6.3 "Breakfast Serialism" for laptop orchestra and improvisers: A study on twelve-tone indeterminacy using computer mediation

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Abstract

This paper presents the concepts developed for my piece "Breakfast Serialism", for laptop orchestra and improvisers. This piece introduces several conceptual and technical aspects made possible by the use of computer mediation using network communication between the conductor and the performers.

The piece is intended as a study on some of the technical and musical potential of the networked laptop orchestra. It is divided in six sections, each one exploring different musical possibilities for the application of the computer as a mediator, that 'listens' to all the events from the ensemble, and algorithmically adapts the pitch and dynamic possibilities using custom software developed in the Max/MSP programming environment.

The concepts and technical aspects will be described, as well as an insight to the background and some of the specific points of interest and concerns in electronic music ensembles, reflecting a conviction that laptop ensembles present vastly rich, unique and underexplored compositional possibilities.

This piece was composed for the 'EME – ESART Electroacoustic Music Ensemble', of the School of Applied Arts of the Polytechnic Institute of Castelo Branco, with my students from the Electronic Music and Musical Production course, and guest instrument students with experience in free improvisation. It was premiered in the "Serralves em Festa" music festival, in June 1st 2014, at the library of the Serralves Foundation, Porto.

Keywords: *Laptop orchestra, Computer music, Computer mediation, Wireless communication*

1. Introduction

The laptop orchestra is a very particular musical formation. It provides for the electronic music performers the experience of playing in an orchestral or ensemble-like context, and provides an immensely rich platform for collective exploration and creation of new music. From a compositional perspective, it can present an interesting but difficult challenge, as there are virtually no pre-established constraints defining the range of soni and performance possibilities.

With a brief history of only a decade as a formal and continued project, the laptop orchestra is still in its early years. Much work has been done that validate the laptop orchestra as an undoubtedly valuable musical formation, with broad and rich potential for musical expression, as well as a valuable asset as a music learning experience.

Nevertheless, from a conceptual perspective, several interesting questions were and can still be raised, that challenge the definition of this type of group, in which practically every aspect that will define a piece and its realization has to be planned by the composer(s). The variables are many, including the sound of the laptop instruments and the resources to achieve it, the best control and synchronization strategies, whether there will be the need for a conductor or not, what type of indications and gestures will be more appropriate, what degree of difficulty is reasonable for the performers, what type of score will be more adequate, if any at all, and to which extent will the piece be replicable by a different laptop orchestra.

The piece described in this paper is a personal approach to some of these questions, and gathers some of the concepts and technical approaches that were developed during my experience as a teacher of the EME laptop ensemble since 2008.

1.1 Motivation

The composition of this piece was driven by three main practical concerns: 1) the study of network communication as a compositional element; 2) the use of traditional harmonic procedures in the context of a laptop ensemble; and 3) to contribute to the formation of a laptop ensemble repertoire.

2. The laptop orchestra

The laptop group performance practice can be tracked back to 1978 with the "League of Automatic Music Composers" and in 1985 with "The Hub (Chadabe, 1997), or possibly even before that with the Canadian Electronic Ensemble (Eigenfeldt, 2010). However, it was only in 2005, with the creation of the PLOrk - Princeton Laptop Orchestra [1] by Dan Trueman, Perry Cook, Ge Wang and Scott Smallwood that the laptop orchestra took shape as a broad and systematic musical formation. Unlike the previous groups, in which the performers were the composers and developers, the PLOrk paradigm is - to a certain extent - closer to that of the traditional orchestra, in which the performers, mostly students, perform the pieces by the composers. Since then, a considerable number of pieces were commissioned and specifically composed for this orchestra. Simultaneously, and possibly one of the most interesting aspects about PLOrk, is that it works also as a kind of practical research laboratory for the experimentation of the technical, esthetical and artistic potential of this medium, and, as a pedagogical tool, provides an engaging learning and creative experience.

Starting in an academic and scientific context is not a coincidence at all. The laptop orchestra is a complex endeavor that gathers a great number of fields of research, including live computer music performance, group improvisation, spatialization, the physical modeling of instruments and their patterns of sound radiation, computer music programming languages and real-time performance, and computer music pedagogy (Trueman, Cook, Smallwood, & Wang, 2006). Some of the previous research projects that motivated the creation of PLOrk include human-computer interface design (Trueman & Cook, 2000), programming language design (Wang & Cook, 2003), speaker design for electronic music performance (Trueman, Bahn, & Cook, 2000).

Composing for the laptop orchestra can be as challenging as it is interesting. (Trueman et al., 2006) identify some of the challenges:

> The challenges are many: what kinds of sounds can we create? how can we physically control these sounds? how do we compose with these sounds? There are also social questions with musical and technical ramifications: how do we organize a fifteen players in this context? with a conductor? via a wireless network?

Following Princeton, the laptop orchestra has spread to many other universities inside and outside the US. In 2008, Ge Wang, one of the creators of PLOrk and author of the ChucK programming language, moved to Stanford University, and started the SLOrk – Standford Laptop Orchestra [2]. Although the format and methodology is basically the same, there were some important differences, mainly in the available resources, which led to the creative development of a setup consisting in inexpensive materials, like the speaker array with IKEA salad bowls [3]. This versatility and simplicity became a part of the SLOrk identity, and served also as an inspiration for many of the upcoming laptop orchestras around the world.

Some of the laptop orchestras that since then were created include the Carnegie Mellon Laptop Orchestra (Dannenberg, Cavaco, & Ang, 2007), Louisiana State University (LOLs), The Huddersfield Experimental Laptop Orchestra (HELO), Istanbul Bilgi University Laptop Orchestra (IBULOrk), Birmingham Laptop Ensemble (BiLE), Barcelona Laptop Orchestra, Concordia Laptop Orchestra (CLOrk), just to name a few. A list of some of the existing laptop orchestras with links to the corresponding websites can be found in the website of the "International Association of Laptop Orchestras" [4].

In Portugal, the ESART Electroacoustic Music Ensemble (EME) [5] is, to my knowledge, the oldest and only formally established academic laptop orchestra, in continuous activity since 2008. In 2010, Filipe Lopes, by then the curator of the "Digitópia" service of Casa da Música, in Porto, started the "Digitopia Collective", formed by the Digitopia members, who are musicians, composers, researchers and performers with strong connections and experience with music technology. The concept of a laptop ensemble in the Digitopia Collective is rather different to most of the academic ensembles. Because the members are experienced musicians, each of them has their own distinctive contribution to the group, with resources that range from totally software-based to completely analogue setups.

2.1 Instruments

The notion of instrument in the laptop orchestra is a particularly complex subject. As there are no acoustic instruments [6] with physical constraints, there is no predefined timbre, pitch range or amplitude constraints to define the orchestral sound. Instead, these attributes will be defined in the software, which can be some adequate configuration of existing or custom software. The laptop can be thought of as a meta-instrument, and the "instrument" as such is typically planned for each piece by the composer or composers. By using appropriate software and hardware, the laptop becomes an instrument.

In the case of PLOrk, the instrument is a generous setup consisting in a laptop with pre-installed Max/MSP, SuperCollider and ChucK programming languages, a hemispherical six-channel speaker, and an audio rack with two audio interfaces, amplifiers, and an ElectroTap Teabox sensor interface. In addition, several input devices and sensors are available to use, according to the needs for each piece (Trueman et al., 2006).

3. "Breakfast Serialism": general remarks

The number of laptop players can vary but should be a minimum of three. The improvisers can include any type of pitched instruments, and preferably should be processed in real time in order to better blend the sound with the ensemble. For the present paper I will describe the "canonical" version of the piece, as it was initially planned, for an ensemble comprising twelve laptop players, two string improvisers (cello and contrabass), and two other laptop musicians, processing the sound of the string players in real time. The diagram in Fig. 1 presents a possible layout for the placement of the orchestra and improvisers on stage. The white circles represent the laptop players, and the numbers inside the circles represent the group number, which they have to select in the software. The shaded circles are the improvisers, and behind them, in the squared shapes, are the laptop players that will receive the sound of the improvisers and process it in real time. These players should be thought as two improvisers as well, as the piece doesn't provide or require any particular software. Instead, as the improvisers may change, so the real time processing can change from one performance to the other.

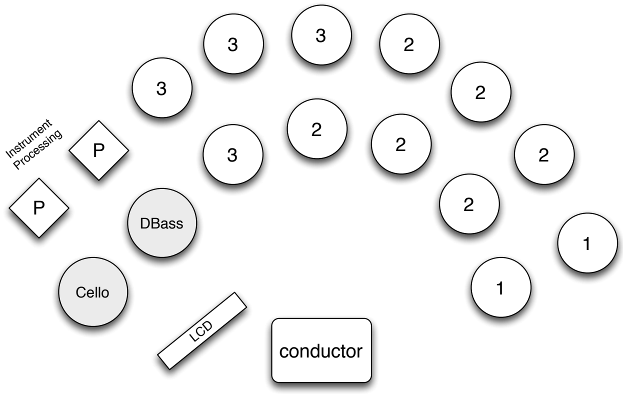

Fig. 1 A possible configuration of the orchestra and improvisors.

The piece requires two custom programs created in the Max graphical programming language. The programs are named 'Conductor', and 'Performer'. All the laptop musicians run the 'Performer' program (Fig. 1), which includes a custom-made synthesizer, keyboard and controller mapping parameters and network settings.

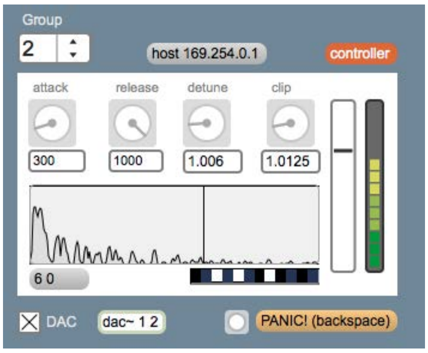
Group 2
host 169.254.0.1
attack 300
release 1000
detune 1.006
clip 1.0125
☒ DAC
dac~ 1 2

Fig. 2 The ‘Performer’ Max patch.

The performance of the piece requires all the laptop players and the conductor laptop to be connected to the same Wi-Fi network. For optimal performance, this network should be internal, configured for the performance of the piece, but not connected to the Internet. Typically, the conductor’s laptop creates the network and the performers connect to this network (more details on this below). The conductor runs the ‘Conductor’ program, which will receive all the performers input events, and make the necessary calculations for each section of the piece. The conductor’s laptop has to be connected to a secondary screen or projector that will show the “score” for the improvisers.

Throughout the entire piece, the laptop ensemble is divided in three groups, divided by three pitch ranges: Low, Medium, and High. Each laptop is assigned to one of the groups, and selects the corresponding option in the Max patch. The score is a guide to the performance of the piece, but merely approximate in what concerns the absolute notes, registers, quantity of events and durations.

3.1 Synthesizer

The sound of the piece is composed by three sound sources: the sound produced by the laptops, the acoustic sound of the instrument improvisers (both direct and amplified), and the sound of the instruments processed in real time.

The sound of the orchestra is obtained with the custom made software in the Max/MSP programming environment. The ‘Performer’ patch (see Fig. 2) implements a simple custom-made synthesizer, which corresponds to the white central area of the patch. The sound engine (Fig. 3) implements a basic subtractive model, with a rectangular waveform oscillator going thru a band pass filter and an Envelope Generator for the amplitude contour, which controls over the ‘attack’ and ‘release’ stages are available in the synthesizer patch.

In order to have some sound variation, a second oscillator, this time a sine wave oscillator, is added to the signal. The frequency of this second oscillator is set by the same control input as the first one, but with a “detune” control, to slightly alter the frequency and create a subtle *tremolo* effect. The amount of detuning is controlled in the ‘detune’ parameter in the patch interface. This second oscillator runs through a clipping process, which amount is also a controllable parameter in the patch interface. This ‘clip’ parameter ads a slight distortion to the signal, and is intended as a second possibility to create some timbre variations throughout the piece.

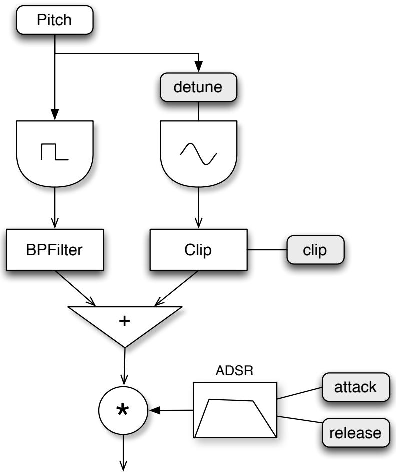

Fig. 3 The synthesizer implemented in the Performer patch.

These two parameters (‘detune’ and ‘clip’) are the only ones available for this purpose. The reason for this relates to the fact that it is meant specifically for the laptop orchestra. Because all the laptop players will be using the same patch, the effect will be multiplied and what seems to be a very subtle change in the sound in one single patch, becomes much more perceptible in the orchestra. Also, because this piece has the harmony as a central dimension, the sound of each laptop has to have a very clear and perceptible pitch. The synthesizer was thus planned with this objective in mind. Future improvements on the overall sound of the laptops may be implemented in future versions, as long as the pitch remains perceptible.
The control of the synthesizer parameters during performance can preferably be done by the players using appropriate external USB controllers. However, the software allows these parameters to be controlled remotely by the conductor. In this case, the control will be simultaneous for all the members of the orchestra. This allows some interesting performance possibilities rendered possible be the creative use of the network communication. Since the conductor has full control of the durations and character of the phrasing and gestures in the piece, having direct control of the laptop sound parameters gives him the possibility of amplifying those moments with a perfectly synchronized timbrical correspondence. For the initial versions and first performance of this piece, USB controllers for all the players were not available, so the parameters where controlled remotely by the conductor. However, doing this resulted somewhat uncomfortable for the conductor. Using one or even both hands to control the parameters may eventually compromise the indications for the orchestra. Also, for the laptop players, as their main role during the piece is to trigger the notes using the computer keyboard, which is quite simple, having the control of these parameters may render a more engaging performance experience.

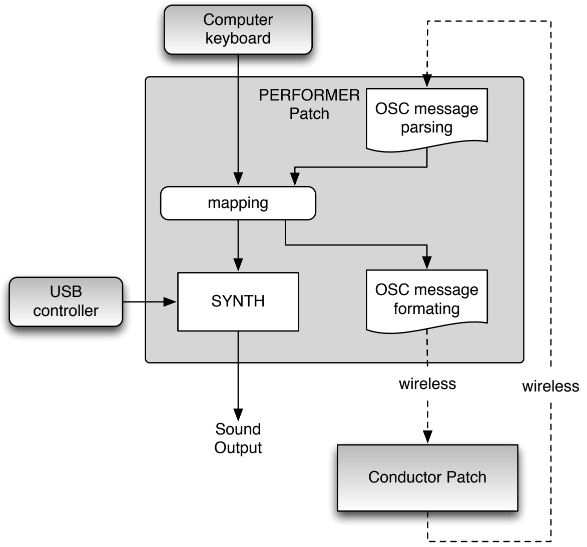

Fig. 4 Scheme of the 'Performer' patch

The performer uses the number keys of the computer keyboard to select the note or notes that will be played. However, the mapping of the keys to the notes is not always linear, and it will change during the piece, as will be described later for each section. The control over the mapping is done in the Conductor patch. As mentioned before, the communication between the performers and the conductor is done by wireless network, and the messages are formatted as OSC [7] messages. This ensures total flexibility for the development of the piece and for possible future versions. The note messages are sent to the conductor patch wirelessly, where some data filtering or transformation may occur, depending on the section. The mapping information then is sent back to the performer patch. The external USB controller will control the synthesizer parameters ('attack', 'release', 'detune' and 'clip').

4. The Score

4.1 Section 1

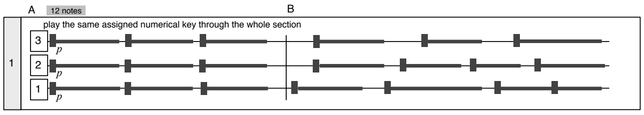
A
12 notes
B
play the same assigned numerical key through the whole section
1
3
2
1
p
p
p

Fig. 5 Section 1

The first section is divided in two parts, A and B. Part A consists of a series of block chords, in which the laptop players use the numerical keyboard of the computer to play a single note or more, depending on the number of available players, so that all the twelve notes of the chromatic space or Pitch Classes (PC) are played. If twelve laptop players are available, each of them will press the same single key during the whole section. If the number of players is inferior to twelve, some or all of the players are required to press two or more keys.

Following the conductor's indications, all the players press their assigned key simultaneously. Because each one has a different note, these chords will have twelve notes. However, the Max patch is programmed in order to introduce some variations on the input. In this case, every time a key is pressed the octave and the dynamics are randomly selected inside restrict pre-determined ranges. Therefore, although the laptop musicians are pressing the same key every time, the note's octave and dynamic level will possibly vary, making the resulting overall chord vary considerably.

Part B uses the same idea and harmonic content using twelve-note chords. However, these chords are now fragmented into subsets of Pitch Classes, divided into the three different regions.

4.2 Section 2

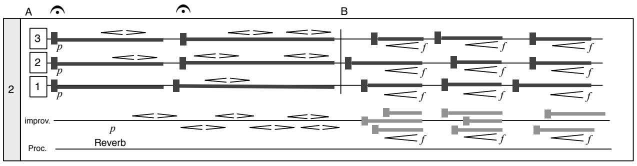

Fig. 6 Section 2

The beginning of section two goes back to block chords by all the groups. But, while section one presented the chords with no distinct dynamics, in this section, the aim is to expose different harmonies from within the twelve-tone space by using crescendo and diminuendos, over a pianissimo background. As such, although all the twelve notes are still present, by intensifying only a few notes, different harmonies emerge from the background.
In this section, the improvisers make their first appearance, by using the same crescendo-diminuendo gesture. The notes to be used are being presented in real time in the video monitor for the improvisers. Using a direct relation between the dynamics of the notes and their visibility in the real time score, the more audible notes are also the more visible they become. This allows for a harmonic and melodic integration between the laptops and the acoustic instruments.

4.3 Section 3

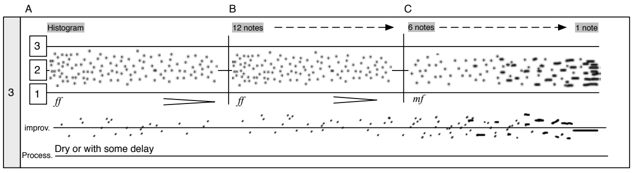

Fig. 7 Section 3

Section three presents a different texture, formed by short, staccato notes, to form a granular cloud texture. The laptop performers can use any pitch, using any of the numeric keys randomly with short and fast key presses, and the improvisers mimic this texture using short events that can be arbitrarily played in *staccato*, pizzicato, *col legno*, *col legno battuto* or even fast movements of the bow.

Pitch Class Filter

The custom software implements a Pitch Class filter, which will be used in parts B and C of this section. Every note played by the ensemble is received by the conductor program, which creates a histogram, counting the number of notes for each PC. The output is an ordered list of PC, starting with the most played PC to the least played one. While the improvisers play continuously during the section, the ensemble breaks the gesture abruptly, following the conductor's indications. In each of these breaks, the number of allowed notes is reduced using the ordered list from the histogram. As the number of allowed notes is reduced, only the pitch-classes with higher play count remain.

By the end of the section, every key triggers the same note so only one single pitch is heard. The texture also changes gradually to longer notes, represented in the score by the dots turning to lines.

4.4 Section 4

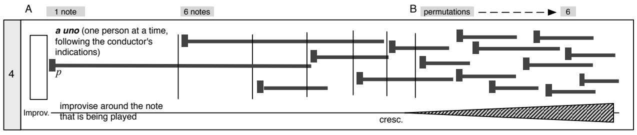
A
1 note
6 notes
B
permutations
6
4
a uno (one person at a time, following the conductor's indications)
p
Improv.
improvise around the note that is being played
cresc.

Fig. 8 Section 4

This section starts with the single note held from the previous section, and has a completely contrasting static and calm character. The conductor signals the entrance of each new note with direct indications to the ensemble individually. After the initial note, the PC filter is opened to allow six PC, which, as defined in the previous section, will correspond to the six ones with a higher play count. In part B, the chords continue with six notes, but the list is rotated to allow moving through the permutations of the chord, until the complete twelve PC are used.

The improvisers are asked to improvise around the notes as they are introduced in the ensemble, and during part B they start preparing the next section, by creating a gradually denser texture, together with the live processing of their sound.

4.5 Section 5

Fig. 9 Section 5

In this section, the improvisers (instruments and live processing) are left free to develop the materials (melodic, rhythmic, etc.) as they see fit. The selection of improvisers is open for each realization of the piece, as well as the real time effects processing. The piece doesn't pre-determine any special type of software programs or hardware processors, as there are only a few indications for these players.

In this section, there are absolutely no indications, as I intent to leave to the improvisers the space to develop any of the previous materials according to their own ideas and perspective on the piece.

4.6 Section 6

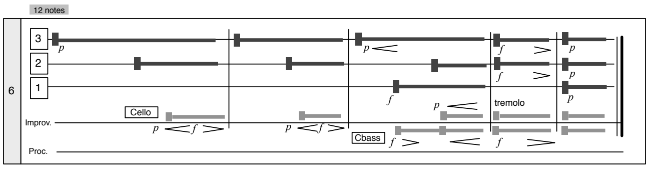

Fig. 10 Section 6

The last section gathers some of the ideas introduced in all the previous ones, and finishes with a block chord of the twelve PC similar to the very beginning of the piece, but in piano, and with both the ensemble and the improvisers together. The texture and gestures are a combination of the crescendo-diminuendo and static notes of the previous sections, and the PC filter is completely open to allow the twelve notes of the chromatic space to be played.

5. Conclusions

This piece was intended as a study on both the use of conventional harmonic and melodic procedures in the context of the laptop orchestra, and the exploration of the creative and compositional potential of the use of computer mediation through wireless network communications between the performers and the conductor. Only a few possibilities were included in the piece, while some others were tried and left behind. More importantly, the composition of this piece together with the custom software developed, revealed very promising for future developments, and while some conventional composition procedures can be used in the composition of a piece for this medium, it is even more exciting to explore the new possibilities offered by the use of the control and communication technologies and strategies. Some of the processes developed wouldn't be possible in other contexts, including the use of indeterministic procedures to obtain subgroups of pitch-class sets, in a process that could be loosely described as "indeterministic serialism". The title of the piece is meant to be as playful and superficial as it sounds, as a mere and intentionally light invocation of the term serialism, that I believe carries a sometimes inappropriate and disproportional heavy bourdon in composition history. It is nevertheless, a statement of the possibility of developing this kind of compositional operations (as are many others) in this context.

It is my conviction that the laptop orchestra is a vast and exciting medium for computer and electroacoustic music creation and performance, as well as a powerful and engaging pedagogical device. Although there is already a considerable number of laptop orchestras and compositions, there is much to be done concerning the creation of a repertoire and the use of compositional processes that are both specific and adequate to this medium, as well as rich and thorough.

Acknowledgments

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piece, as well as the improvisers, instrument students Ricardo Sousa (double bass) and Pedro Cruz (cello).

Notes

[1] http://plork.princeton.edu/index.php

[2] http://slork.stanford.edu

[3] http://slork.stanford.edu/history/

[4] http://www.ialo.org/doku.php/laptop_orchestras/orchestras

[5] EME at the School of Applied Arts of the Polytechnic Institute of Castelo Branco

[6] Although some pieces for the laptop orchestra may include acoustic instruments, they are in principle not a fixed member of the orchestra.

[7] OSC: Open Sound Control network communication protocol. http://opensoundcontrol.org/introduction-osc

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