Projekt Komposition-Computermusic
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Recursiones: A guided approach from the conception to the performance of a Live-Electronic piece.

Electronic Music has opened the means of sound production and manipulation beyond the use of typical acoustic music instruments. This has lead to an interesting field of experimentation, research and development of new instruments, interfaces and interaction possibilities own solely to electronic music. The performance practice of electronic music has created a wide range of manifestations that explore the interaction between the performer and the electronic music instruments. From Laptop performers to embodied electronic music, the interaction possibilities is one of the main interest of electronic music performance in realtime.

The following analysis covers three fundamental aspects of my piece for Live-electronic performer *Recursiones* from 2013 starting from conception and exploration of the instrument, its formalization and finally the notation of the score. In the first part I will describe technical aspects regarding the construction of the different synthesizers that create the musical instrument used in the piece. The following chapter handles formal aspects of the piece in relation to the patch's architecture, its immanent manipulation possibilities and the influence that the external interface as well as the parametric mapping has on decisions that impact the compositional concept. In the third chapter I discuss the role of Notation in live-electronic music and pose some questions regarding this practice and its relation to traditional notation as a means of conveying the piece its character as such, followed by a detailed description and explanation of the notation of the piece for performance practices. In the last chapter I make a retrospective overview of the piece, and address some problems that electronic music faces if viewed as a common performance and interpretation practice in a similar manner as instrumental music.

The Digital Instrument:

Live electronic performances require electronic music instruments or synthesizers that one can customize to one's own particular interest. This instrument, in analogy to the ones used in instrumental music, have a wide range of possibilities like an ensemble with different timbres; or can focus on one particular sound as if it were a solo instrument. This depends on the composers idea for the piece, on the tools that he or she has at his or her disposal. There isn't, however, a particular convention in this respect in electronic music, every electronic musician builds up his or her own setup, it is a practice more related to the production studio where the composer can patch different generators with different effects to produce sounds. The software used to program this synthesizers contain many different elemental generators and effects such as Synthesizer, Filters, Processors, Sequencers that can be interconnected, expanded and customized. These are then designed to be operable through different interaction devices such as Mouse, and Keyboard within the computer, but can be also controlled externally through other devices such as Midi-interfaces, Arduino or other Microcontroller-related interfaces and other motion tracking technologies originally used in the gaming industry such as Nintendo Wii or Microsoft Kinect. In my opinion the interaction with electronic instruments is vital in the composition process, specially if the piece should be performed in a live situation without the use of automatizations or other sequences. In this case the interaction becomes an important part of the piece as a whole.

The Synthesizer used in *Recursiones* is made up of four different granular synthesizers, two granular sequencers, and two convolution synthesizers. Each synthesizer has its own modulation parameters with some similarities between them. The piece uses audio files for the sound processing material. The audio files are loaded into different buffers and are processed in realtime by the synthesizers throughout the piece. I was very interested in realtime manipulation possibilities given by the granular synthesis instrument because it allowed to do very “plastic” manipulation possibility of the sound material.

The audio material for the Buffers:

For the sound material of the piece I used feedback recordings that I manipulated to get some derivations. This was the main material of the piece, however I also used also some contrasting material like a processed Gong recording and some other processed sound files that

shared a “metal” kind of sound with the original feedback recording. The sound files were loaded into six buffers. The sound files never sound in the piece in their original form, they serve material for the granulators.

The Synths:

Granular Synthesis is a powerful sound generation and manipulation tool that allowed me to shape the sound in different ways simultaneously. In this piece I use the Granular Synthesis techniques to make variable time stretching, grain density and duration modulation as well as pitch shifting and buffer position modulation. Another important component of the synthesizer are the convolution units that convolve (multiply) the spectral information from a recorded sound file (Kernel) with a Pitch shifter module in real time. The sound gave a very plastic feel, that was a a good contrast the sound material prepared in the buffers. Even though the Granulators and the two Convolution synths produce very different results I found a way to combine them to create differentiated sound textures throughout the piece.

Synthesizer Components:

In the following section I will describe briefly the instrument name and the parameters that are used in the piece. The Synthesizer is programmed in Supercollider.

Granulator 1: Granular synthesizer with the following variable parameters:
Buffer: the sound file to be played.
Amplitude: The overall amplitude of the synth.
Playback pitch: The pitch of the playback.
Grain density: The number of grains to be generated.
Grain size: The size of each grain.
Buffer position: The position inside the buffer.
Buffer read speed: The speed with witch the buffer is being read.
Pan: the panning of the instrument is made through a VBAP (Vector Based Amplitude Panning) module with 8 channel outputs.

Granulator 2: Modular synthesizer with a Granular synthesizer and an FFT-Freeze module with variable parameters:
buffer, amplitude, playback pitch, grain density, grain size, buffer position, buffer read speed, pan and freeze toggle.

Granulator 3: Modular synthesizer made of a Pitch shifter and a Granular Synthesizer with variable parameters:
buffer, amplitude, playback pitch, buffer position, grain density, grain size, pan,
pitch range: the modulation of the pitch of the pitch shifter module,
pitch dispersion: the pitch dispersion degree from the center pitch of the pitch shifter module.

Granulator 4: Modular Synthesizer with an FFT-Bin Smear/Freeze and a Pitch Shifter module with variable parameters:
buffer, amplitude, pitch range,pitch dispersion, pan and freeze toggle,
Bin Smear: Average a bin's magnitude with its neighbors.

Two Granulator Sequencer units with variable buffer: Two sequencer routines that modify the sound files in similar ways as the granulators but automatized.

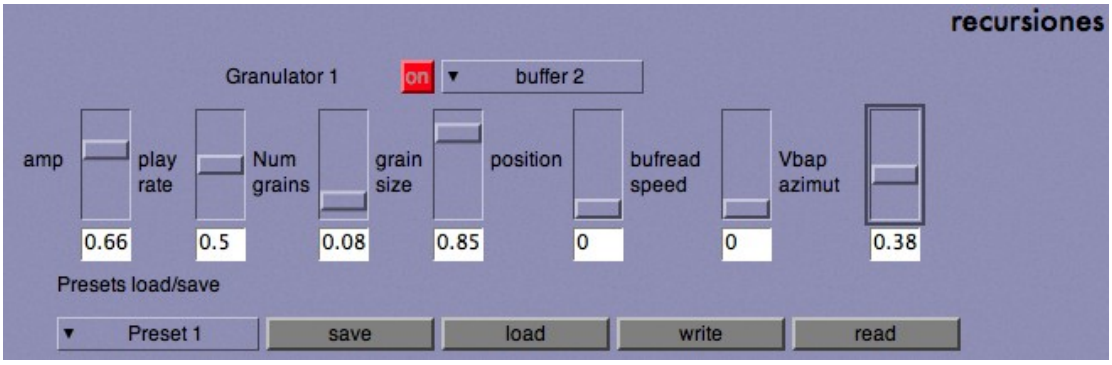
Convolver 1: Convolution synth running thorough a sequencer with adjustable amplitude and pan.

Convolver 2: Modular synthesizer with a Convolution synth and a Pitch Shifter module with adjustable amplitude, pitch range and pan.

The Graphical Interface:

The graphical interface "GUI" is a representation of the parameters to modify in the synth. It should only display the most important elements and leave out all unnecessary, unused or redundant information. The graphical representation of a an instrument gives us an understanding of its operability and at the same time conditions its exterior manipulation e.g. a fader in a GUI corresponds to a fader in the hardware interface. Non the less, the mapping of the interior parameters of the synth to its exterior manipulation device could be completely different, given other kinds of computer/performer interaction. In this piece I limit myself to a fader/button graphical representation. Mainly because its intuitive operability permits you to see what is being modulated in the synth, and permits you to use the mouse as an interaction device.

One other important aspect of the GUI and also of structural relevance to the piece is the Preset function. The Preset function saves different parameter setups that can be saved and loaded in real time. This feature enables the performer to change the preset and thus control more than one parameter of each synth simultaneously. The impossibility to operate more than one parameter of each synthesizers at the same time made me rely on the preset function as a gradual multi-parameter modulator and became an important aspect of the composition. In *Recursiones* I limit the operability of the synth through the preset function and some other parameters that I will explain in the following chapter.



Graphic 1. GUI-Exerpt of the Recursiones-Synth. The Granulator 1 Synthesizer with its control parameters and Preset Unit.

The graphical representation of the Synthesizer can make its operability directly dependent of its representation. e.g. The “Num grains” fader increases its position from 0 to 1 and makes a linear increase of grains from 1 to 130 per second. All the parameters in the synthesizer are mapped linearly where each parameter is assigned to one fader in the GUI that behaves in a linear way. It is possible, however, to make more complex mappings where the parameters do not behave in a linear fashion. It would also be possible to map two or more parameters to a 2D fader with a X and Y coordinate to two different parameters that are codependent of each other, this would turn the fader into a matrix and the 2d representation be symbolic of an n-dimensional parametric space. There are, however, other kinds of Graphical representation that simulate a 3-d Space

The external interface:

The original Idea for the operability of the synthesizer was to manipulate many of the parameters as possible in realtime. As the synth continued to develop It became very complex and its operability as originally conceived somewhat unpractical. The final version of the synthesizer had more than 30 faders and 10 buttons, therefore the mapping of the parameters to the external interface with which the synthesizer was to be controlled became a problem. For the first version on the piece most of the parameters of the synth were assigned to faders, knobs, buttons and keys of the following device:

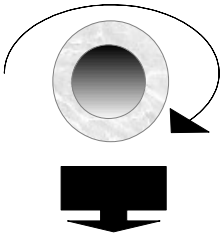
1) Behringer BCF2000 "B-Control" with eight knobs, eight faders and 16 buttons and multiple preset function.

Even though the mapping of most of the parameters was possible, it was still necessary to create many "scenes" on the interface in order to to cover all the parameters. This limited the operability to certain combinations of mappings per scene and made it impossible to manipulate certain parameters simultaneously. The consequence of this restriction had an impact in the performance of the piece due to the impossibility to make drastic changes or contrasts in a short period time because of the mapping constraints of the external interface and the physical limitation of the performer to control only two parameters at once.

After having performed the preliminary version of *Recursiones* I realized that the mapping that I had chosen did not work in the way I had expected. Some questions arose regarding the piece, its performability and the compositional concept behind it. In this moment I realized the importance of the external interface as an instrument, and how the performance of the piece is very entangled to the interaction interface that one chooses, in a similar way a piece for a particular music instrument is idiomatically written for it. I sought to understand the operability of the interface, to learn its idiomatic possibilities so I could use this to my advantage.

For the final version of the piece I wanted to optimize the operability of the synth and avoid the constant changing of scenes of the external interface so I could concentrate on fewer parameters. It was a somewhat difficult task to constraint myself without being monotone. In the last chapter I mentioned how a preset function was implemented to have access to multiple parameters at once with just one button. As I explored the features of the interface I discovered some features that helped me develop the the concept for the piece based mainly on the preset function. This was possible due to the functionality of the "BCF2000" interface that I will describe briefly:

Graphic 2: Upper part of the BCF2000 - "B-control



Graphic 3: Dagram displaying the functionality of the knobs.

The row of knobs on the upper part of the interface has a double function that permits a double action: rotation and toggle. This feature allowed to map the knob to the preset menu of each synth and the button feature to the preset load function. Since I relied almost completely in the preset function to change the sound gradually this became a central part of the piece.

On the first version of the piece I limited the use of the preset function to contrast changes of the sound texture and gave little importance to this feature. Given the limitations mentioned above and the practical fact of its operability in the external interface I used the preset function as a discrete modulator that is key to the piece as a whole. For every synth I created a discrete "modulation path" inside a sound continuum and saved each configuration of the modulation path as a preset. Every synth has its own path, although they all share similar passages, but then develop into different directions of the sound continuum. The Formal concept consisted on a slow developing stream of sound with small interruptions that acted as contrasting entities to the main sound stream. The interruption opens the sound texture and sometimes closes it back to the starting state. Gradually the interruptions become irrecognizable as such as the sound stream expands in timbre and becomes more diverse.

Notation

Music: a notated practice

Music regarded as a social practice needs is a means of communication that in order to be understood and performed socially by a group of people needs to be codified. In doing so it has created a convention and a practice that people can understand and partake in. Western music notation has undergone a long process of development and standardization through out its history, and has even replaced traditional musical systems of notation in non-european cultures. It has developed roughly from a graphical representation of voice inflections in the neumatic notation of the 9th century through a period of symbolic latticed representation from the early baroque to the romantic period and slowly back towards a graphical representation of sound on certain cases of the 20th and 21st century.

The relations between speech (intonation) and notation were slowly replaced by relations between text, pitch and rhythm, as the texture became polyphonic leaving slowly the characteristics of timbre slowly out of the representation, focusing on the pitch content, dynamic and duration as the main aspects to be represented. Electronic music poses some questions about the usefulness and purpose of this practice in relation to a music where the notated cannot often be reduced to a series of symbols and signs; where the timbrical changes of sound become an important aspect of the composition; where sometimes no performative informations are conveyed. For the acusmatic music notation has reached the point of becoming superfluous, only some composers still notate their fix media pieces. Non the less, graphical and or symbolic representation of sound has proven to be a useful analytical tool for the structural-functional understanding of electronic music. Such is the case of Stéphane Roy's analytical method of analysis of electronic music.

Notation is still relevant for electroacoustic music setups such as solo instrument with fix media tracks and/or live-electronics because it requires the synchronized execution of a performer together with an electronic part. There have been some attempts to create a convention in the notation of electroacoustic music where signs of traditional notation have been incorporated to represent time structures and dynamic processes. In this cases the score handles timing aspects between the performer and the electronic part and information about the content of the sequence is reduced to short textual descriptions or very basic graphic representations of certain sound processes.

On the other hand, notation could be understood as an inherent necessity from a scribe-oriented civilization, where only the notated acquires validity and is thusly allowed to enter the world of objective scrutiny. In this case a notated piece of music legitimizes itself as a "composed piece" with a measurable form opposite to an improvisation or an electronic music piece that escapes written fixation. Non written musical practices pose questions concerning the hierarchical relevance of notation and undermine its hegemony in a current performance practice of live electronic music.

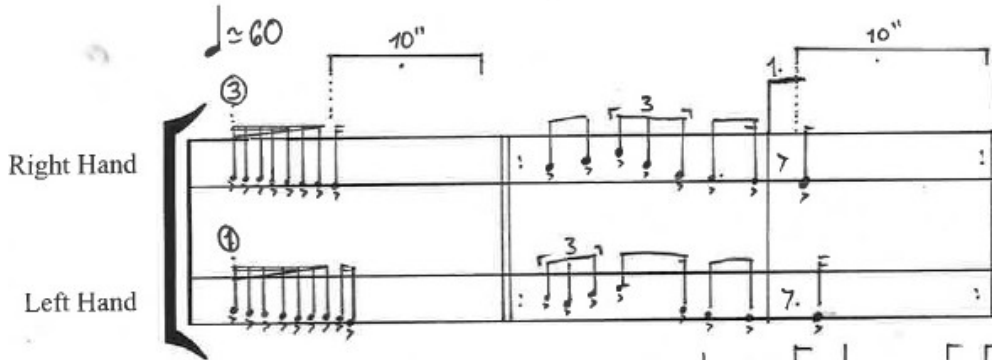
The advent or portable synthesizers, sequencers and sound generators, of personal home and later portable computers enabled the creation and production of music at a larger scale. This created a new kind of individualized non-academic solo electronic music composer/performer and became a performance practice where notation as a means of conveying performative instructions became less and less relevant. The variety of the external interfaces and controllers and the ongoing development of newer TUI (tangible user interfaces) present some problems in the conventionalization of a notational practice. I have talked earlier about the interaction between the interface of an electronic instrument and the performer in relation to the conception of a piece: Idiomatic gestures inherent to the interface might have an important role in the conception and performance of the piece that the replacement of the external interface would mean a modification of the piece as a whole.

In my opinion the score of a piece for live electronic performer should be strictly related to the interface with which the piece is to be performed. The score in in this case a sort of tablature for the particular interface, the "performing instrument" and it would serve the performance of this particular piece provided that the interface is the same. Even though this practice of electronic music is performer oriented, the use of a performance score can help guide the performer, so that the performance can be reproduced in different occasions without relying solely on memory.

The notation of Recursiones

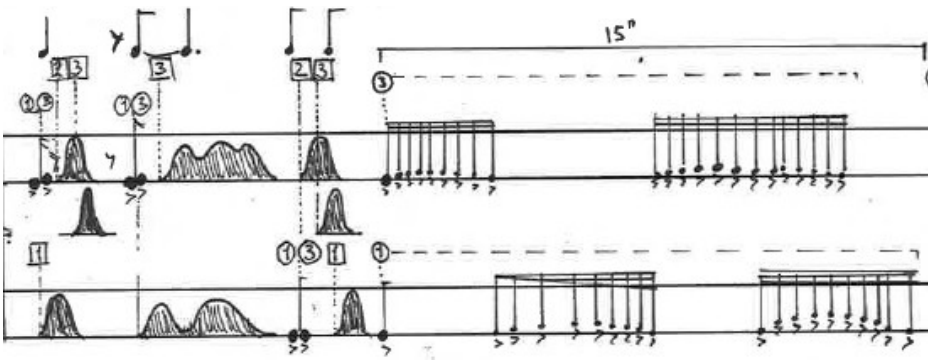
The score of *Recursiones* uses conventional musical notation with some graphical elements that represent the movement curves and position of the faders and knobs. The first important decision was to decide what actions should be represented and how. An efficient representation method for the Interface was important for the interpretation of the score: how to represent the knobs, the faders and the buttons so that the piece could be read and performed. For the general layout I decided to separate the actions of the two hands and placed them in different systems

placing the actions of the left hand on the lower system and the actions of the right hand on the upper one. The vertical space between the two lines of the system represents the value space of the parameters. The knobs are indicated with a number inside a circle, the faders with a number inside a square and the Buttons with a capital letter inside a circle and are written below the lower system. The notation of the piece focuses mainly on the rhythmical triggers and modulations contained in clear segments of time. It is, however, less strict on certain aspects regarding the choice of the material through the preset function that I mentioned earlier.



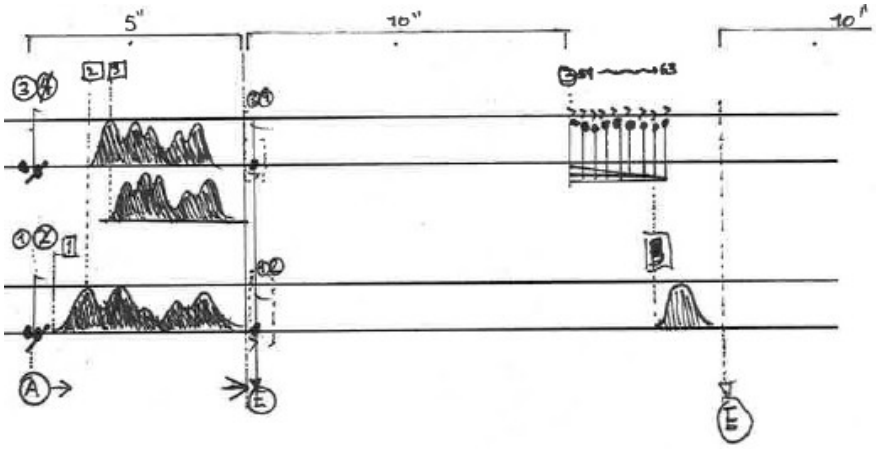
Graphic 4: Opening bars of Recursiones (Hand written score). The hight in the System represents the value space each of the parameters. In the first bar it represents the Preset Bank of each synthesizer.

The first section of the piece focuses on the knobs that access the preset bank of each synth. the space between the two external lines of the system represent the range of the presets from preset one at the lowest position on the line to the last preset of each synth on the top line. The spatial notation is related to the approximate position of the knob or fader in relation to its range. The accent on every note indicate when the knob should be pressed down in order to set the new preset.



Graphic 5: Representation of pitch, grain density and grain size modulation. Followed by a discrete preset sweep of the first and third synthesizer.

As I mentioned above the preset function became a very elemental part of the composition because it allowed to make sudden multi-parametrical changes in the setup with just one button. In the second and third part of the piece I used the preset function to jump to particular preset configurations of all synthesizers simultaneously. This function helped me create contrast and delimit formal sections. It was through this function that I could open and close the sound, by this I mean change suddenly from homogenous sound textures to heterogenous ones with just one button. The buttons are also used for the triggering sequences, the convolution synths, and for turning the four main synths On and OFF.



Graphic 6: The letter A stands for a sequence trigger to be pressed during the five seconds. The letter E inside the circle corresponds to a change in presets of all the synths.

The time structure of the piece is somewhat fix, and allows some flexibility regarding the passages where no tempo indication is given. The duration of these passages is up to the performer to decide how long they should be, however, the performer should not exceed a relative time segment depending on the length of the particular sequence in the score in terms of spatial notation. The amount and velocity of the modulation of the faders is relatively free, the score serves as a guide but the performer is free to do some arrangements as he or she pleases.

In spite of the relative freedom allowed the piece has a clear form with elements that have clear structural functions, in opposition to an improvisation that might rather take an instantaneous approach to the instrument without material relations between each segment and that might also sound different every time the piece is performed since there is no temporal fixation on what should be first and what should come after. As I remarked earlier: notation fixes down an Idea for its documentation and later reproduction.

Conclusion

The detailed analysis of *Recursiones* helped me become aware of the different levels that interact from the conception to the performance of the piece and at the same time allowed me to observe my personal way of working in order to be able to theorize and reflect upon it. I consider the conscious realization of the artistic intentionality to be an elemental aspect in the compositional process because it allows us to objectively analyze the way we work. The analysis and its textual fixation also helped me become aware of some problems regarding live-electronic setups in relation to its performability as a common practice in opposition to a composer/performer based practice where notation becomes less and less compulsory and the performing platform (software/hardware) is always different according to the case.

Regarding the question of the perdurability of the piece, it is sometimes a problem to perform a piece including live-electronics after some years due to further software developments that require constant upgrade of the instruments' code so that it can be compatible with newer versions. This undoubtedly poses some important questions concerning the actual practice of electronic music and its sustainability as a collective practice since there is no compatibility between the different tools used in the composition process that would allow the possibility to choose a platform according to each case and there isn't a general convention either regarding the notation. In order for a shared performance practice to be possible the electronic musician should be able to use all platforms, or the pieces should have to be notated at a very elemental yet technical level so that it could be implemented on any platform according to the performers choice. Because both scenarios are highly unlikely to establish themselves at a large scale I believe this practice will continue to develop as an individualized musical practice of our time.