensional experience that embodies relevant complex cultural and empirical processes. The piece illuminates scientific analysis as well as cultural and political issues surrounding global climate change. Creating the score, libretto, media content and IT software customizations for Auksalaq has been a sustained effort by two co-creators. After conceiving the project and overall structure of the work together, one collaborator penned the music and libretto and the other created the media content and IT production design.

1. INTRODUCTION

Auksalaq is designed for performance across 5 remote sites over the Internet. The opera explores global climate change from a northern geographic and cultural perspective. The narrative incorporates fragmented and conflicting perspectives about the state of climate change as experienced in Alaska and the Arctic. These accounts, portrayed in the form of a scientific commentary and interviews with people of the region, are woven into a story about change in the far north. The music expresses interlocking environmental forces as eco-musical forms, expressing the profound changes in the ice-flows of Arctic waters. The opera is performed over research-grade, high-speed networks such as Internet2, which enable the connection of media-rich spaces to the real world using modern communication systems to create evocative experiences.

The performance of Auksalaq renders an effect of layering each site onto another, with overlapping entries of musical lines and media. Scientific data is computer processed, enabling the artistic realization of the data feeds. While audiences at all sites will be able to observe the entire opera in performance, no site has the same experience. Additionally, interactive elements are built into the performance for observers as much as for performers. Audience members are able to hold discussions with other viewers and performers at the end of the opera, and a virtual wall enables them to post thoughts during the performance from their own computers or personal handheld devices. This allows the performance to continue after it has ended. As a result, audiences become participants in the performance as their interactivity continues to generate discussion and thought.

Auksalaq embraces the ethos that is currently emerging out of the growing canon of telematic works. The aesthetic dynamic of TA is centered on social intelligence processes within online partnerships. This means that performance and computer artists working remotely in realtime together foster a nuanced and sophisticated mode of interaction. As Roy Ascott (1989) wrote: "Telematic culture means, in short, that we do not think, see, or feel in isolation. Creativity is shared, authorship is distributed…enabling one to participate in the production of global vision through networked interaction with other minds…"

Two musical sections of Auksalaq, as well as prepared electronics and media content, were premiered in April, 2010, at the Intermedia Festival held in Indianapolis, Indiana. A concert version of the opera was presented in October 2010 at the Ear to the Earth Festival in New York. Joan LaBarbara served as narrator and singer, and was supported onstage with a pianist, and three chamber ensembles, one online ensemble, and multiple sources of media. During the New York concert, four media narratives were presented. These included a series of interviews with prominent climate scientists and other experts on the far north, video sets of climate change computer modeling and analysis data, video sets of the arctic scenes manipulated in real time, and a new interactive software application called NOMADS, developed by the University of Virginia Interactive Media Research Group for the opera. NOMADS enabled audience engagement with the performance in real-time in the form of text and sound-generation, both of which became part of the performance.

1.1 Musical/dramatic/telematic structure

The computer music and instrumental score were composed specifically for the telematic medium. Optimally the music occurs on five simultaneous remote stages, each with its own audience. Each audience experiences a live event and they will hear events happening in remote locations. In no single location will the audience perceive the full work. In this way the musical spatial architecture underscores an important concept: we are separate from some of the things we affect and that affect us. The local event will be of primary importance to those listeners, and so each musical stage needs to function as foreground music. Like an ecosystem, these musical elements create interacting layers and must fit together to form one

macro-timbre. They are not independent. The musical pieces are thus designed to sound complete independently, and to lock together into a more rich and intricate structure.

1.2 Design of Score for use in Telematic Medium

As discussed above, the telematic medium imposes certain limitations on synchronization and timing for live musical performance. *Auksalaq* is a non-improvised, score-based composition and so macro and micro timing issues must be coordinated carefully between the players in order to stay in synchronization with the score. In addition, as with any telematic musical performance, musicians face the added difficulties of interacting sensitively across a network. These limitations helped define the ensembles for each stage of *Auksalaq*. Tightly coordinated parts, like the five intricate percussion parts of the *Six Ecoacoustic Quintets*, could not be performed accurately in ensemble over the network and so these players were grouped together onto a single stage. Other parts, such as the ensemble music of *Cloudprints* were designed to be distributed across the internet. The synchronization and the margins of interactive coordination are flexible enough to support the temporal fluctuations of telematics. Some of the music is designed to distinguish a single stage, and other music functions as a binding glue between the stages.

1.3 Story of Auksalaq

Tdhe story of Auksalaq unfolds in several parallel streams. The interviews with scientists describe the rapid warming trend and accompanying environmental changes over the past 40 years. The Arctic Ocean region has undergone irreversible change in this time span. One manifestation of this is the dramatic melting of millions of square kilometers of permanent ice. The creators of *Auksalaq* have collaborated with the chief ice scientists in the world to develop this piece, and *Auksalaq* includes interviews with these scientists and visualizations of their data.

In parallel with the recorded interviews, the *Auksalaq* libretto tells the story of a boy who grew up in the Arctic and left his home to live abroad. He returns home decades later after hearing news of the dramatic changes and politicization of his home. The character has changed, yet he still feels a powerful attachment to the land and people of his home. The story describes a common contemporary social relationship to the home-place. It uses the telematic approach to illustrate this paradoxical feeling of closeness and simultaneous disconnectedness. The story is designed to address the subtle emotional effects of climate change. The emotional impact of global environmental change is often underemphasized in the contemporary discourses, which understandably focuses more on the environmental and economic impact of these changes, or on far worse human suffering outcomes.

The fictional story and the scientific data both look at roughly 40 years of change, creating a parallel temporal scope. A third narrative plays out through underwater, sub-ice ecoacoustics. The opera applies the linearity of environmental change across 40-years of ice-extent change in the Arctic Ocean and folds that across the moment-by moment changes underneath the Arctic Ice. In this music, the sound of the ice deformations becomes voiced along with the sounds of the animals living under the ice, and the human interpretation and experience of these phenomena. An ongoing interaction between the audience and the performance allows the listeners to affect major aspects of the piece such as the libretto, sound, lighting and graphic displays. In order to enable this audience interaction across the five stages, the opera uses an innovative software system called NOMADS, created by the Interactive Media Research Group (IMRG) at the University of Virginia.

1.4 NOMADS

The Network-Operational Mobile Applied Digital System (NOMADS) is an independent server-software project developed by Matthew Burtner, David Topper and Steven Kemper of the Interactive Media Research Group (IMRG) at the University of Virginia. NOMADS arose from Burtner's work with multi-agent interactive systems such as the 250-person MICE human-computer Orchestra (Burtner, 2006). In *Auksalaq,* NOMADS allows the audiences in each of the five stages to interact with one another and with aspects of the music and multi-media. The audience uses their own portable computers to communicate with the singers and musicians through NOMADS. Their data input creates the libretto for two of the arias. Audience input creates a part of the music in *Windprints,* and at the beginning of the opera, the audience performs the melting of a glacier, person by person, drop by drop. The audience also controls aspects of the lighting and graphic display on one of the video screens. Throughout the performance the audience can interact with one another through NOMADS and these communications are projected in the hall in real time. The thoughts, communication and reactions of the audience become part of the work's dramaturgy.

2. TECHNICAL ISSUES FOR AUKSALAQ

The challenges common to telematic performance primarily consist of: latency, echo, lighting, staging, coordination, and network control. Network control refers to managing the telecommunications aspects of the performance, and involves working to prevent packet loss, artifacts, and other problems. However, it is important to mention that the overall design of *Auksalaq* was created with these issues in mind. Consequently, these areas not so much *problems* to solve as they are *factors* to be dealt with, allowed for, and even to be instrinsically introduced into the inner workings of the opera. This is because fundamentally, telematic art is an expressive action involving human-computer and human-computer-human interaction, where verbal and graphic narratives, musical concepts, data, and feedback combine with gestures to create a vivid information

environment possessing media-IT dimensions. In order to achieve an optimal performance for public audiences, it is essential to embrace the entire spectrum of telematic charactersitics. To be certain, there is a trade-off between the tried-and-true traditional artistic modes and more recent activities intended for the networked, media-enriched environments. On one hand, tested norms can be relied upon to help ensure artistic success. On the other, distilling new creative processes in media environments illuminates emergent ideas.

2.1 Timing

A good example of how telematic issues were incorporated into the design of *Auksalaq* is the treatment given to the issue of timing and the ever-present latency inherent in telematic work. Therefore, achieving synchronistic accuracy in telematic performances is a matter of combining good musicianship with practical networked realities. For example, performing rapid and rhythmically intricate passages between musicians is an effective musical activity. However, while possible in a telematic work, this is not naturally inherent over networks, where timing is always delayed. In a telematic score, the same passage could be performed over networks, either by keeping the number of performers small or by employing synchronization software such as *Netronome*, developed at the Digital Worlds Institute at the University of Florida, in order to link players together (Deal 2006). However, a more inherent approach would be to perform the passage in one location between musicians, then send it over the network to be mixed or otherwise processed before reaching an audience. This is not to say that one cannot perform rapid musical passages with other online performers. In the production of *Interplay: Loose Minds in a Box*, two musicians successfully performed long, rapid passages in a percussion-electronic violin duet between locations in Alaska and Montana, while being viewed as a performance at SIGGRAPH 2005 in Los Angeles.

In the case of *Auksalaq*, a common-clock scenario was introduced, where all of the performers and media crew logged into a software application authored in Max that could be observed with either a laptop computer or iPhone. Each ensemble and/or soloist possessed a master timing chart detailing to the second their entries and exits of performance. Additionally, texting in CXP chat between sites during the performances was employed as a backup to cue performers into the music. The music was composed in such a fashion that groups and soloists perform precisely with musicians in their physical proximity, but less so with remote players. Between sites, the music is more overlapping in nature. This layering proved to be one of the most compelling aspects of the performance, and it was enhanced by the layering of multiple and simultaneous media events.

2.2 Other Technical Challenges

Audio issues for a large telematic work require a working team with dedicated audio artists at each site. Strategies for video and audio transmission have been in development for the past ten years by researchers. Dr. Brian Shepard of the University of Southern California has developed techniques involving the placement of conventional audio mixers, microphones and speakers in such a way to eliminate echo between two remote sites. Professor Chris Chafe of Stanford University and collaborators Pauline Oliveros of the Rensselaer Polytechnic Institute, Mark Dresser of the University of California San Diego and New York musician Sara Weaver have been using *Jacktrip* in conjunction with the Apple iChatAV teleconferencing software (Weaver, 2009). These developments greatly improve conditions for performance, but there is still much to do. Managing echo between multiple sites remains a challenging issue, as is combining slower video feeds with faster applications like *Jacktri*p. The *Auksala*q has a multi-site configuration, and the creators have worked to insure ample rehearsal and testing in the weeks leading up to the concerts. Currently software used to transmit telematic art was designed as teleconferencing software, meant for conversations between people in remote sites. While it is very good for conversation, there are dramatic gaps in its ability to provide for the needs of online artistry. Further development in the area of audio/video conferencing software is needed.

2.3 Technical Toolkit

Auksalaq calls for a large toolkit of software and hardware, ranging from various video manipulation and telecommunications applications to dedicated video switchers. The primary conduit for connecting five remote sites globally is the *Conference XP* videoconferencing application. ConferenceXP (CXP) is an open source videoconferencing platform designed to address the needs of academic distance learning, multi-institutional instruction and advanced collaboration scenarios. It is intended to be both a tool for end users and a platform for developing solutions for distributed applications. ConferenceXP is a prime application for telematic art because of its multicasting capabilities and also because the audio/video resolution can be scaled to fit the needs of its users. CXP supports advanced capabilities needed for the opera, including high definition video sharing up to 1080p as well as desktop conferencing via USB or firewire cameras. The audio parameters for CXP allow for the use of high-end audio interfaces. The Tavel Lab has successfully employed a number of popular interfaces for pre-internet, multi-channel audio, including the Mackie Onyx, MOTU 896HD and MOTU MicroExpress, to name a few. Scalable audio settings range from compressed audio, 22khz, 20kps through fully uncompressed, 96khz at 16 bits. The ConferenceXP was originally conceived in 2001 by the Microsoft Research Learning Science and Technology team and released under a shared source license. As of December 2010, it is managed as an open-source application through the OuterCurve Foundation.

There currently is a broad array of videoconferencing applications harnessed for telematic works. This list

includes *Access Grid, DVTS, Artmesh, Lifesize, Tandberg and Polycom* as well as commodity applications such as *Skype* and *iChat*. While different applications work more or less effectively for various telematic projects, ConferenceXP was selected for use in the design of *Auksalaq*. In the Ear to the Earth performance, CXP performed flawlessly between an Apple Macbook Pro in *Bootcamp* (Windows 7) in New York, and a Dell T3400 desktop (running Windows XP) in Indianapolis. Even though the audio is of high quality, it is unfortunately, only two channel. Therefore, the *Auksalaq* telematic construct uses *Jacktrip* audio software as an alternative. As previously mentioned, *Jacktrip* is specifically designed for networked, high quality audio performance. It will support as many audio tracks as the network can handle, fully uncompressed. It is available for use on Linux and Mac OS X machines, therefore its flexibility between users is adequate. Currently, *Jacktrip* is regarded as the premiere audio transport application over networks when working with multiple sites.

Proper selection of cameras is another important consideration that must be balanced in tandem with the allowances of the available bandwidth and compatibility of equipment. If inexpensive webcams are used, latency between sites is a minimal problem, but the video quality is poor to the point of distraction. If the quality of the image is too high, the video may be pristine and clear, but the latency can climb as high as two to three seconds, unless one is using an extreme amount of bandwidth, such as a 7 to 8 GB connection, which in most cases will only occur in unicast mode. Telematic artists employ a broad array of cameras for projects ranging from simple Logitech webcams to HDSDI-supported video cams such as the Sony XD CAM. While the XD CAM provides stunning video quality, as mentioned, it proves to be too slow for most telematic applications. The happy medium for cameras is a digital, pro-sumer-grade videocam that employs HDV quality tape and connects with an iLink Firewire connection. These cameras, are available in a variety of models from all of the leading manufacturers, and they provide a high quality image without sacrificing too much time sending packets across the network. A good example of this kind of camera is the Sony HVR-A1U HDV camcorder. The HVR-A1U provides 1080i HD acquisition and formats onto a DVCAM™ mini cassette.

For both performances of *Auksalaq*, a combination of web cams (from the main stage to a non-audience site) and HDV cameras were employed. This provided for quality imagery when essential and for speed of coordination as much as possible. MaxMSP and Jitter was employed for all of the real-time media mixing. Two patches were created, one that acted as a staging area for more than 100 clips of scientific data, expert interviews (pre-recorded), and Arctic imagery coming from approximately 80 GBs of photo and movie sets. The second patch was used to manipulate the imagery in a coherent fashion in order to assist with providing the opera with an over-all visual "tone".

CONCLUSION

Auksalaq creates the conditions for a mult-tiered form of dramatic narrative, born of the Internet. Telematic art is distinct because it is capable of this kind of presentation in live performance. In the past, audiences were exposed to either movies, which possess great power in media but are not live, or theater, which possesses live actors to create a dynamic that draws live audiences. In *Auksalaq*, these two mediums merge, so that multiple levels of narrative, information and art are placed before audiences for them to choose where to interact or observe. Viewers will see a traditional performance comprised of staged musicians, actors and dancers who will be in turn interacting with performers from remote locations presented on screens. Another level is the ability to mix and blend audio and video data in real time. Furthermore, scientific data feeds, including information obtained through remote sensing, satellite capture, and field measurement are incorporated for presentation along with prepared commentary from experts in the fields of science, anthropology, sociology, political science, journalism, and literature. These seemingly disparate areas of inquiry integrate into the multi-tiered media presentations occurring throughout the two-hour performance. Tangentially, the telematic audience experience stands in distinct contrast to the traditional passive observer role in older mediums. The *Auksalaq* project explores several formats of audience interaction. Viewers are able to interact with the opera performance via texting to a displayed chatroom, and scenarios for audience to performer discussion are also be presented. As an original and cutting-edge operatic form, *Auksalaq* is a timely addition to new frontiers in performance as well as an artistic illumination of contemporary ecosystem concerns forwarded by the international scientific community.

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