ÕDAIKO:

A REAL TIME SCORE GENERATOR BASED ON RHYTHM

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ABSTRACT

The interaction between composers and performers has recently acquired new challenges with the advent of scores in real time. Such systems potentiate new approaches to composition and performance by imposing new possibilities and constraints.

Õdaiko is a real-time graphical score generator and features a composer playing live electronic music, an assistant to the composer generating the scores and finally the performer(s). In this paper, I present Õdaiko, focusing on its implementations and the related composer-assistant-performer interactions as a basis for development.

1. INTRODUCTION

Recent computation and network power make possible to generate scores in real time thus opening a new paradigm for the composer-performer interaction.

In Õdaiko, I create a system relating rhythm, density changes over time, real time score generation and live electronic music. Scores generated in real-time pose novel approaches to composition and performance. The motivation to design Õdaiko was to explore the possibilities that such a system can contribute to the composer-performer relationship and to composition itself.

In Õdaiko, a score is generated in real time using graphic notation, providing cues to a performer (or group of performers) on when to play musical events. These musical events are pitches or other sounds relating to pre-defined electronic music events that are played live by the composer. In a performance using Õdaiko, the musician(s) have to respond to the music being played according to the temporal cues being generated by the system in real time.

2. STATE OF THE ART

Computers and network technologies have fostered and simplified the development of new interfaces while enhancing new relationships between musicians and composers.

The work done in this area has been increasingly growing in the last decade. Systems such as Automatic Notation Generators (ANG) [1], eScore [2] or Flock [3] address in different ways the use of real-time generated scores in performance, each of them focusing on different elements of interaction and different performance situations.

The ANG consists on various custom software tools developed to aid algorithmic composition. One of them is the LiveScore, developed by Harris Wulfson [1], which connects computers through a wireless network and displays a proportional notation system using a standard 5-line staff. A stochastically oriented algorithm accomplishes the data for the score. In this system synchronization is important and it is achieved by a moving vertical line indicating when and which to play. eScore was developed at Queens University in Belfast by McClelland and Alcorn [2]. Through an interactive drawing table, the composer can send musical gestures to the screen of the performers, and at the same time (s)he is triggering electronic music effects and/or samples. It features three different notation possibilities including page mode, scattering mode and scrolling mode, all of them based on standard music notation.

Flock [3] is an environment developed by Jason Freeman and Mark Godfrey that includes musicians, dancers, video, electronic sound and audience. Through a camera installed on the ceiling, the software keeps track of position of performers and generates musical notation according to the xy coordinates of the performers . The notation used is either standard or graphical. Throughout the performance, different musical density textures are created.

3. ÕDAIKO

Õdaiko continues the trend of live score generation. The main feature that distinguishes this system from the ones

presented above is its focus on rhythm and temporal-domain data. The sieves, developed by Xenakis [4], is the fundamental core of rhythm generation and music development, providing a way to place musical events in the time domain which the performers have to respond. All the previous examples presented here are pitch based whereas Õdaiko uses rhythm as the foremost structural element, not presenting any pitch indications.

3.1. Overview

Õdaiko offers flexible scoring possibilities. Based on a sieve formula, rhythmic events are positioned in time, allowing a composer to arrange rhythm and to modulate it in real time.

The Õdaiko environment produces graphical scores by the action of a human assistant who makes use of a dedicated interface to perform a pre-composed guidance score. In addition, the composer performs live electronic music having previously composed a guidance score for the assistant. The purpose of Õdaiko is to make available the possibility to structure music by means of rhythm and also offer the possibility to shape density and, consequently, formal structure in real time.

Õdaiko is a cross-platform, stand-alone application for performance developed in MaxMSP [5] and Processing [6]. The MaxMSP part of the application enables the composer to play live-electronic music, provides the interface for the human assistant, and sends data to be rendered as real-time scores by an application developed in Processing. All of the software modules communicate with themselves by Open Sound Control (OSC) [7].

3.2. The importance of sieves

Sieve theory was developed by Xenakis [4] and recently summarized by Ariza [8]. Xenakis used the sieves to produce pitch scales and rhythmic series in many of his compositions, although it could be used to generate data for several musical parameters. The sieve consists on a formula of one or more residual classes, combined or not by logic operators, producing a sequence of integers. A residual class consists of two integer values, a modulus (*M*) and a shift (*S)*. While the modulus can be any positive integer, the shift must be 0 or *M*-1. In Õdaiko, the modulus and the shift are notated *M@I,* as proposed by Ariza [8]. Given a sequence 4@0, each value in the sequence consists of all integers x where the following condition is satisfied: x%4==0. This is will produce the following sequence […-8, -4, 0, 4, 8…]. In Õdaiko only the positive part of the resulting integer sequence is used, up to a maximum of 300, to place events in time. It follows that if only one sieve is used then the sequence will be periodic with a period identical to the modulus. In Õdaiko, the sequence produced by the sieve is the reference to place musical events in a score. Although Xenakis used several combinations of sieves in his pieces, producing complex sequences, in Õdaiko only combinations of two can be used facilitating the assistant to make an accurate guess on how much a performer will play.

The sieve is one of the main elements in Õdaiko since it allows the assistant to work rhythm on the immediate present but also prepare the future shaping the scores in real time.

3.3. Beyond pitch notation paradigm

The focus of Õdaiko is the possibility to shape rhythm and form in real time upon an established framework, letting historical significant aspects like pitch, dynamics or articulations to happen spontaneously. Õdaiko notation doesn't provide pitch information, only rhythm.

Pitch, and the intrinsic musical features mention above, are dealt in rehearsals through collaboration between performers, assistant and composer, leading to the establishment of sectional areas and general sound textures. An established framework, or sectional area, is embedded in an assumption of materials fostering the composer to compose them in real time. This established sectional areas are the ones that the composer will use to create the guidance score, indispensable to the assistant.

For Õdaiko, I propose that rhythm should be the foremost feature of organization and development of music along a performance.

3.4. Typical Setup

A typical setup of Õdaiko will include a laptop for each performer, a laptop for the assistant and a laptop for the composer/manipulator of the electronic music. Each of these stations has dedicated software.

All the communications are accomplished using OSC [7] in a hierarchical structure from composer-assistant-performer. The composer controls the main clock and sends data to the assistant about succeeding sections of the piece, expressed in the form of letters, which he/she has to perform according to the pre-composed guidance score. The assistant then interprets and sends the data for the performer(s) computer(s) screen in order to render the score(s). In addition, the assistant can also alert the composer if he/she is doing, or is going to do, a solo.

3.5. The role of the assistant

In Õdaiko the composer performing electronic music is considerer as autonomous as each musician performing his instrument, creating the necessity to have someone dedicated for the score generation.

The assistant is someone who knows the system and essentially is able to facilitate the composer's musical ideas while generating the score(s).

The assistant is responsible for leading the music through the sectional areas, operating gradual passages in the scores, making his contribution active and vital in the musical outcome. Although he/she is interpreting a guidance score pre-composed by the composer (see Figure 1.), his interpretation and musical time flow contributes decisively to the musical outcome of the piece, making its influence significant in both the creative process of composition and performance.

Part A
Everybody start at the same time, with the same sieve, combined by the logical operation Union.
30@0
20@1
prob. size: big; shape: square

Part B
Slowly, instrument by instrument, start to break the pattern with regular patterns for each one.
Gongs should have sieves no less than 20@0

Part C
When all the instrument are playing different patterns, maintain the flow a little bit
Change to solo panel Sarons and one of the Bonangs – originally PR, MM, AP and JQ

Part D
Silence everybody at the same time
Electronic Music alone

Part E
After Electronic Music solo, one of the bonangs starts solo again – originally JQ

Part F
Send the same sieve to everybody (for instance 20@0)

Part G
Put in silence one instrument after the other but in such a way that the Gong finishes last.

Figure 1. Pre-composed score

4. NOTATION AND INTERFACE

Non-traditional scores offer demanding commitment from musicians, especially if they are generated in real time. Õdaiko uses a graphical approach to notation based on the classical piano-roll.

Each score can have three different situations. These can be the sieves panel, the solo panel or the silence panel. The passages between each panel are made through a cue on the top-right corner of the screen that fades out.

4.1. The Sieves panel

Each sieve places moving events (from right to left) on a graphical staff (see Figure 2).

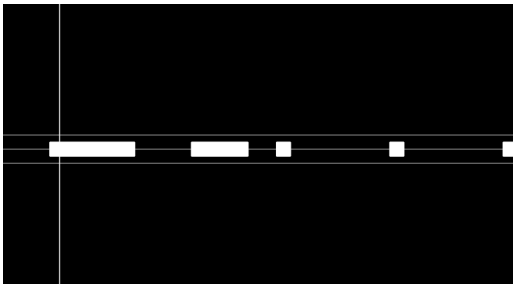

Figure 2. The sieves panel

These events should be performed when they hit a barline. The events can have five possible durations and three different shapes (triangle, square, or inverted triangle – see Figure 3). Each shape has a different performance intention. When the performer sees a square she/he should play the musical event with little or no modification over time whereas the triangle results in a dramatic change on the event. For example, if a square appears and the performer plays a chord, it should maintain itself still while if a triangle appears the same chord could be repeated over its duration while doing a crescendo or an accelerando. Although the shape for a stream of events is always the same, their durations is chosen making use of a probability scheme which includes the possibility of having most of the events big, most of them small or random size.

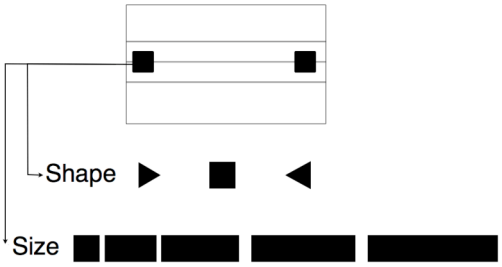

Figure 3. Event attributes

The score display is 1080 pixels width and 680 pixels height. The vertical barline default position is 120 pixels from the leftmost of the score layout. The smallest event is a square of 30 pixels and it represents the 16th note in reference to the main time/bpm clock. (see Figure 4). This means that there are 32 units divisions on the score. In the case of a sieve of 1@0 [0,1,2,3,4…300] it means that there will be an event in each unit division. In the case of 10@0 [0,10,20,30…300] it means that for each 10 unit divisions, it will be placed an event.

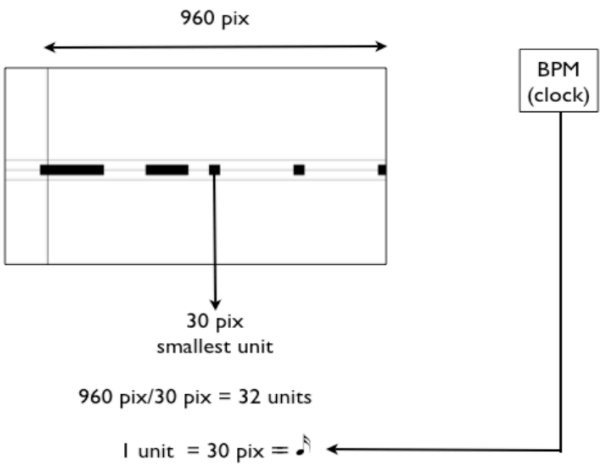

Figure 4. Pixel relationship

The assistant, in addition, can move the vertical barline along the x-axis. This results in smaller or bigger time spaces between the appearance of the event and its performance. The maximum displacement the vertical barline can have is up to 60 pixels from the right end of the score layout.

4.2. Solo panel

The solo panel (see Figure 5) allows the performer to do a solo. It features a line in the middle of the screen and a circumference in the middle of the line. Both randomly change brightness with occasional blobs of white shapes masking everything.

There is no specific musical meaning for the animation, however it has been helpful to enhance performers less comfortable with free improvisation, providing something to keep them going.

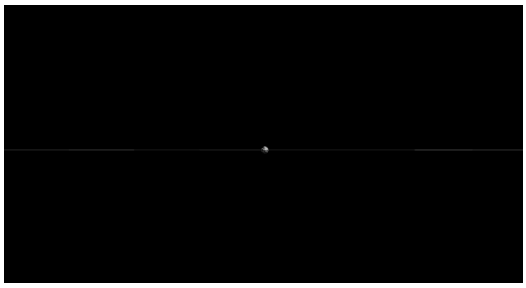

Figure 5. The solo panel

4.3. Silence panel

A black screen tells the performer(s) to stop playing

4.4. Assistant Interface

The application (see Figure 6) includes a section where the assistant can choose which panel to display in each performer screen, which sieve to use, the probability size of each event and its shape. He can also move the vertical barline that provides the cue of each performer. There is also a more general section that includes the possibility to change, at the same time, for the same panel, all the laptops. It is also possible to send the same sieve to all the laptops, enhancing synchronization of the ensemble, as well as sending a warning to the composer if he/she is doing a solo.

In addition, there are tools that provide the assistant to check if the wireless network is working properly and also to receive information, sent from the composer, about which section of the piece is being played.

4.5. Electronic Music Modules

Electronic music is performed using modules (see Figure 7). Featuring a maximum of 25 modules, they are designed in such a way to share common rhythmic characteristics.

Each module has two important parameters: The time distance between consecutive events and their associated time periodicity. The first one controls the time space for each event, and the second one, within the time space defined by the first one, controls its linked regular or irregular division of time. The composer chooses the time reference in beats per minute, which is the same that controls Õdaiko score engine.

A composer can sonically design each module, programming it in MaxMSP making use of a template. In this way and by the benefit of using a computer, the composer can address real-time synthesis based on rhythm at a sample level or control electronic music gestures making use of musical processes defined in each module.

In addition, the use of electronic music also offers the possibility to blend acoustical with electronic music.

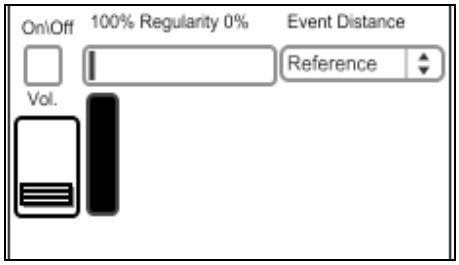

Figure 7. Electronic Music Module

Figure 6. Assistant Interface

5. COMPOSITION AND PERFORMANCE

Õdaiko allows the composer to shape rhythm and form in real time.

Using sieves allows the possibility of complex rhythmic textures, on a vertical or horizontal level. Aspects like beat, pulse and meter along with polyrhythmic and polymetric music can be enhanced within a group of performers. The sieves also allow exploring the aspect of time and form while generating and changing it in real time. Nevertheless, a long performance made only by the sieves panel could become troublesome and musically uninteresting. Since Õdaiko lends itself for performers comfortable with improvisation, a solo panel was added in order to free the performance from continuous limitations. It is also clear that, regarding rhythm, silence is as important as sound, thus, a panel of silence was incorporated. The mixture of all these three possibilities is very exciting and rich for composition and interactive systems.

The assistant is a vital part of the system since he is in charge of generating the scores and mediating the composer's thoughts. Upon a given structure, the assistant generates the scores and operates the gradual changes between each section of the piece, assuming him as a lead element for the musical outcome.

Figure 8. Performance Relationship Models

6. PERFORMANCE ISSUES

Õdaiko is tool for real time composition developed in a very personal compositional perspective. Generally speaking it allows a composer to address flexible musical densities in a stochastically way and in real time.

The most obvious challenge is the way the performers will interpret the graphical score giving the fact that no pitch indication is provided. This is particularly challenging as it goes against the traditional practice of instruments and also most of the academic music teaching. The performers also abandon the concepts of form and development since the scores are generated in real time. These features make the rehearsals one of the more important aspects in order to achieve a good performance.

The most musically effective performances have involved the use of percussion instruments such as the Gamelan or, in the case of pitch instruments, coherent pitch zones. This lends the performers a sonic quality that offers constancy in combination with recurrent electronic music pitched sounds samples.

7. FUTURE WORK

Performance based studies will be accomplished in order to attain a better insight on the matter of rhythm relations and graphical notation. A second parallel study will be about the constraints that a real time score has in performance.

Recent pieces composed for Õdaiko demonstrated that rhythm and real-time score generation can be compositionally rewarding and that the possibility of screen-based notation can be immense.

Different musicians and instruments, from traditional acoustical ones to electronic based ones, will be invited to play Õdaiko and share ideas and thoughts.

Õdaiko is intended for public release.

8. CONCLUSIONS

In this paper I've shown Õdaiko, a real time graphical score system based on rhythm that enables the composer to address rhythm in a structural manner. This way of addressing composition promotes the composer to establish rhythm relations "in the present" but also to focus on musical form, thus, the future.

The usage of real time graphical generated scores enhances new relations between composer, performers and performance itself. I then presented some practical outcome and future work to be developed.

9. ACKNOWLEDGEMENTS

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