VALUING OUR HERITAGE: EXPLORING SPATIALISATION THROUGH SOFTWARE EMULATION OF STOCKHAUSEN’S OKTOPHONIE

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ABSTRACT

The studio setup employed by Stockhausen for the spatialisation of Oktophonie might, to C21st music technologists, appear a rather bizarre and antiquated arrangement. Even by the standards of 1990 it was a somewhat strange hybrid collection of analogue, MIDI and digital resources very much in contrast to the cutting edge technology Stockhausen had earlier used at IRCAM for the electronic version of Kathinka’s Gesang. In a recent article the authors have explored the practical and creative reasons for Stockhausen’s approach to spatialisation in Oktophonie, in particular his concern above all else to be able to ‘perform’ the studio rather than pre-program it.

This paper develops one aspect of that article and discusses an attempt to facilitate a deeper understanding of Stockhausen’s approach by emulating the techniques he used. It discusses a project to create a model of the key spatialisation techniques Stockhausen used in Oktophonie in MaxMSP. The software will be demonstrated.

1. INTRODUCTION

The purpose of this project is not to try and recreate Oktophonie. Nor is it to attempt to recreate the precise characteristics of the equipment used, warts and all. Rather it is intended to simulate the strategies and approaches to octophonic spatialisation employed by Stockhausen, the purpose being to learn more about his approach through practical engagement both as a means of developing a deeper understanding of this aspect of Stockhausen’s work and of examining what potential relevance this approach might have to composers in the C21st. This strategy is similar to that used by Clarke previously [1] [2]. More details of the precise equipment and techniques used in Oktophonie can be found in the preface to the score [4] and in our discussion of the work [3].

Oktophonie is a fixed media (‘tape’) work in eight channels distributed across eight sets of speakers surrounding the audience in a cubic formation (the audience sitting on the bottom plane of the cube). Today more and more composers are working with multi-channel speaker setups projecting sound in 3-dimensions. Although technological advances and increased availability of equipment now make such arrangements much more practical there still remains the question of how to manage such 3D sound movements (be it in real-time or pre-recorded) both conceptually and in terms of physical controllers (if desired). Stockhausen was one of the first to address such issues. There is perhaps a tendency in music technology, with the rapid turnover of hardware and software, to write off past experience as irrelevant. We believe this to be too presumptuous and likely to result in an impoverishment of the field. Examining his ideas and approaches might not only help us to understand his achievements more fully but also, through dialogue with the past, provide useful lessons for the future.

Stockhausen’s approach to the spatialisation of Oktophonie grew out of his concern to perform the studio as far as possible (rather than pre-programming events). Inevitably, especially given the technology of the time, he faced the need for compromise. But even with unlimited technical resources there would be human limitations: to perform live the independent movement of eight different (mono) channels of sound across a 3-dimensional array of eight loudspeakers in real-time is probably an impossible task for one person whatever resources are available. Short of deploying an ensemble of people to perform the task (which is indeed an interesting possible solution) certain elements will have to be pre-programmed or alternatively different layers of material will need to be performed successively and overlaid. Examining the options Stockhausen chose in resolving these issues and experiencing them in emulation is enlightening.

There are a number of key decisions Stockhausen made in tackling this challenge:
2. SOFTWARE EMULATION

The MaxMSP emulation described below demonstrates this approach and allows users to engage with it practically. It is built in a modular fashion, each module reflecting a different aspect of Stockhausen’s approach. This also facilitates reconfigurations of the arrangement to permit experimentation with alternatives. It is not intended that it be used as a complete, pre-packaged utility, but rather as a toolbox. Specific aspects of Stockhausen’s technique can be extracted and played with. Being written in MSP, elements can be taken and adapted for contemporary use in different contexts. For example, adapted to work with different spatialisation algorithms or with a larger number of channels. Each module will be described in turn:

2.1. Mixing/Recording

This module allows the playback of one or more source channels (from pre-recorded sound files) for spatialisation together with eight channels of previously spatialised material. The newly spatialised eight channels can then be mixed with the earlier spatialisation and recorded in an 8-channel sound file. Although modelled for completeness, this is perhaps the least interesting aspect of Stockhausen’s working method for today as more flexible approaches are now easily possible. For example, the spatialisation of each mono source can be separately recorded and then all 64 channels mixed at the final stage. This allows more flexibility, for example the remaking of certain layers in the light of the spatialisation of other tracks, and also the independent balancing of each layer against all the others in the final mix (once Stockhausen had submixed layers there was no easy going back). A separate module therefore allows the more literal modelling of Stockhausen’s approach to be replaced by more flexible alternatives.

2.2. Static Cross-fading

Stockhausen uses this method to move a sound between a precise take-off position on one plane to another exact arrival point on another plane. This module models this approach. The mono source is sent to two groups of four faders representing the two planes. Each group of faders is then set to position the sound within that plane. Group faders are then used to cross-fade between the two planes. Following Stockhausen, this movement can be performed ‘live’ in the studio (either with the mouse or better using external MIDI control faders) or, if one wishes to work contrary to Stockhausen’s live approach, pre-programmed.

2.3. Circular Movement

Stockhausen used two alternative approaches for creating patterns of movements between four channels (almost always the movements used by Stockhausen in Oktophonie are circular, but in principle they do not have to be): an EMS QUEG and two linked DMP7 digital mixers (see [3] [4] for more details).

2.3.1. Circular movement by hand

The analogue QUEG was used by Stockhausen to move a mono input around four output channels by means of a joystick. The movement was therefore manual and again performed live. In our model this two-dimensional movement can be simulated either by the mouse or more helpfully by an external joystick.

2.3.2. Pre-programmed patterns with speed control

DMP7s might not seem an obvious choice for movement around four channels since they have only two output channels. The approach used in Oktophonie was an ingenious, if rather makeshift, solution to the problem of how to program spatial movement given the equipment that he had available. The same mono source was sent to both DMP7s and these were controlled with MIDI by a sequencer running on an Atari. The sequencer controlled the levels of each of the 2 x 2 output channels enabling movements to be made around a plane defined by four channels. Patterns of movement could be pre-recorded as MIDI sequences and these sequence patterns were then played back in loop mode. Clearly much is lost here in terms of live performance in the studio, the main control Stockhausen manipulated live in this context was the speed at which the sequence was played back and thereby the speed of the spatial movement, the speed of rotation. For ease of operation this speed control was implemented using a fader attached to the Atari. In themselves these technical details are only of historic interest, it is unlikely anyone would want to replicate this with hardware today. However, the idea of creating patterns of motion, and playing these at different speeds (something Stockhausen developed further in his final electronic work Cosmic...
Pulses) is relevant especially in conjunction with the ways he used this as part of more complex movements as will be described below. Emulating this part of his technique is simply a question of automating the module for manual circular movement.

2.4. Spiral Cross-Fading

The reduction of live control just described in the approach using the DMP7s may seem contrary to Stockhausen’s desire to perform the studio live. However, this simplification of one aspect of the process freed him to control other more complex aspects of the spatialisation.

The second, pre-programmed circular setup is normally used in conjunction with a variation of the cross-fading technique described earlier to create spiral movements which were performed live. In this case the 4-channel output from the DMP7s was sent to two different groups of four faders, each group (as with the static cross-fading) representing a different plane. For example, the first group might be assigned to channels 1-4 (the lower four speakers, numbered clockwise from left-rear) and the second group to channels 5-8 (the upper four speakers, again numbered clockwise from left-rear). Cross-fading between the two groups therefore results in the sound moving upwards or downwards whilst turning in a circular (or other) motion. At the same time the speed of rotation can be altered by changing the speed of the Atari sequence as described above. This complex motion is possible for one person to perform live: the control is in the form of two group faders (one for each set of four channels) and the fader controlling the speed of rotation. The emulation works in much the same way, with two groups of four faders each controlled by single group faders with a third fader controlling the speed of rotation. All these controls can be operated using external MIDI devices for ease of performance.

2.5. Complex Assignments

The technique just described is modified and refined by Stockhausen is two further ways. The first of these is by using complex assignments. For example, instead of a rotational movement between channels 1-2-3-4 (a simple circular movement) by assigning each output from the QUEG or DMP7s to a single channel, each output may be assigned to two or more channels. For example, the spatialisation of track 5 in Part 1 between 1’00” and 10’42.1” contains this complex assignment: 1/2/3-5/6/2-8/6/7-4/7/3. This results in a rotation between sets of three speakers, each set forming an ‘L’- shape from three adjacent speakers and each movement retaining one of the speakers from the previous set. A diagram in Stockhausen’s introductory notes to the score illustrates this (see [4] p. O XXIII – for the English version). Technically, working in MSP, complex assignments such as these are not difficult to emulate. Indeed it is easy, using a matrix, to try many different assignment patterns and this is where the main interest perhaps lies, in experimenting with Stockhausen’s approach, learning what it offers and possibly adapting and extending it.

2.6. Multiple Cross-Fades

The second refinement to the Spiral cross-fading technique builds on the first: The complex assignments just described for track 5 are in fact used as part of a multiple cross-fade. In the passage in question there is not just a simple cross-fade between two different sets of assignments (such as described in Section 2.4 above) but a sequence of cross-fades between four different sets of assignments. The complex assignment described in 2.5 is just one of these. Practically, instead of two group faders being cross-faded, four are used. In other words, the fours channels from the DMP7s are sent to four groups of faders. The first group is four channels forming the vertical back plane of the cube, behind the audience. So with the first group fader up the sound rotates vertically around this plane. The second group sends the sound equally to corresponding front and back channels. So with this group fader up the sound rotates vertically around both the front and back planes of the cube (in effect the sound has moved forward to rotate in the middle of the auditorium). It is the third group that relates to the complex assignment described above with three speakers active at each point in the rotation. The final group is again just four channels, this time the front plane of the cube. In summary, therefore, the sound has moved from a vertical rotation at the back of the hall to a similar rotation at the front via a sophisticated sequence of cross-fades controlled in live performance in the studio by means of four group faders. Once again, it is relatively straightforward to program this in MSP (see Figure 1 below) and even easier to experiment with a range of different assignments and cross-fade options. It is therefore possible to discover at first hand the spatialisation technique employed by Stockhausen in this work and also to explore its further creative potential in different contexts.

3. CONCLUSIONS

Stockhausen is particularly helpful in providing detailed descriptions of the technical workings of certain of his compositions. Too often however these commentaries go unread. Or if they are read, their full implications are not appreciated. Perhaps the best way in which to unpack their meaning is by engaging with the techniques and strategies themselves, by working with the same approach at least if not the same technology. Only in this way perhaps can their full significance be realised and the software presented here is intended to facilitate this. What can be learnt about the spatialisation of Oktophonic is, we believe, best discovered by practical experimentation. But a few
key points might be summarised: Firstly, although Stockhausen used a rather dated and seemingly haphazard collection of hardware in making this work, on closer inspection there is a very clear and sophisticated strategy behind his working methods. What might at first seem haphazard was in fact a clever solution to a precise task at that time and place. Secondly, Stockhausen is sometimes presented as a composer who placed planning and ordering ahead of listening and performing. Here, however, he clearly went to great lengths to find ways in which he could perform the spatialisation in the studio. He needed to be able to interact with his sound materials and play the work live, even if the results were then to be frozen on tape.

As with all aspects of electronic music much has changed, and very rapidly, since the composition of *Oktophonic*. There are many good reasons why composers today would be unlikely to want to use the same technical setup as Stockhausen employed in Cologne in 1990. But if computer music continually throws away the lessons of the past and does not build on what has been achieved surely it will be impoverished. For some composers, engaging with the approaches to spatialisation used by Stockhausen may clarify why they want to move in a very different direction, for others, there may be positive lessons to be learnt and built upon. For example, strategies of how to control multiple speakers in a 3D arrangement in a way that allows both complex patterns of movement yet at the same time facilitating ‘live performance’ be that in the studio or in concert. Certainly the technology of today makes multi-channel composition much easier technically and expands the range of options greatly. Building on the work of our predecessors can help us to make the most of these possibilities.

4. REFERENCES


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**Figure 1.** Screenshot from one of the MSP emulation modules.