ANALOGUE TO DIGITAL: AUTHENTICIY VS. SUSTAINABILITY IN STOCKHAUSEN'S *MANTRA (1970)*

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ABSTRACT

The authors introduce and examine the digitization process of a classic work for two pianos and live electronics by Karlheinz Stockhausen, *Mantra* (1970). Originally written for custom-designed analogue ring modulators, pianos and percussion, *Mantra* presents many challenges to the contemporary performer wishing to program the work. Problems and solutions are discussed in this realization of the original electronic processing in a digital computer-based version. The authors argue the merits of presenting this rarely performed piece in an accessible and sustainable format while taking into account considerations of authentic performance practice and studying the earlier analogue technology. Conclusions are drawn based on preparations for the 2008 tour by the Pestova/Meyer piano duo (Xenia Pestova / Pascal Meyer)[1].

1. INTRODUCTION

Updating, archiving and preservation of live electronic repertoire of the past has become a major issue in recent years [9]. As both equipment and software change rapidly and performance platforms become obsolete, much of our musical heritage is rendered literally unplayable. Keeping important pieces from the repertoire and sustaining them for future performances is a highly problematic task, involving delicate issues of practicality and authentic performance practice. These issues are clearly present in the important instrument and electronics works by Karlheinz Stockhausen (1928-2007), and are especially paramount in *Mantra* (1970) for two pianists and live electronics.

1.1. Background

Mantra (1970) is preceded by a series of highly influential works by Stockhausen that provide illuminating examples of the early uses of live electronics. These pieces ask for unusual instrumentation in conjunction with amplification and processing, and include the seminal *Mikrophonie I* for amplified tam-tam (1964), *Mixtur* for instrumental ensembles and ring modulators, *Mikrophonie II* for twelve singers, Hammond organ and ring modulator (1965), *Prozession* (1967), *Stimmung* (1968), and the intuitive text-based work *Aus den Sieben Tagen* (1968). Like most of these works, *Mantra* also requires a highly specific and complicated set-up. In addition to playing on the pianos, the two performers are asked to strike crotales and woodblocks with percussion mallets, requiring an unfamiliar and unpianistic technique, as well as to use their voices and make theatrical gestures over the course of the 70-plus minutes that the piece takes to unfold.

Mantra is a "formula-composition" with the whole work expanding from the first eight bars. Despite a strict serial system, the composer allows himself various freedoms, occasionally introducing humorous and whimsical elements into the otherwise serious and absorbing context. Like many of Stockhausen's piano works, the acoustic instrumental writing is often influenced by electronic music techniques and "simulated electronic transformation" [4]. These are based on the composer's extensive experience with analogue studio equipment in the 1950s that culminated in important works such as *Gesang der Junglinge* (1955-56) and *Kontakte* (1958-60). Examples of these techniques include gradually slowed down or sped up woodblock/piano gestures in bars 364–421, or "looping" with varied "reverberation" (pedal) in bars 571–576, as well as the compression of the whole work into an accelerated coda at the end. Fascinating to study and perform, these techniques are some of the elements that make *Mantra* one of the creative highlights in Stockhausen's output.

1.2. Analogue to Digital

Despite the artistic merits of *Mantra*, there is a certain short sightedness built into the work. In addition to the practical and physical difficulties that are presented by the percussion instruments, the electronic set-up is highly problematic. In the preface to the score, the composer asks for a short-wave radio receiver or a tape recorder with a volume control and two sets of "MODUL 69 B", a ring modulator built especially for the piece according to Stockhausen's specifications. The composer writes: "This piece of equipment has 3 microphone inputs with regulable microphone amplifiers, compressor, filters, sine-wave generator and a particularly refined ring modulator" [6].

Each modulator comes with a dial that the pianists must adjust constantly during performance, controlling the modulating sine tone frequency that is used to process the pianos in real-time. The resulting sound is mixed with the unprocessed piano sound and projected into the hall, resulting in a highly unusual and rich range of harmonized and distorted timbres. Due to these highly

[1] http://www.xeniapestova.com/mantra.html

specific and outdated technical requirements, *Mantra* provides a perfect example of an important work on the verge of obsolescence. Performances are rare, expensive and difficult to arrange, and the bulky analogue set-up contributes to the complications of touring the work, making it a prime candidate for digitization. This is a trend that is developing with increasing urgency and concerns all classic live electronic repertoire. Percussionist Robert Esler is one of several performers who support digitization, and gives several practical, aesthetic and theoretical reasons for his transferral of a classical analogue Stockhausen work, *Solo for a Melody Instrument and Feedback Loop* (1966) to PureData [3]. In a related article, composer Christopher Burns stresses the need to rescue early live electronic works such as Stockhausen's *Mikrophonie I* (1964) from "technological obsolescence" and describes the process of doing so [1]. Following these examples and porting *Mantra* into a contemporary digital format would help ensure its survival and guarantee future performances by greatly simplifying the set-up and lowering production and touring costs. Another positive aspect resulting from the change would be the cleaner and more accurate digital sound quality without the analogue hiss or unstable sine waves associated with equipment contemporary to the piece.

2. INTO THE DIGITAL DOMAIN

From the initial stages of the project it became clear that *MODUL 69 B* would be obsolete. The first steps taken were to contact performers who have played the piece and worked with the composer. Pianists Ellen Corver (the Netherlands) and Benjamin Kobler (Germany) were forthcoming and offered several suggestions. After following the various leads provided, two solutions became apparent. *MODUL 69 B* has been officially replaced by an updated design by Stockhausen's assistant Bryan Wolf (Germany). Pianists wishing to work on *Mantra* have the option to rent this equipment (along with the sound engineer) for each concert, or have the equipment built for approximately 2,000 Euro. Another option was to create a lower-cost digital alternative, such as the MIDI version designed by Stockhausen's former sound projectionist Jan Panis (the Netherlands). The final decision was to design and build an original digital version that would allow the performers to be independent and carry the equipment on tour.

2.1. Authenticity

Digitization of classic live-electronic repertoire involves many technical, practical and aesthetic aspects. The question of authenticity is one of them, and requires the performers to carefully consider all the available options prior to embarking on the project, while bearing in mind the important concept of being "true" to the composer's intentions. In a 2006 article, composer Simon Emmerson introduces the performer to an interesting paradox: the importance of sustaining and digitizing older repertoire is paramount today, yet what about "authentic" interpretation in terms of historical instrument performance practice? Emmerson presents a parallel with the early music performance practice debate, pointing out that the analogue hiss and specific sound quality are in fact part of the aesthetic appeal of the music, presented along with the visual aspect of the technology as an "aura of its time" [2]. Indeed, rather than being inferior, could it be that aging technology should be viewed in the same light as period instruments that can be seen as "different" rather than "limited" in comparison with their modern counterparts [2]?

To further complicate the situation, Stockhausen himself is known to have had strong opinions on the matter, and was very particular in asking the performers to use very specific instruments and equipment, down to a certain type of egg timer that resonates in the tam-tam in *Mikrophonie I* [7]. In the case of *Mikrophonie I,* special analogue filters were designed for the piece, and according to Stockhausen, computerized simulations only ensure that "their characteristic sound goes to hell" [7]. The composer elaborates further: "It is extremely important to comprehend works, which were born to a particular historical moment, for their uniqueness. It just won't do to be continually discarding everything and making something different, but rather we should be preserving things and adding new ones. Anyway, it is my experience of music that every instrument, every item of equipment, every technique can produce something unique, which can be achieved in no other way. Since that is the case, then we can speak of an original technique, and thus deal with an original instrument. If it is imitable, then it is also not worth much [7]."

However, as if in response to the authenticity debate, Stockhausen himself makes the following statement in the introductory booklet accompanying the second edition of *Mantra*: "Whenever new compositions of mine… become available to listeners – that is, after their creation and completion – then they are no longer a private matter relating only to me; the result serves everyone and is at everyone's disposal [6]."

This declaration could be interpreted to mean that the work is expected to live on away from the composer's control and allow new performing possibilities and interpretations to appear and develop. Similar conclusions are drawn by Robert Esler in his quest to obtain "digital autonomy" in Stockhausen's *Solo for a Melody Instrument* by replacing the required technical assistants with parameters controlled in a PureData patch, which allows a "contemporary interpretation" of the piece to emerge [3]. In another recent article, Christopher Burns is also concerned with continuing to develop an "evolving performance tradition" while sharing classic pieces like Stockhausen's *Mikrophonie I* with new audiences [1].

3. *MANTRA* IN MAX/MSP

The design and implementation of a digital version of *Mantra* took place in 2006 and 2007 at McGill University and was first tested during a career development residency at the Banff Centre for the Arts in February 2007. Subsequent testing was carried out in July 2007 during the Stockhausen Courses in Kuerten in

the presence of Stockhausen's official sound projectionist Bryan Wolff and pianists Benjamin Kobler and Frank Gutschmidt. The performers had the opportunity to compare the sound and control of the digital version with the analogue version, resulting in further modifications. Final testing and the first concert took place in Luxembourg in January 2008 with Jan Panis as sound projectionist.

Mark T. Marshall designed and built the two hardware controllers that allow the pianists to regulate the modulating frequencies and glissandi in the score, while Jacob Sudol programmed a Max/MSP patch. The resulting set-up ended up being a fraction of the cost of the analogue equipment and is easy to assemble, consisting of an Apple MacBook Pro laptop computer, two controllers and an interface box that connects to the computer with a standard USB cable.

Each controller consists of a single plastic enclosure with controls on the top surface. The controls consist of a potentiometer, which is used to modulate parameters of the software system and 1 or 2 switches. The switches are used to control state changes in the software system (e.g. changing register or starting and stopping the short-wave radio sounds).

Each controller is connected to the interface box using two regular XLR cables. These cables were chosen as they are commonly available in a variety of lengths to suit different performance spaces and offer a sturdy locking connection mechanism to ensure reliable connections in a concert situation.

The interface box itself makes use of an Arduino[2] Mini and Mini USB adapter, which acts as the analogue to digital converter for the system. The voltages from each controller are read by the Arduino and converted to 10-bit precision digital values, which are sent over a 115200 bps USB serial link to the Max/MSP patch, which reads the data at a rate of ~150Hz. Lowpass filtering, implemented both in the interface box hardware and in the Max/MSP software patch, is used to reduce high frequency noise which may be picked up by long cable runs.

Everything fits into one briefcase, with the only larger piece of hardware required being a FireWire interface.

Figure 1. The hardware controllers and interface.

The patch itself was also designed to be simple to use, with a "performer-friendly" user interface. For example, the virtual dials in the interface show the modulating pitch of each controller, while the mix of the "dry" and "modulated" piano signal can also be modified at this level.

One problem that remained was the "short-wave radio sound" that has to be manipulated by piano 1. Since short-wave radios can be difficult to obtain, the controller for piano 1 has a switch that turns the frequency dial into a volume control and starts the pre-recorded *Mantra* "Kurzwellen-Morsen" (CD available from Stockhausen-Verlag[3]), resulting in a simple and elegant solution. At the end of the short-wave section the switch activates the frequency dial again, while the pre-recorded sounds stay at the volume specified prior to the switch and are brought down by the sound projectionist, as indicated in the score.

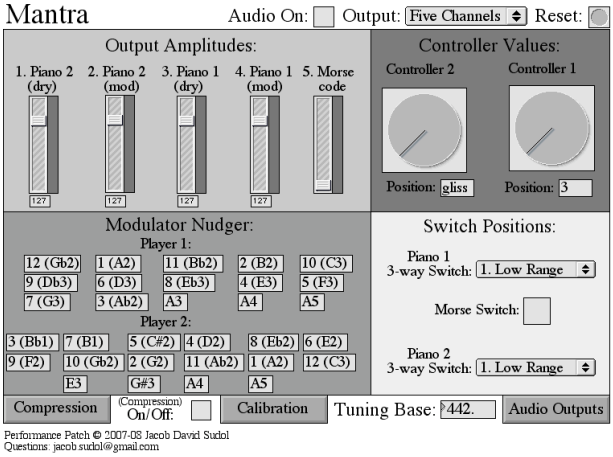

Figure 2. Max/MSP interface for *Mantra* displays the positions for each performer's controller and switches as well as levels and other features that can be controlled by the sound projectionist.

3.1. Problems and Solutions

As expected, various problems arose during the testing process. For example, there is no haptic feedback since the dials are meant to slide continuously between the modulating frequencies, creating further problems for programming. One simple solution involved defining small bandwidths around the position of each modulator where the desired modulating frequency doesn't change. In addition, a "Modulator Nudger" that allows the sound projectionist to nudge the performers' modulating frequency to the correct position in the case of performer error was included in the patch to provide further robustness in performance. The hardware is also not immune, and the controllers tend to drift away from set positions while being transported. A solution to this issue has been to build a "Calibration" feature into the patch that allows the performers to redefine and reset the modulator positions inside the software.

Another problem turned out to be the difficulty of achieving the glissandi ranges specified by the composer. While during most of the piece the pianists

[2] http://www.arduino.cc

[3] http://www.stockhausen.org

simply move through a "series" of 12 pitches, at certain sections they are also required to be able to slide continuously between "as low as possible"[4] and 6,000 Hz in fast glissandi. This is a very wide range that falls far outside the rest of the specified frequencies, and calls for an extra "mode" to be built into the controllers that would allow the performers to switch between the two. In addition to these two modes of operation, both pianists are required to be able to go to an extra-low range at certain points in the score. The final solution was to build a three-way switch into each controller with positions for the normal, extra-low and extended (high) ranges.

Finally, migrating to commercial software also raises issues of sustainability [9], and presenting the piece in a PureData environment might be an interesting option for the future, currently beyond the scope of this project.

4. CONCLUSIONS

Having examined the issues of sustainability and authenticity related to porting *Mantra* to Max/MSP, we conclude that this option offers the best solution for preserving this important piece for future generations. As analogue equipment becomes increasingly rare, musicians must find a way to ensure that the quality music of the past survives. The computer version of the piece appears to offer better sound quality in addition to high cost effectiveness and ease of portability and set-up. Unfortunately, *Mantra* can never be truly portable or accessible due to the expensive and rare percussion instruments required for the performance (for example, the set of crotales used by piano 2 includes two extra-low pitches that are not available commercially and have to be ordered especially, unless an alternative is found). This is a characteristic example of the "Stockhausen performance practice", which requires utmost dedication from the performer and attempts to strictly govern all aspects of interpretation. The "authentic performance practice" issue also remains, but can perhaps be treated in the same way that open-minded contemporary musicians often approach standard repertoire of the past: a pianist might try playing on a piano of Brahms' time to get an idea of the sound, colour, pedalling and spacing of events required by the instrument that the composer wrote for, and then take these considerations into account when working on their interpretation on the modern grand piano. In the case of *Mantra,* this might mean working with analogue equipment that resembles the original as closely as possible and comparing the "feel" and sound with the digital version. From our experience, this can nourish creative ideas and influence interpretative decisions that can in turn be implemented in performance with the contemporary version. Finally, we must remember that as David Wetzel puts it, "for each new work, not only will the technology used at the time of composition become unavailable, but eventually so will the composer" [10]. This is now the case for Karlheinz Stockhausen, and the performance practice tradition of his works will have to change and expand beyond the control of the composer and his disciples in order to survive. Ultimately, creative decisions will have to be up to us.

[4] While this frequency is not indicated in the score, Stockhausen specified it as being approximately 50 Hz according to sound projectionist Bryan Wolff.

5. REFERENCES

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