

FULL AUTOMATION IN LIVE-ELECTRONICS: ADVANTAGES AND DISADVANTAGES

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ABSTRACT

The paper's aim is to show a personal approach to the programming of live-electronics, which relies on the full automation of the real-time processing. After defining the term 'live-electronics', the article gives a summary of the main periods of development of what is generally understood today by this term; it further describes in a general way the tools and methods/processes employed in each period. Finally, the last few sections explain the way automation is implemented in some works of my own since 2002 (all utilizing full automation of the electronic part), showing the most important features and techniques involved, added to the advantages and disadvantages involved in the automation of most (or all) of the real-time processes in those works. Automation is not a new technique in the live-electronics scene, but full automation as described here needs some special attention, due to its impact on the performance and its perception. This paper aims to fully explain these main issues in the last sections in the light of my own experience as a performer and composer/programmer in the past 15 years.

1. INTRODUCTION

To start a discussion about this particular subject, I find necessary first to define the term *live-electronics* and its implications. The "ElectroAcoustic Resource Site project" (EARS)¹ defines it as: "A term dating from the analogue age of electroacoustic music that describes performance involving electronic instruments which can be performed in real-time. The term is more commonly expressed today as music involving interactive instruments." [1] This generally implies the interaction, which transforms and/or processes live or recorded sound in real time.

Although in the last 40 years many very different types of interaction have been identified as *live-electronics* (LE) and therefore many types of musical pieces can be included in this category, my preferred choice is to analyse the history of live-electronics from the perspective of the historical development of the technology employed. Normally, when I teach the subject, I consider three periods, which however do not intend to be either inclusive or exclusive; the purpose here is to give a general view of how interactive music art has been changing through the periods mentioned and therefore contrasting aesthetics emerged for each period. These periods can be found in section 2 below.

2. BRIEF SUMMARY OF HISTORICAL PERIODS

As mentioned above, these periods have been categorised by the type of technology involved in the LE processes available during their own time:

2.1. Analogue live-electronics, ca 1960-1970:

During this period, no digital equipment was available, but even if some electrical devices like the Theremin which could be as well considered as a real-time sound processing were already in use several years before 1960, it was not until the middle of the 1960's, that Karlheinz Stockhausen, (Germany, 1928-2007) began to experiment and compose (and actually write even detailed scores for the electronic part for his pieces), that we can really talk about live-electronics as defined above. The 1960's saw not only a rapid analogue development of equipment (the most significant might be arguably the Moog synthesizer, from 1964), but also a lot of experimentation with other sound synthesis methods. The most common for this period were: *filters and different types of modulation*, mostly amplitude modulation (AM) in its easiest form: ring modulation (RM).

Some important works by Stockhausen during this period are:

- 1964: *Mikrophonie I* (Tam-Tam, 2 microphones & 2 filters)
- 1964: *Mixtur* (5 orchestral groups, 4 sine generators & 4 modulators [RM])
- 1965: *Mikrophonie II* (Choir [12 singers], Hammond & 4 modulators [RM])
- 1970: *Mantra* (2 pianos, RM, sine generators)

2.2. Analogue and digital live-electronics, 1970-1990:

This period, which is quite long, combines the path from pure analogue equipment to digital devices. While Stockhausen concentrated by the end of the 1970's in his major project *LICHT* and quite abandoned the kind of real-time processing he initiated in the 1960's in favour of synthesizers, tapes, live mixing and transmitters, other composers like Luigi Nono (Italy, 1924-1990), did the inverse path, composing many pieces for tape in the 1960's and 70's and turning to LE from the end of the 1970's.

The most common processes used in this period are *delays and reverberation*, which can be found in some important works by Nono during this period:

- 1979: *Con Luigi Dallapiccola* for '6 esecutori di percussione e live electronics'.
- 1981: *Das atemde Klarsein* (Bass flute, piccolo, choir, tape & LE)
- 1983: *guai ai gelidi mostri* (Ensemble, LE)
- 1984: *Prometeo* (Singers, orchestra, LE)
- 1985: *a Pierre, dell'azzurro silenzio, inquinatum* (Flute, clarinet, LE)
- 1987: *Post-Prae-ludium per Donau* (Tuba, LE)

2.3 Digital live-electronics, 1990 - nowadays:

The development of the digital techniques and devices began

¹ <http://www.ears.dmu.ac.uk/>

already in the 1980's, but it was not until the 1990's, that almost every kind of real time processing could be achieved. The types of processes involved increased, whereas some new were discovered or even if existent, they could only be properly applied in this period. The synthesis in real time include from this period processes like *Convolution, Granulation, Modulation, Delays, and even Spatialization*², etc. At the beginning of the 1990's, computers alone were not in the position to cope with the power needed for real-time processing. Therefore, additional hardware like the ISPW [2] (*IRCAM Signal Processing Workstation*)³ or the AUDIACSYSTEM⁴ was needed. With the appearance of the G3 processors on Macintosh computers and laptops in 1997, the additional Hardware began to be not indispensable and since then, most live electronics can be played directly from a laptop or computer (with or without the inclusion of an audio interface). Most common platforms nowadays are MAX/MSP⁵, PD⁶, etc. [3]

Some important works and composers during this period are:

Cort Lippe (USA) (University of Buffalo, NY)

1992: *Music for Clarinet and ISPW*

1993: *Music for Sextet and ISPW*

1998: *Music for Hi-Hat and computer (MAX/MSP)*

Pierre Boulez (France, born 1925)

1997: *Anthèmes 2* for Violin and LE.⁷

I would like to add here my piece *Gegensätze (gegenseitig)*, for alto flute, 4-track tape and LE from 1994, as it was the first piece composed for the AUDIACSYSTEM after a quite long period of research and development at the ICEM - Folkwang Hochschule Essen (Germany). [4]

3. GENERAL CONSIDERATIONS FOR PROGRAMMING AND COMPOSING PIECES INCLUDING LIVE ELECTRONICS. AN ALTERNATIVE APPROACH: AUTOMATION

Since 1998 I have been constantly composing pieces for instruments and live-electronics using MAX/MSP; in most of them, I have programmed them using complete automation of the real time

² Algorithms to simulate the movement of sound from one speaker to another, generating a sense of surrounding sound environment.

³ A project started in 1989 at IRCAM (Paris-France). It involved a real time synthesiser card for the NeXT computers.

⁴ AUDIACSYSTEM: hardware-and-software environment for real-time processes, a project carried on by the ICEM (Institut für Computermusik und Elektronische Medien) at the Folkwang Hochschule-Essen and the company Micro-Control GmbH & Co KG, both in Germany. The people involved in its whole design were: Dr. Helmut Zander, Dipl. Ing. Gerhard Kümmel, Prof. Dirk Reith and the composers Markus Lepper and Thomas Neuhaus. The project began in 1987 and involved not only the hardware architecture, but also the software itself, which was exclusively created for this particular environment (APOS). The hardware architecture of the AUDIACSYSTEM was conceived with the principle of the specialized subsystems. It has not only been made to generate organized forms for the musical production, but also incorporated the generation and working up of sounds in real-time. The whole implied at its time a huge measure of different demands in relation to its computing potential, which could only be solved with the above mentioned subsystems and their communication capacities.

⁵ MAX (without the MSP part, which means 'Max Signal Processing' was developed also at IRCAM (Paris-France) from 1980 by Miller Puckette. It works with a set of objects than can be connected with each other. The first development for the Macintosh included only MIDI. From 1997 David Zicarelli used the PD audio part developed the year before by Miller Puckette and released MSP, as the DSP part for MAX.

⁶ By 1995, as the ISPW hardware was being let aside due to cost reasons, Miller Puckette (creator of MAX) began to develop PD (Pure Data), an improved version of the latest MAX/ISPW and mainly MAX/FTS.

⁷ Electronics (programmed at IRCAM by Andrew Gerzso) include pitch shift, spatialization in 6 channels, harmonizer and score following.

processes of the electronic part. This decision comes after considering the main basic issues involved in this kind of compositions, which are shortly exposed below:

3.1 Programming the electronics

Programming LE is a part of the compositional process. How much the degree of concordance between those processes and the musical (notated or improvised) part will become can vary quite substantially from one piece to another and from one composer to another. In the particular case of my own pieces, programming the electronics means that both music and electronics are essential parts of only one final product, the composition itself. Therefore, the creative process is only one, even if it involves different and additional steps compared to exclusive instrumental compositions. This conception implies a detailed and exact programming of each section of the piece, so that for each of them, both the desired musical and the real-time processes concur in the desired aesthetical and dramaturgical effect. In order to achieve this, the composer has to be in a high degree of control over both musical and programming aspects of the whole piece. *Automation* of the LE can be an affordable and very effective option for achieving this goal, as it will be later demonstrated.

3.2 Choice of equipment and devices

The main idea for the choice of equipment and devices for a composition involving LE should be based on the type of venues where this particular piece could be performed. Concerts involving live-electronics take place generally in academic circles and the pieces performed in a single concert could vary enormously (regarding instrumentation, type of devices involved, etc.). Therefore, the planning of the devices utilised for each composition could be resumed under the motto: "keep it as simple as possible". This concept implies and includes:

(a) **Equipment and platform planning:** the simplest way of setting up the equipment is generally also the most effective. Platforms that only work in fixed places have the big disadvantage, that they do not generally allow the performance of those specific pieces outside the context in which they were created. In this regard, pieces using MAX/MSP (for Macs or Windows), PD (multiplatform) or even SUPERCOLLIDER - the most common platforms nowadays- allow the performance of these pieces in almost any concert hall. With these environments, it is possible to transport the algorithms (patches) to any hardware (generally computers with or without audio interfaces), regardless of the hardware on which they were originally created. So, as we can see, a careful planning and a primordial decision has to be made in order to achieve the highest possible accessibility to the electronics in almost any venue. All these platforms allow the possibility of achieving complete automation as well.

(b) **Planning the type of controllers and switches used by the performer on the stage to trigger the LE:** there is a direct relationship between the number of the extra activities required by some LE processes to be initiated or triggered by the player and the increasing amount of added technical difficulties, which in many cases can be detrimental to the concentration of the performer and also of the audience (with its impact on the perception of the piece). In many cases, performers have to wear different devices in their clothing, or activate several pedals or switches, which in some cases, must be triggered very fast and even with special movements, all what might contradict the dramaturgy involved in the music. In other cases, the switches are left to a second person, usually the composer, who triggers

those processes via controllers or a mouse. This latter case has a positive effect on the concentration of both performers and audience. However, if the person in charge of that particular activity is not the composer, it is in my experience very difficult to find someone who will spend the necessary time rehearsing how to activate them in an impeccable timing (important for the synchronization of the live interaction between instruments and LE), not to mention the issue of which process comes at what time. Normally this person should be a trained musician, capable of reading the music, following accurately the score, and also having the knowledge of how to activate every single step of the LE. Some pieces may allow more freedom than others regarding the processes involved and the way they are used in a piece of music. But if specific processes are required at a specific time, manual steering of the system does not always end up in the intended results.

Automation is therefore a valid alternative for all the cases mentioned above: it can set the performer as free as possible from any extra-musical activity and there is no need to have the composer or somebody versed in music to trigger the LE (allowing more frequent performances of pieces too). In this way the performer is allowed to concentrate solely on the interaction with the electronics and on the music itself, without the need of having to activate pedals or other devices of the kind or to be anxious on what the second person will do (or not do) during the performance.

One way of achieving this is using different types of *score-following* algorithms, which actually follow the pitches played live; this is normally the case of pieces having a full written score and therefore, it is not quite frequent regarding improvised pieces, depending on the degree of improvisation included in each particular case. A typical case for this is the already mentioned *Music for Clarinet and ISPW* by Cort Lippe, who wrote a paper in 1993 about this particular piece and system, using MAX [5]. A further example from 2003 is Noel Zahler's *Concerto for clarinet, chamber orchestra and interactive computer* composed under the same principle, even if using completely different algorithms as the ones applied by Lippe. In Zahler's case, the computer uses a -by that time- new score-following algorithm, which was created by Zahler himself, Ozgur Izmirli and Rob Seward; the algorithm was especially programmed for this composition using MAX/MSP [6]. In the past years, several composers have been using on MAX/MSP the IRCAM software FTM, which basically is a real-time object system and a set of optimized services to be used within MAX/MSP externals. These include score-following as well. *Etudes for listeners* by Miroslav Spasov (University of Keele, UK), for piano and LE, is a good example of this. And of course, Boulez's *Anthèmes 2*, as already indicated in section 2.3 (footnote). [7]

Another way of achieving synchronization without the need of a person activating the LE is the usage of Time Code. TC in the form of SMPTE shown on a display on the stage makes a quite simple but effective solution to how automated processes can be synchronised. SMPTE displays are not easy to find, but there are several companies (many of them in Germany) building and selling them. There are several ways of sending the SMPTE to the display: one is to generate it for each performance; another one is to have the bi-phase modulated square wave recorded as an audio file within the LE software (e.g. MAX/MSP), which then runs during the whole piece, beginning normally by frame 00:00:00:00.

3.3 The performer's role in the piece

For pieces including LE, it is essential, that the performer is given a clear idea about the own role throughout the piece. To allow this, the piece must be generally edited in a full score (or similar, like e.g. precise graphics), which include some type of guidance, giving a clear picture of what to do at each particular moment of the piece and how to interact with the LE on the stage.

4. EXAMPLES OF AUTOMATION IN SOME OF MY OWN COMPOSITIONS

If automation at some degree is the choice to achieve a performance in which some of the topics mentioned above have been considered, the composer/programmer normally has two basic decisions to make: firstly, the degree of how much of the LE overall should use automation and how the performer can follow and understand it as simply as possible; secondly, the composer must weight the musical and technical advantages and disadvantages that automation implies for the intention of the piece and its performance.

In order to give a practical description of the former statements, it will be attempted now to show them applied on some pieces of my own authorship:

- *Intersections (memories)*, for Clarinet and live-electronics in 5.1. Surround Sound [MAX/MSP] (2007)
- *Hoquetus*, for Tárogató (or Saxophone) and multi-track live electronics [MAX/MSP] (2005)
- *Ableitungen des Konzepts der Wiederholung (for Ala)* for Viola and MAX/MSP (2004)
- *NINTH (music for Viola and computer)* for Viola and MAX/MSP (2002)
- *Farb – laut E VIOLET* for Viola and MAX/MSP in 5.1 surround sound (2008)

4.1 Description of the works

4.1.1. *Intersections (memories)*

This piece for clarinet and 5.1 LE was composed based on a hidden story regarding real facts of my personal life. The audience though, is not supposed to know about the programmatic issue. Linked to this is the fact that the electronics are a substantial part of how the story is being told musically by the performance. Automation was in my view the only way to achieve an absolute accuracy between player and computer. This is best shown in the long notes (of variable duration) played throughout the piece, which are all the 18 notes with their original duration of the first Leitmotiv from Wagner's Parsifal (Liebesmotiv). As the notes are played in quite an isolated way, the audience has no idea of their real purpose. But the electronics record and store them in a cumulative buffer, so that when all notes have been played, the Leitmotiv appears (granulated) in its original form, having a very precise dramaturgical function. In order to record all 18 samples to be cumulated and playback as a full melody afterwards, absolute accuracy was required, which was not possible without programming the LE to work in absolute automation. Besides this particular case, a significant number of different DPS processes are activated, deactivated and reactivated in different combinations, all of them having a particular dramaturgical reason, acting together (and being excited by) the music composed for the live instrument. These DSP processes include granular synthesis, delays, reverb, surround sound (5.0 spatialization), real time pitch shift using a phase vocoder, etc.

4.1.2. *Hoquetus*

This piece was commissioned by Esther Lamneck (NYU) to be premiered at the Florida Electroacoustic Music Festival 2005. The instrument chosen was the Tárogató, although it can be also performed by a soprano saxophone. It works with multi-track live electronics (7 channels). It is based compositionally on the

concept of the “hocket”, a medieval composition technique (Ars Antiqua, about 1200) where different voices in the counterpoint alternate, creating an effect similar to a “hic-cup”, which is the meaning of the word *Hoquetus (truncatio vocis)*. Like the former example, several samples must be recorded, stored and played at very precise moments alongside several DSP processes. A special algorithm, which plays a hocket with the main instrument, by inverting the pitches played by Tárogató has also been incorporated and automated.

4.1.3. *Ableitungen des Konzepts der Wiederholung (for Ala)*

This piece for Viola and MAX/MSP works with the principle of repetition and its consequences and possible variations of the main musical materials (e.g. pitches, rhythms, form, etc). All DSP processes are also based on the concept of repetition. The main reason for the usage of automation for this piece, besides the ones already mentioned for the other pieces, is that the piece was composed to be played by myself. In this case, and in order to avoid problems regarding the steering of the LE, automation appears to be an ideal and natural solution for this special case.

4.1.4. *NINTH (music for viola and computer)*

Another piece for Viola and MAX/MSP; it works with music materials (pitches, rhythms, form and samples) taken from the 3rd movement (Adagio) of Anton Bruckner’s 9th Symphony in D minor. The main reason for this piece’s full automation of the LE part is similar to the one explained in 4.1.3. A main difference though, is that from all pieces listed here, this is the only one in which MAX/MSP is not completely in charge of live interaction of the electronic processes, but includes pre-recorded materials too, so that the computer supplies multiple functions, which in the past were distributed among different devices (like tape recorders, etc).

4.1.5. *Farb-Laut E - VIOLET*

My last piece of for Viola and MAX/MSP, it was specially commissioned for the festival *farb-laut* in Berlin (Germany) in November 2008. Samples recorded during the performance have their interaction throughout the piece in many ways, so that the main reason for the full automation of this piece is similar to the ones already explained in 4.1.3 and 4.1.4. Processes besides live recording include different types of granulation, delays, reverberation, COMB filters, ring modulated COMB filters and a 5.1 diffusion of sound. This piece will be performed during the *re-new / ICAD09* Festival in Copenhagen, with the purpose of showing how the concept of full automation works in a live concert situation.

4.2 Description of the main technical characteristics regarding the LE in the former examples.

All the pieces above share the following features:

- (a) Minimal technical requirements: they all need computer, microphone and an audio interface with at least one INPUT and a maximum of 8 Outputs (i.e. MOTU 828 mkII, Traveler or similar) to be performed.
- (b) The MAX/MSP patch consists of multiple sub-patches, each of them having algorithms with different functions like: granulation, convolution, phase vocoding (pitch shift), reverberation, dynamic delays, AM, sample and hold, filtering, live recording, spatialization, etc.
- (c) All share the fact, that the LE generate “solo” electronic moments during the piece, where no interaction between

the soloist and the computer occurs (the performer has virtually a break during those sections).

(d) Performance:

(i) the MAX/MSP patch is completely automated. The activation of the electronics takes place by pressing a button on the patch (MAX: *bang* function through the object *button*, see Fig. 1 for more details) at the very beginning of the work with a delay of about 10 or 15 seconds between pressing the button and the actual beginning of the patch/piece, to allow the player time to take position to play. All processes have a fixed duration, which require only mixing activity on the console and no manipulation at all on the electronics’ part itself.

(ii) as everything in the MAX/MSP patch is completely programmed in forehand, the evolution of every event like sound synthesis processes (filters, modulations, granulation, delays, sound diffusion in space, etc), recording, partial or final level controls, stereo or multi-track spatialization and others have to be accurately specified and timed, so that the performer can accurately interact with the LE. This allows each composed music moment to have its own electronic environment programmed (and composed) as well, serving the higher purpose of its assigned dramaturgy. To achieve this goal, an electronic score (an internal MAX/MSP sub-patch with begin and ending times for different processes) has to be programmed, a process very alike to that of composing music. Fig. 2 shows the “electronic score” for the piece *farb-laut E - VIOLET*.

(iii) To be able to play the piece, the performer has to follow a complete written musical score, which has added at some points (bars) clues describing precise times for the performance. These act as a guidance and refer to a TIME CODE (SMPTE), which the performer must follow, in order to be aware at any time at what point of the piece he is at. The TC, which shows the time in HOURS, MINUTES, SECONDS and FRAMES, has been already programmed and included on the MAX/MSP patches (an audio file containing the bi-phased modulated square waves for each bit of the frames), so that the performer can read it either on the computer screen directly or through a SMPTE display, whatever will be placed on the stage. In my own experience, and after talking to several performers of my music about this issue, I can categorically state, that to follow the TC on a display or computer screen does not require further skills from a musician than to follow a conductor’s baton in the orchestra. All of them (including myself) found it a very pleasant experience, which needed minimal efforts to become acquainted to.

(iv) Due to the automation, the performer is only required to follow the score looking at the TC display. No further activity rather than playing the instrument is required, as the electronics play automatically. This has a big positive and relaxing impact on the concentration of both the player(s) and audience. In the case of bigger pieces, the TC display should generally be followed by the conductor, thus making no difference at all to the ensemble’s members.

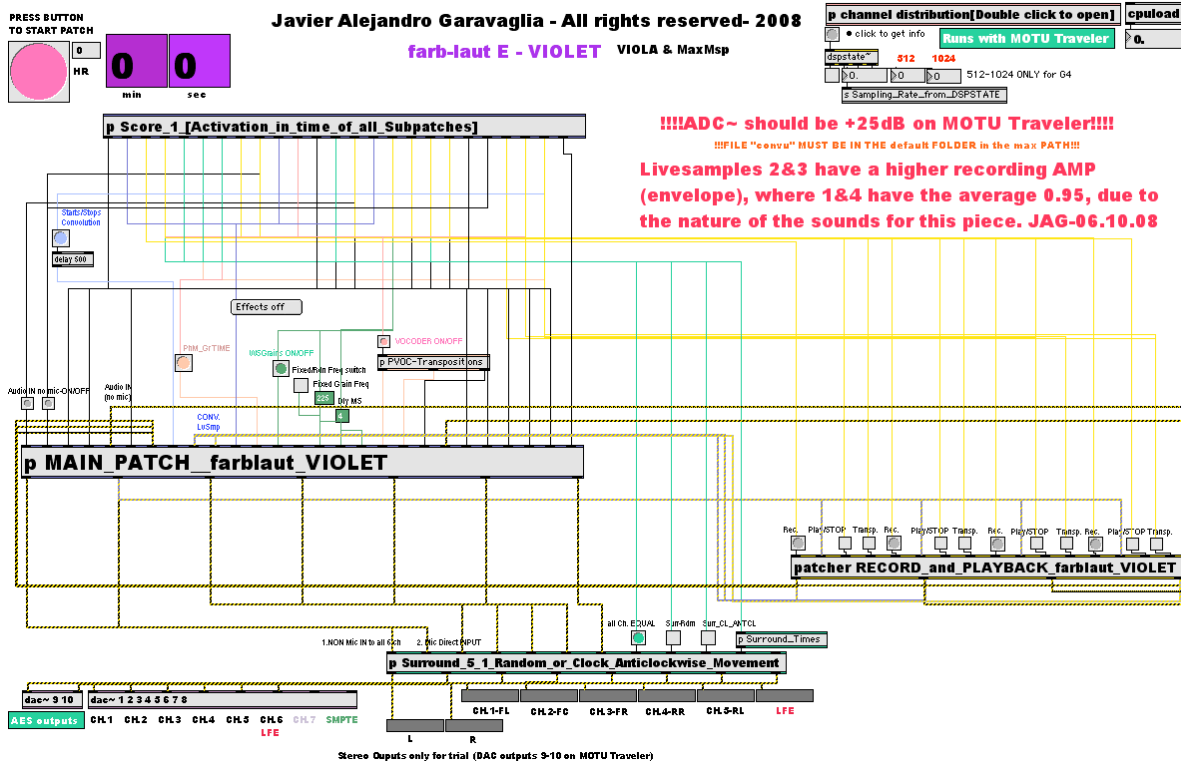


Figure 1. shows the main MAX/MSP patch for the piece *farb-laut E - VIOLET*. All synthesis processes are contained in the *MAIN_PATCH* subpatch. Spatialization can be seen on the subpatch *SURROUND_5_1* at the bottom, before the DAC. At the very upper-left corner, the initial button (MAX: BANG) activates all processes on the patch automatically. At its side, the SMPTE is shown. The SMPTE comes also as an audio signal from Channel 8 for a SMPTE external display device if needed.

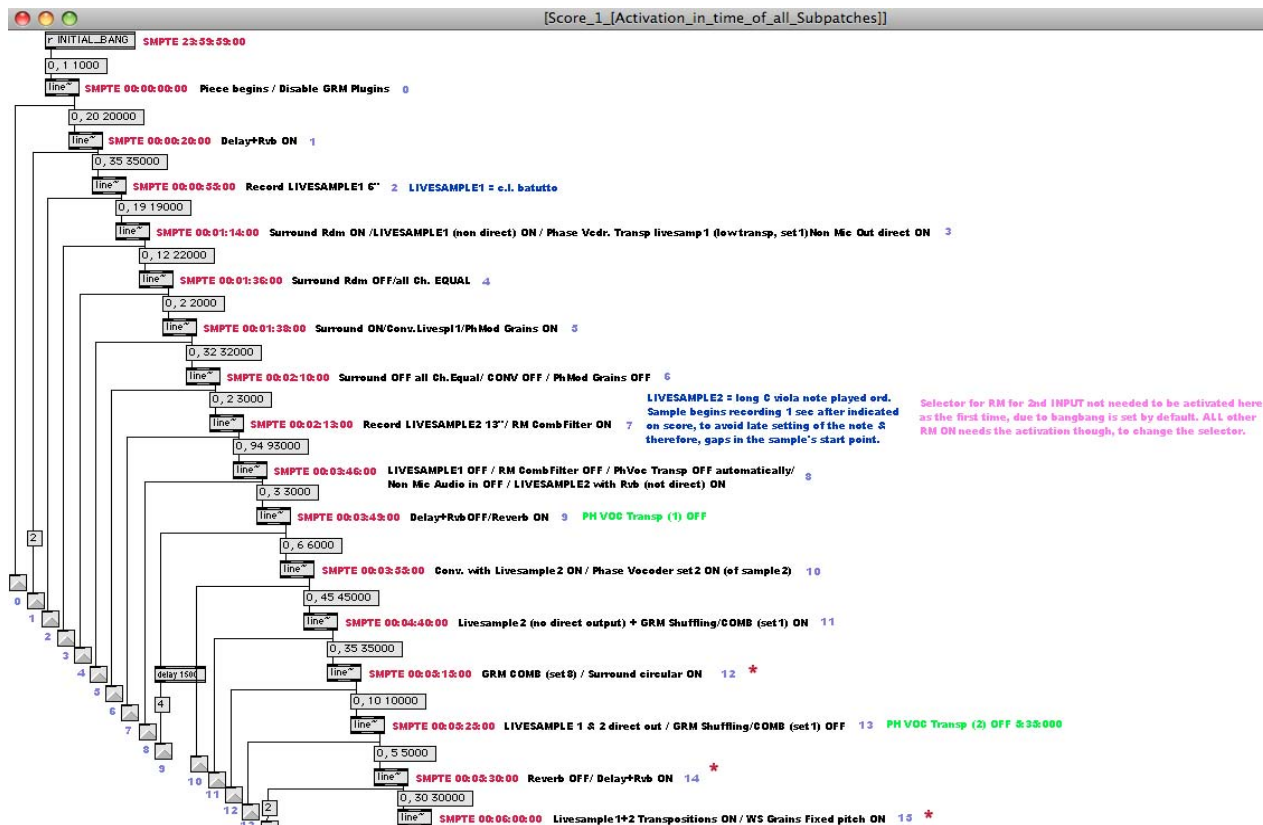


Figure 2. An example in MAX sub-patch electronic score for process activation for the piece *farb-laut E - VIOLET*. Time is shown in milliseconds.

5. ADVANTAGES AND DISADVANTAGES OF USING AUTOMATION.

As usual, when a composer makes his choices for writing (and programming) a piece, he leaves other choices aside. A composer should always be aware of this and should know that for the sake of the piece and of his personal aesthetics, he cannot afford to make use of all choices at his disposal. This reflection implies an awareness of the limitations that the choices bring with themselves. This said, I shall try to enumerate and explain the degree of impact that automation has on the musical performance of pieces including LE.

5.1. Advantages

- *Concentration and reduction of unnecessary activities.*

One of the obvious advantages is that the performer can dedicate his complete concentration to the pure musical aspects of the performance. This has a further implication (even if it might be quite subjective): if a performer is involved in multiple activities that are required for the realisation of the electronics (pressing pedals, touching the screen or the mouse, or making movements specially required for triggering the electronics, which might not suit the musical context they are required for), these can be a distraction factor not only for the player, but also for the audience. Even if it is true, that the nature of the piece itself might have a bigger or lesser impact regarding the audience's perception, this activity, if not part of another event involved in the piece (i.e. some kind of acting), will always be a factor of distraction to some extent.

- *Relative independence of the electronics from the composer's presence during performance.*

Regardless of the composer's presence or absence during the actual performance, the LE should not need further manipulation, as everything is already programmed. This allows more frequent performances of the piece and facilitates its transportation, as the patch itself (given the correct version of the Software) needs only to be copied on any computer available capable of running that particular version of the software for the performance. Once installed in the right environment, all events of the piece should run automatically after pressing the initial button

- *Better combination of processes and less risk*

This method allows in addition a more accurate and complex combination, crossover, fade in and out, etc. of different real-time processes. The risk of improvising in a live situation with the combination of processes cannot avoid sometimes the risk of accidentally exceeding the limits of the CPU performance on the computer. With automation however, as everything should have been tested beforehand, this rarely happens.

- *Ideal method for composer/performer in one person*

As in the case of the viola pieces described above, where the composer was intended to be the performer as well, a method like this allows shorter and more efficient rehearsal times, as nobody has to learn how to use/run the patch.

- *Additional solution for synchronization of events and processes related to performing time.*

For all the pieces mentioned in section 4, and as a consequence of the automation of the processes, following a TIMECODE is a secure way to read a score: it guarantees a very accurate way of interaction with the electronics, mostly when i.e. the recording of live samples for further use in the piece is involved. Some computer methods like "score-following" (through i.e. pitch recognition) are sometimes very successful

(like the already mentioned case of Lippe's *Music for clarinet and ISPW*), this is however not always the case, depending mostly on how they are applied (e.g. what is used to recognise pitches). Negative effects like some processes not being triggered in time (or at all) seem to be frequent using score-following algorithms.

5.2. Disadvantages

Despite all the advantages pointed above, some problems do appear though adopting full automation for the composition of LE, which can be resumed as a general lack of flexibility, imposing some limitations to the performance/rehearsal situation.

From an aesthetical point of view we face the following problematic: can a process that repeats itself quite similarly by each and every performance be identified as 'authentic live-electronics'? I am aware that for some composers and performers, the very essence of LE relies mainly on the possibility of live manipulation, adaptation, interaction and variation during the performance itself. However, if we keep in mind the definition given to the concept of LE in the introduction of this paper, the answer should be definitely yes, as this should be still a clear case of "*performance involving electronic instruments which can be performed in real-time*" even if limited up to some degree. Moreover, all the patches of the pieces mentioned in this paper cannot work if there is no live "input" (the performer) present (mostly as many processes need recorded sound from the live performance).

An obvious disadvantage is that the work is quite fixed in itself; if changes will be applied to the music in future revisions, the electronics have to be substantially reprogrammed as well. This involves the accurate reprogramming of all levels within the patch, including an intensive testing in the programming-composing period.

Another disadvantage attached to the last one is, that the patch generally runs from the beginning to the end of the piece, so that partial rehearsal of some moments cannot be achieved without waiting until the precise SMPTE moment arrives.

6. SUMMARY

The discussion of whether this is or not an original method to compose, programme and perform pieces including LE belongs to another forum. The aim of this paper is simply to be in a position to show and explain, that applying this degree of automation on the real-time processes for the electronics brings in the end more benefits than problems to the actual performance (and even rehearsal) of the pieces. This is not only stated from my point of view as a composer, but I include here as part of my research my quite long experience in performing own works as much as others in different venues, with different technical facilities and different musicians, whether I have been sitting on the mixing desk diffusing the piece, or even playing them myself (as in the case of the viola pieces).

Having the LE timely "composed" on some kind of "electronic-score" (i.e. a MAX sub-patch that allows the computer to know when to begin or end each process), allows the performer to have more artistic freedom during the execution of the piece, concentrating mainly on the score, the performance and the interaction but not in extra activities like switching pedals, etc. It also guarantees, that even if the composer does not attend the performances and/or rehearsals, the piece can be likewise quite easily activated. Using

environments like MAX/MSP or PD brings also benefits like easily installing patches on different computers, with minimal adjustment requirements.

Due to the synchronization between performer and the electronics through TC, processes like live recording to a buffer for a future usage during the piece (i.e. recording an amount of a few seconds of a specific part of the piece in order to use this sample later as i.e. a pick up sample for a convolution process) as well as other interaction processes, can be easily achieved on a quite accurate timing, without further requirements such as additional programming, pitch detection or even other devices.

The overall positive consequences result in an easier, costless, more effective and more frequent distribution of these pieces, as the latter requires only a score and the patch. A further implication is, that a better distribution should allow also an easier, more artistic and more frequent performance of these pieces. Therefore, the minor disadvantages do not have in my view a big impact on the overall end-results and can be considered as minor inconveniences or limitations to face, which cannot be eluded, but however do not invalidate the usage of full automation by composing and programming pieces with live-electronics.

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