The Black Swan: Probable and Improbable Communcation Over Local and Geographically Displaced Networked Connections as a Musical Performance System

Alyssa Aska
University of Calgary
aaska@ucalgary.ca

ABSTRACT

The Black Swan is a networked performance system for two groups of non-specific performers. The work derives its title and inspiration from Nicolas Taleb's description of extreme and catastrophic events. These "black swan" events are characterized as being outliers, unpredictable, and yet completely explainable when viewed in retrospect. *The Black Swan* uses this concept in performance; throughout the piece a group of instrumentalists is solely responsible for interpreting the score while a group of motion-tracked performers advance the score. However, when the "Black Swan" occurs, the motion-tracked group begins to generate sound, an event that the instrumentalists could not have anticipated. A third party is responsible for distributing instructions to each performance group over the network during the performance. Therefore, *The Black Swan* explores the way networked performers communicate with each other as well as the dramaturgy between ensemble members in a networked setting.

1. INTRODUCTION

Communication over a network, including the Internet, text messages, and social media, is ubiquitous in modern society. Therefore, it follows that the creation of artistic and musical performance systems which convey information via a networked setting is expected and relevant to both present and future forms of art. *The Black Swan* is a network-based piece that was developed as a work to be performed in concert or installation as well as a performance system intended to engage performers in a networked setting. The work makes use of the network primarily through communication, currently using data; future developments will also include audio communication. *The Black Swan* consists of two performance groups: a group of instrumentalists and a group of performers interacting with motion-tracking software. A third party is also required, to act as a server/master controller that sends messages containing instructions via the network to each group of performers in real time during the performance. The concept of *The Black Swan* is derived from Nicholas Taleb's book of the same name [1]. Taleb describes a black swan as an event that contains the following three principles: "rarity, extreme impact, and retrospective (though not prospective) predictability."[1] The Internet, and therefore networking itself, especially in its success and widespread use, is a black swan event by his definition; the scale of use and popularity of the Internet could not be predicted. The idea of the black swan is also manifest in this piece because for the first two-thirds of the piece, only the performers in the instrumental group serve as producers of sound. The motion-tracking group spontaneously begins to produce sound after this point to the surprise of the instrumental group. Additionally, a fail-safe is implemented to end the piece; the master controller can crash the software on the other computers via a "kill" message.

2. THE PERFORMANCE SYSTEM

2.1 The Score

The Black Swan consists of three pieces of software; each is intended to convey instructions to the performers. One of these pieces of software is distributed to the instrumental performers and contains a display with score and text instructions. This piece of software, therefore, functions analogous to a printed musical score; for this reason it will henceforth be referred to as the score. The score is open to various soloists and ensembles, and is not limited in the amount of players it can facilitate. It uses notation derived from standard western musical notation, but flexible enough to be interpreted by instruments of all types and ranges. The score consists of a staff without a clef and notes that are placed in relative vertical locations on the staff to indicate potential relative pitch, or frequency between each note. The size of each note is intended to convey a potential dynamic. Additionally, there are different notehead types used in the score which the performers are instructed to interpret using different timbres or playing techniques: regular round noteheads, diamond noteheads with outline only, and filled-in diamond noteheads. The instruction of each instrument to change timbre rather than instructing specific techniques, such as breath sound, key clicking, or scratch tones, is intentional

[1] N. Taleb, *The Black Swan* (London: Penguin, 2007), xviii.

in order to retain the open score capabilities. In addition, the score is not intended to be played through once from beginning to end; rather, the ensemble is instructed to interpret the score as it changes as a result of the actions of the camera performance team. The score itself is displayed using the mgraphics environment within Max/MSP[2]. The score images are loaded in an mgraphics window and different fragments of these images are displayed as a result of data received via the network from the motion-tracking team. There are built-in sections programmed into the Max patch which the instrumentalists progress through, but the score does have the ability to move both left and right through each section as a result of the data generated by the motion-tracking team. This allows the piece the ability to be of variable duration and form, yet still somewhat limited by having a specifically notated score.

2.2 The Motion-Tracking

The Black Swan requires a secondary group of performers/interactors to engage with another piece of software, which contains modules from Jean-Marc Pelletier's "Computer Vision for Jitter" [3] and Martin Ritter's MR.Jit Computer Vision Toolbox. This software requires use of an internal or external camera; for both performances thus far the computer's internal camera has been used. The motion-tracking software tracks the left-right and up-down motion of any moving elements picked up by a camera. Depending on how many pixels are in motion and in which direction, the data either increases or decreases. This data is then transmitted via the network to the software that is displaying the score. In this piece only the left-right motion is used. The motion-tracking software is distributed to the motion-tracking team. This group can consist of any number of performers, and can be dynamic throughout the piece as long as at least one individual is engaging the software at all times. These performers do not need to be musicians, or trained in any sort of movement. They are given written instructions from the master controller over the network as the piece progresses regarding how to interact with the camera. The software also displays a large number box with a range from one to one hundred; this is intended to help the performer(s) advance the piece. Performers receive instructions throughout the performance on how to move and how quickly to aim for arrival at one hundred as doing so will cause advancement through sections and eventually end the piece. The motion-tracking team is therefore the most influential in determining the form and duration of the piece. Depending on the number of performers and their ability or desire to follow directions explicitly, they may perfectly comply with instructions or disregard them completely.

2.3 Performance Forces Required

There are three separate computers required for the facilitation of this piece, one of which must contain a camera. Since this work is a networked piece, the computers must be able to connect to each other via User Datagram Protocol (UDP). If performing with a group in another location, the motion-tracking performance team and the instrumentalists must have a means of transmitting audio to one another, such as JackTrip[4]. The actual instrumentation is open and flexible; so long as there is one musical force available to play the piece can be performed. The camera performance team can consist of any amount and type of personnel. The third, separate computer consists of an individual facilitating the performance and sending messages from the master software to each of the computers. The operator of the master software can be any individual that is familiar with the piece and how the communication system works. For long distance networked performances, all groups will need loudspeakers and microphones or other means of transmitting audio data to each group in the network.

3. PERFORMANCES

3.1 Eastern Bloc, Montreal

This performance consisted of four performers in Montreal: accordion/electronics, turntable, tape, and banjo/electronics. Performers at the local site in Calgary included one individual executing the motion tracking and audio performance instructions. This was also the first use of the software in a networked setting with a geographically displaced location.

3.2 Syneme Lab, Beijing

This performance consisted of one erhu player in Beijing and two performers at the local site in Calgary: one engaging with the motion tracking and one prepared to create audible material when it is required in the piece.

3.3 Results of Performance

The first performance in Montreal was successful but did have minor issues: primarily that the performers were unsure about score interpretation. Contributing factors to this likely included the score itself as well as the nature of the instruments that the performers were using. Additionally, the camera performer had never interacted with the technology and took much longer to advance the piece than expected. This indicates that more text and oral instruction should be given to the motion-tracking team beforehand and perhaps a short practice interaction with the software should be implemented before performance. This will allow the motion-tracking team greater ability to understand instruction and further mastery of the software. The subsequent performance in Beijing was much more successful; the erhu player had managed to interpret the score with less difficulty than the performers in Montreal, likely due to the closer proximity of the erhu player to an interpreter of standard western notation. Additional improvements in this performance included the increase in performers on the motion-tracking team. In addition, the performer primarily engaging with the camera had some experience prior to the performance and

was much more able to execute instruction. It was also much easier to hear an interactive element in the piece; the backward and forward motion of the score was clearly audible. This indicates that specific, rather than general instructions in the score are more effective in both conveying information to performers as well as displaying the interactive and networked components of the piece to the audience. Finally, both performances lacked a general and coherent thread between them that clearly demonstrated to each team what sort of data was being generated by the motion-tracking team. This could be improved by implementing on the motion-tracking side some sort of auditory as well as visual feedback; the visual feedback gave the team a good indicator of how they were moving in the environment but an auditory result that was directly linked to the data output itself would provide the performers with a more coherent and precise link to what sort of data the motion-tracking produces. Therefore, for future performances, the motion-tracking team will affect audio processing of the instrumentalists' generated sound.

4. NETWORKING COMPONENTS

4.1 Dramaturgy

The Black Swan does require a network to be performed. Thus, it is important to understand the dramaturgy and role distribution amongst the performance teams and how they interact using the network. Pedro Rebelo described the importance of this in his paper, "Dramaturgy in the Network"[5]: "it is evident that the organisational or topological nature of the network has an effect on creative practice in this medium."[2] *The Black Swan* uses the organisational nature of the network as part of its inherent aesthetic; the relationship between the network nodes is one of the major compositional forces of the piece. There are three computers networked. One computer serves as a master/server to both the instrument and the motion-tracking teams, as it sends instructions to both. This computer does not receive any data from either of these teams that controls the piece in any way. The motion-tracking team has the ability to send information to the instrumental team; in fact, they control the score of the instrumental team, indicating that the motion-tracking team and instrumentalists are in a server-client, not peer-to-peer, relationship. The motion-tracking team, however, still remains as client to the master computer, as it still receives instructions and information from the master but does not transmit any instructions or control information back. The instrumental team is client to both the master controller as well as the motion-tracking team; the instrumental team only receives data and information and does not send any. However, this is the role distribution only as it pertains to network DATA. When the above-proposed audio exchange is taken into consideration, the role distribution changes slightly to reflect the two-way equal transfer between the instrumental team and the motion-tracking team; they essentially become peer-to-peer when this audio is considered. The instrumentalists send audio to the motion-tracking team, which is then modified by the motion-tracking team. This modified audio is then sent back to the instrumentalists, therefore, the audio is an equal two-way transfer with no clear server-client relationships.

4.2 Score and Instruction Distribution

The score and instructions are all distributed via the network; this includes the text instructions sent to both computers as well as the numerical data generated by the camera team that is then sent via UDP to the instrumental performers. This data sent over UDP effects which portion of the score is displayed. The network also contains the ability to display time and section information to the instrumentalists as well as the camera team so that everyone is aware of how much time has elapsed in the piece. This way the performers are not required to synchronize outside of the network and everything is self contained and network distributed. This self-contained network distribution allows for a continuous, uninterrupted performance with the avoidance of communication difficulties that may arise without the UDP synchronization. IP destinations of data are dynamic within the software; the motion-tracking team and the master computer need only to type in the IP addresses of the data destinations into a dynamic window at the start of the piece. Due to the dynamic IP capability, no additional patching or programming is needed to perform the piece in new environments. The use of the network, using the ontologies described by Barbosa [6] in "Displaced Soundscapes: A Survey of Network Systems for Music and Sonic Art Creation" could be performed on a "Local Interconnected Musical Network" or a "Remote Music Performance System"[3], as the computers may be on a local network during performance or in geographically displaced locations.

5. FUTURE DEVELOPMENTS

5.1 Audio-Visual Information

Audio processing that will be controlled via motion tracking will be implemented for future performances. The audio signal sent by the instrumental team to the motion-tracking team will be modified via some sort of processing such as delay, filtering, or granular processing. The motion-tracking data will effect this processing using the same data that is sent to the instrumental team. This will allow for an audio component to occur on both sides that is clearly linked to the performance motion, and will also allow a new relationship dynamic to occur between the two parties. I additionally intend to refine the instru-

[2] P. Rebelo. "Dramaturgy in the Network," in *Contemporary Music Review* (Vol. 28, No. 4/5, August/October 2009), 388.

[3] A. Barbosa. "Displaced Soundscapes: A Survey of Network Systems for Music and Sonic Art Creation," in *Leonardo Music Journal*, (Vol. 13, 2003), 57.

mentalist's score interface so that the region to be played at each given instant is less ambiguous. Finally, additional visual information to be conveyed to all performers in future versions of the software includes higher level of detail regarding current section of the piece and length from the end, and an additional element in the display that shows the performers the precise location in the score to interpret. This element will be a solid line that is clearly visible to the performers but not obtrusive to the score.

5.2 Future Performance and Installation

The Black Swan would definitely benefit from additional performances, especially performances with several performers on each side. It can be performed in a variety of venues, including inter-continental connections such as the one in Beijing, or simple local network live concert settings. Additionally, *The Black Swan* could serve as an interesting installation with continuously changing performers on both ends (or the same performers playing for an extended length of time).

6. CONCLUSIONS

The Black Swan is primarily intended as a work that engages performers over a network with clearly defined roles at each network node. The goal of this research and performance was to create a performance system that is flexible, engaging, and yet interesting to watch and participate in. The work has so far been successful, although should be attempted by various groups to determine the true flexibility of the piece and it's viability in various venues. *The Black Swan* is also successful in its' use of network distributed messages and information as an integral part of the performance. Further development is needed into making the performance sites even more organically connected, primarily through the implementation of audio effects modified by the camera tracked individuals that will tie the performance together. These audio effects will provide an auditory link to the data generated by the motion-tracking for both sites. For the instrumentalists this would provide an idea of what was going on at the motion-tracking site, as they may not have visual data of the performers interacting with the motion-tracking software. For the audience at the motion-tracking site, this would provide an audio output and result of how the tracking was affecting the data. It would also provide immediate feedback for the motion-tracking team in addition to the visual feedback provided by the software. Performing *The Black Swan* in various venues with various ensembles and groups in each venue will allow the piece to develop and grow as a performance system reliant on network communication for reasons other than geographical displacement. The transmission of information and communication via a network in this piece is an integral function of the piece and serves as commentary on the frequency of network-based communication and consumption that exists in our culture.

7. REFERENCES

[1] N. Taleb, *The Black Swan: The Impact of the Highly Improbable,* Penguin, London, 2007.

[2] D. Zicarelli, Max/MSP Software, Cycling '74, San Francisco, 1997.

[3] J. Pelletier, "cv-jit – 'Computer Music for Jitter.'"

[4] J. P. Caceres and C. Chafe, "Jacktrip: Under the Hood of an Engine for Network Audio," in *Proceedings of International Computer Music Conference,* International Computer Music Association, San Francisco, California, 2009, p. 509-512.

[5] P. Rebelo, "Dramaturgy in the Network," in *Contemporary Music Review,* Vol. 28, No. 4/5, (August/October 2009), 387-93.

[6] A. Barbosa, "Displaced Soundscapes: A Survey of Network Systems for Music and Sonic Art Creation," in *Leonardo Music Journal,* Vol 13 (2003), pp. 53-59.