Interpretation and Learning of Modular Synthesis: Three Studies

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ABSTRACT

This article presents the creation of three progressive studies for modular synthesizer, composed by Pierre-Luc Lecours and interpreted by Maryse Gagnon-Legault. The project aims to facilitate the learning process associated with modular synthesis as well has contributing to the instrument's repertoire. Through a dialogue between composition and performance, the authors address challenges related to musical notation and the reproducibility of synthesis systems across different setups. This paper outlines various historical approaches to synthesizer notation and describes the notational strategies employed in these studies.

1. INTRODUCTION

This paper describes and discusses the creation of three progressive studies for modular synthesiser. These studies were developed in collaboration between composer Pierre-Luc Lecours and modular synthesiser performer Maryse Legault. This initiative is rooted in the desire to contribute to the formalisation of the modular synthesiser interpretation and learning process. We believe these studies can offer a starting point for beginner and intermediate modular synthesis performer wishing to develop new performing skills on their instruments.

We define the modular sound synthesis performer according to the characteristics established by Lecours and Bernier (2024) [1]: "…we define the modular sound synthesis performer as a specialist in the interpretation of a repertoire linked to any electronic or network of electronic instruments producing synthesised sounds which must be programmed prior to their use and whose parameters (pitch, rhythm, and timbre) can be controlled manually or automated with voltage and/or digital control automations. These synthesis instruments can produce sounds from both analogue and digital circuits, excluding sounds from conventional acoustic instruments. This definition therefore also excludes electronic instruments whose synthesis systems are pre-programmed (presets-based) and whose interpretation parameters are mainly pitches and their intensities (e.g., Yamaha's DX7 or SY-77 synthesisers). This definition would typically involve building a synthesis system to meet the interpretation needs of the piece to be played." This research-creation project arose from an interrogation both authors had: is it possible to design musical studies intended to be performed by a modular synthesiser performer? The answer is not simple, and we will discuss our findings in this paper.

The literature or creative project revolving around learning process and interpretation of modular synthesis is relatively scarce. However, there are educators working actively to make this instrument more accessible as well as instruments system specific study. This project is part of this effort to make the initial learning stages of this often-challenging instrument more accessible.

The collaborative work on this project was structured as a dialogue between Lecours' compositional work, who initially created sketches of the studies, and Legault's score analysis and interpretation work, who tested the studies and suggested adjustments based on encountered difficulties.

In this article, several approaches to patch synthesis notation that have been realised in the past will be discussed. In the following sections, we will present different patch notation initiative that had been realized in the past, the three studies composed for this project, analyse them, and describe the collaborative work between composer Lecours and performer Legault. We will then discuss theoretical and practical reflexions that has emerged from this project.

2. MODULAR SYNTHESIZER NOTATION: HISTORICAL CONTEXT

The impetus to crystalize ideas through some form of notation appeared quite early in the existence of the modular synthesizer. Whether it was to take note of successful patches to ensure reproducibility in future performances, or for pedagogical purposes, modular synthesis notation existed in some form or the other since at least the 1960s.

Some early manifestations that guided our methodological process must be underlined.

A precursor in its genre, Allen Strange's book *Electronic music: systems, techniques, and controls* [2], is still today appraised for its forward-looking vision and the relevance of its educational content.[1] The scientific approach of the volume helps both the performer and the composer to understand the mechanisms of synthesis abstractly, outside of any connection with specific gear or modules.

In this book, Strange focusses on the basic types of sound sources, the different kinds of voltage controls one can use to shape these sounds, and other techniques useful to modular synthesis. If Strange includes a variety of graphs, diagrams and visual representations of each subtractive and additive technique broached in the book, he does not specifically approach notation in performative way. However, he solidly places the presence of the synthesizer in the Western Classical music landscape, mentioning parallels between the wide sonic palette of the synthesizer and the timbral aspirations of twentieth-century composers such as Maurice Ravel and Paul Hindemith. In this perspective, Strange raises important questions that guided our creative undertaking: "What are the processes the 'electronic composer' follows, then, to make a composition? What are the parameters involved in the production of electronic music? What are the available techniques and how do they work?" [2].

At the end of the book, he includes a chapter dedicated to performance instructions for various electronic pieces including Douglas Leedy's *Entropical Paradise with Bird Call* (1969), conceived for the Buchla System. He gives the performer a page-long list of instructions, including the position of the knobs, as well as a diagram for the performance of the piece.

A few years after the publication of the first edition of Strange's *Electronic Music*, Suzanne Ciani produced a grant report in which she describes what she calls a "Basic Performance Patch" for the Buchla Series 200 instruments [3]. In this account, Ciani uses a module-specific notation to describe the patches themselves and provides indications to perform with the patches and the transitions from one performance patch to the next.

At the end of her introduction, she underlines that she finds "that the best performances combine the competence of pre-planned and well-rehearsed playing with the magic of being able to follow one's inspiration when inspired by the audience and the moment. To do the latter a performer must be familiar with his patch to the point of not having to "think twice" (at least not more than once) about what effect or series of consequences will be produced by a given action." [3]

The core of Ciani's report is a prosaic description of her patches, along with the reasoning behind her choices. In the second part of the essay, she includes diagrams showing the routing between every module of her system (figure 1). Noteworthy is how she details the behaviour of certain patches (such as the "vertical sequencer" and "keyboard rotations") using traditional western classical notation (figure 2), resembling some examples from Strange's book.

Certain visual similarities can be observed between Suzanne Ciani's Basic Performance Patch notation (figure 1) and the one proposed by Allen Strange in various sections of his book. However, a key distinction lies in the fact that, in Ciani's case, the operators refer directly to specific modules of the Buchla 200 system. This level of precision lends her notation particular value in terms of reproducibility: it enables anyone with access to a Buchla 200 to faithfully reconfigure the original patch. This system can therefore be used to interpret the musical ideas developed in the document, such as *Keyboard Rotations*, *Melodic-Rhythmic Reliefs*, *Vertical Sequencer*, and *String Patch*.

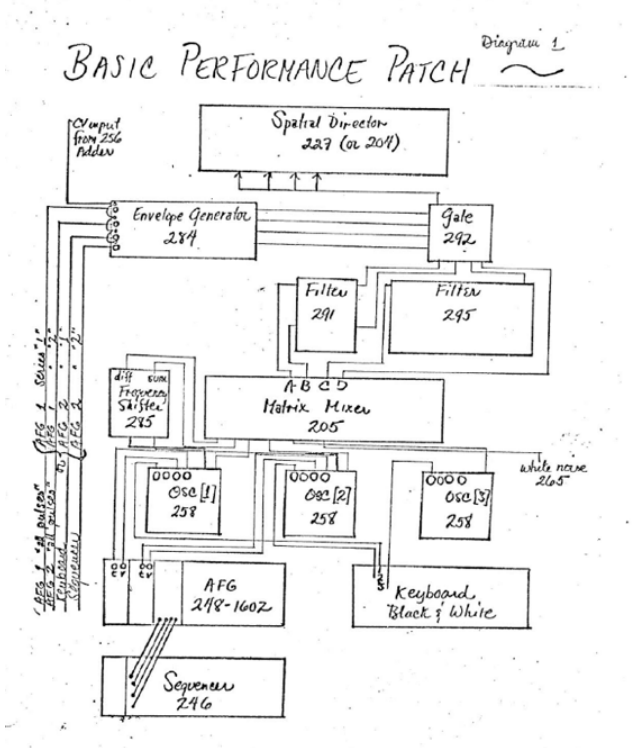

Figure 1. Ciani's diagram for her "Basic Performance Patch" from Report to National Endowment © Suzanne Ciani

An important pioneer in modular synthesis notation have raised the many challenges posited by notation. In an article in the journal *Synapse*, published in 1978, Richard Bugg explains that "in attempting to maintain some semblance of reality in notation of synthesizer patches, it soon becomes apparent that if there is no method to the madness, the former will be lost to the latter. Some form of permanent, or at least semi-permanent, recording of information is needed to allow the reconstruction of a specific sound." [4]

[1] A third edition of the book has recently been published.

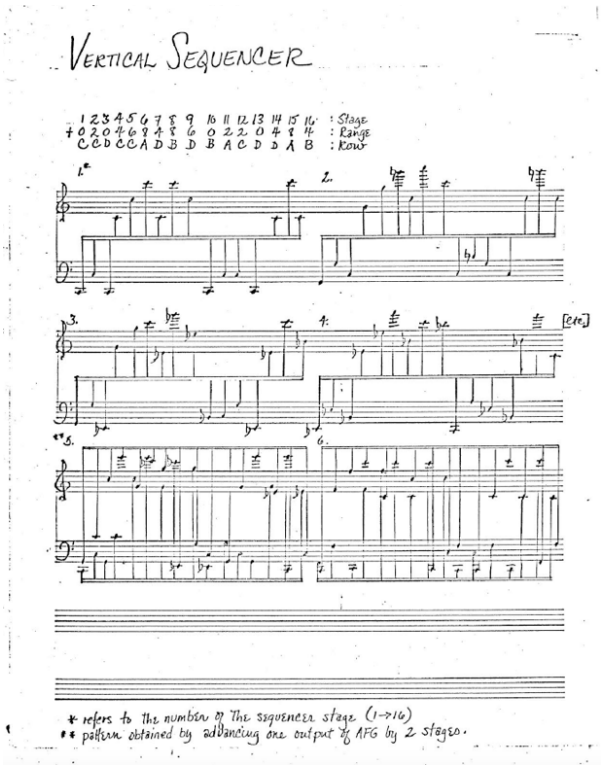

Figure 2. Ciani's notation for the "Vertical Sequencer" from *Report to National Endowment* © Suzanne Ciani.

Bugg's interest in notation is linked with reproducibility. He finds in what he calls the "FRONT PANEL FACSIMILE" notation, developed by makers of small systems, such as the Minimoog and the ODYSSEY, many advantages. This notation, focusing exclusively on a specific system, has the advantage of giving clear, easily reproducible, commands. However, this type of dashboard-focused notation sets limitations when one tries to apply the same commands to a different system, be another set of modules, or simply a bigger instrument.

Another type of notation Bugg mentions in the article is one exclusively focused on modules. Aspiring to be a more universal and widely applicable method, Strange points out some limitations, namely that "several operations may be performed in one module on one type of instrument. The same operations may be in several modules or non-existent on a different type of instrument." [4] Indeed, the plasticity of each module to suit different compositional needs is one of the most attractive advantages of modular synthesis performance, and using such a type of notation has significant creative restrictions.

To offset, these various issues, Bugg suggests focussing on the three general roles modules in any given instrument:

1. Signal sources (oscillators, but also noise generators, ringing filters, other types of modules used as signal sources),
2. Modifiers (envelopes, filters, amplifiers, etc.),
3. Controllers (keyboards, touch pads, or any other module triggering a command).

By focussing on these three groups of modules, we can indeed transpose the patch to different systems and insure a minimum of reproducibility.

The approach we adopted for the notation of the studies scores is based on Lecours's modular synthesis notational approach he developed in doctoral studies which is derived from various methods presented in this section, but more specifically the one established by Bjørn and Meyer (2018) in the book Patch & Tweak [5].

In their book, the authors propose a synthesis system notation based on a series of graphic symbols representing four main categories of operators that can constitute a modular synthesizer patch. Each category is distinguished by a geometric shape containing the symbol, allowing for quick identification of its function. The four categories are audio sources (circle), audio modifiers (triangle), control voltage sources (square), and control voltage modifiers (diamond). The notation of patches is constructed by connecting the different operators (symbols) of the system, following a left-to-right direction for audio and bottom-to-top for control voltage, gates, and triggers. A small textual note can be added to indicate where to connect the cable. The colour of the cables indicates the nature of the signal being transported (yellow = audio, grey = 1V/oct, blue = other control voltage, red = triggers and gates, green = master clocks). Figure 3 shows the implementation of a simple patch using the system proposed by Bjørn and Meyer.

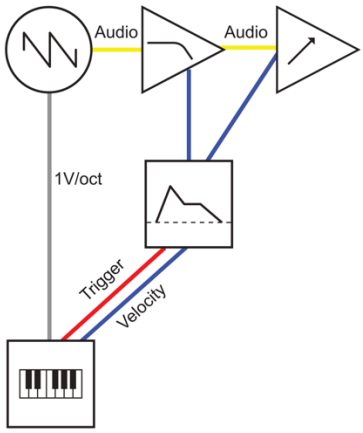

Figure 3. Filtered sawtooth wave patch, with pitch and envelope controlled via keyboard. This example is reproduced from the Patch & Tweak book using the authors' patch symbol library. See the Acknowledgments section for patch symbol licensing information.

We found this patch notation system to be the most comprehensive to date, drawing inspiration from several of the systems described above and others (Strange, Bugg, and Beaver & Krause).

3. THREE STUDIES: THE GENESIS

The project to create studies for modular synthesiser arose in response to several observations. The first is related to the absence of a specific repertoire for the instrument. This instrument is often used in concerts in improvisational contexts or by composers who perform their own pieces. Thus, musicians dedicated to interpreting written music for modular synthesiser are extremely rare. There is also very little repertoire specifically written for the instrument.

There are musicians like Luis Codera Puzo, who compose piece for his specific modular synthesizer instrument and who has created a virtuosic study for modular synth call *Plétora*. The study permits interesting and virtuosos sound manipulation, however, to play the piece, a musician needs to have a similar modular system to the one Puzo used to create it. The indications in the score are module-specific oriented and prescriptive in the parameter-notation approach.

The second observation is the need for pedagogical tools to facilitate the learning of modular synthesis. In this regard, there are very few resources available for learning and playing pieces on this instrument. This highlights an additional difficulty for those who wish to learn to play and interpret music with this instrument. Therefore, this project also aims to address this issue by proposing studies that can be used in a learning and teaching context. This aspect will be discussed further in the text.

3.1. Three Studies for Modular Synthesiser

The three studies for modular synthesiser were created to allow for a progression in the difficulty of execution and patch creation, as well as the exploration of three approaches to sound synthesis and interaction with the instrument. The notation of the studies will be detailed in each of their respective sections of this paper. However, there are some common aspects that can be observed among them.

Firstly, each score consists of two distinct sections. The first section provides instructions for creating the playing system on the modular synthesiser. The instructions are divided into voices, each with its own patch construction guidelines and the parameters that need to be manipulated within each voice (Figure 4).

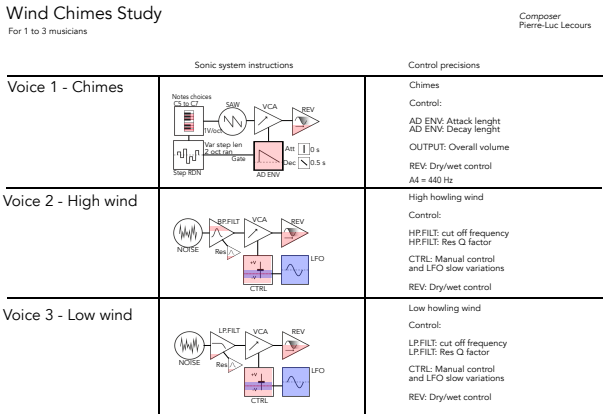

Figure 4. Instruction page for the construction of the *Wind Chimes Study* synthesis system. © Pierre-Luc Lecours

The instrument patch is divided into different voices to facilitate the notation and reading of the various parameters to be performed, and to aid in the visualisation and musical understanding of each voice. This division by voices can also allow for the interpretation of the pieces in small ensembles.

The instructions for creating the patch use the symbols proposed by Bjørn and Meyer in their book Patch & Tweak. Their notational approach has been modified to better suit the needs of the studies. The meaning of the symbols and the reference to categories by the shape containing the symbol (audio sources (circle), audio modifiers (triangle), control voltage sources (square), and control voltage modifiers (diamond)) have been maintained. However, we have abandoned the coloured connections indicating the type of information to be transmitted from one operator to another in favour of a textual indication attached to the cable. The instructions are generally read from left to right, but not necessarily from bottom to top for control voltage indications (unlike the approach proposed by Bjørn and Meyer). An internal colour-coding system has been added to indicate parameter activation in pink and automation in purple.

The writing of the notation systems was approached with an abstract systemic approach [2]: "[…] notation by seeking to abstract synthesis concepts rather than represent them in their entirety. This abstraction takes the form of a network of interconnected icons designed to represent the structural logic of the system. These icons highlight the fundamental units of the system's construction and the parameters that need manipulation […]. Additionally, textual indications complement this iconographic representation, providing performers with interpretative freedom."

This abstract systemic approach allows musicians to build a system using tools different from those used by the composer and to choose how they will perform the indicated manipulations. This approach also inevitably involves a simplification of the patch necessary for interpretation. In the sense that it is a notation that represents the concepts of the patch to be realised rather than the actual connections on the musician's instrument. The musician will thus have to find idiomatic solutions for their instrument in response to the indications proposed by the score.

For the performance instructions, the approach used is derived from those described for *Poussière de Soleil* by Lecours and Bernier [1]. Each voice in the study has a dedicated section indicating the manipulations to be executed (Figure 5).

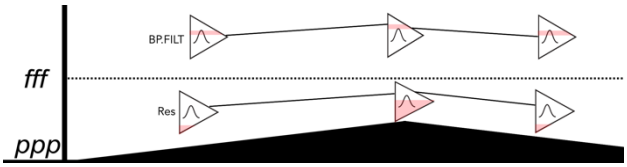

Figure 5. Voice specific manipulation indications from the studies. © Pierre-Luc Lecours

In this example, the lower part with the black triangular shape represents the intensity from ppp to fff; the performer must execute a crescendo followed by a decrescendo. The upper part shows manipulations to be made on a bandpass filter, which should move from a medium-high to a high register while increasing its resonance and then return to their original values.

In other cases, a note to be played might be indicated (Figure 6). In this example, the performer must play a note close to E1 using a controller.

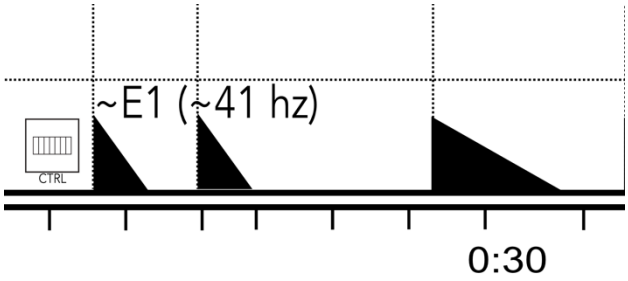

Figure 6. Note indications to play example from the studies. © Pierre-Luc Lecours

These indication aims to allow the creation of an initial multi-voice synthesis system, allowing the performer to manage the resources of their synthesiser to play the piece. As such, the patch and manipulation instructions are always a starting point on which the musician can build and develop. Indeed, we consider it part of the performance practice of modular synthesiser performers to develop and enrich a given patch to approach a sonic and/or timbral aesthetic idea. Orning [3] discusses this concerning Lachenmann performance practice, but the concept applies to any repertoire: "Performance practice has been characterised as 'a term borrowed from the German 19th-century Aufführungspraxis to describe the mechanics of a performance that define its style' (Parrott and de Costa 2011a). Within 'mechanics of a performance' I include knowledge, know-how, and aesthetic preferences on an individual level as well as in communities of practice."

It must be also noted that some of the graphic approach used by Lecours in these scores come from Bernier work with his *Ensemble d'oscillateurs* [4] and his oscillator score notation system.

3.1.1. Wind Chimes Study *no.1*

Wind Chimes Study is a piece where the musician performs a soundscape consisting of a high-pitched wind, a low-pitched wind, and a wind chime.

The two wind voices are relatively easy to create; they essentially consist of filtered white noise with volume control and slight reverb dry/wet modifications. The chimes voice requires a bit more resource to create from the synthesiser. It involves randomly sending notes into a sawtooth wave and triggering gates randomly in the envelope that allows the sound to pass. This voice can be relatively easy to create with certain modules like Make Noise's Wogglebug, but more complex in other cases. It is also necessary to quantise the random pitches to obtain the five tempered notes indicated in the score. Additionally, the ability to vary the speed of the random triggers is required. For the interpretation of the study, the first manipulations involve simulating the sound of the low-pitched wind, followed by the high-pitched wind using filter and volume adjustments (Figure 7).

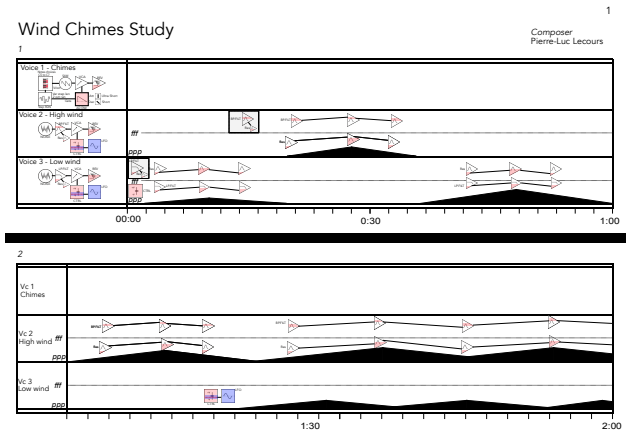

Figure 7. First page of the study *Wind Chimes Study*. © Pierre-Luc Lecours

An automation of the low wind volume occurs around 1m20. The slow volume variation is achieved using a sine wave LFO.

From 2m15, the wind chimes gradually emerge, with manipulations in this section primarily involving volume variation and changes to the envelope release of the chimes. The low wind transforms into a low-pitched sawtooth wave drone towards the end of the piece. The intended duration for the performance of the piece is 4 minutes.

The musician should approach this study creating and playing each voice separately at first and then play them altogether.

3.1.2. Arpeggios and Melody Study *no.2*

Arpeggios and Melody Study explores timbral manipulations on repeated sequences of arpeggio, bass, and a random melodic voice. Rooted in the early aesthetic work of Suzanne Ciani and Caterina Barbieri, this study allows the musician to become familiar with setting up multi-voice melodic and rhythmic systems and to explore an expressive vocabulary through timbre modifications.

Creating the synthesis patch presents certain challenges (Figure 8), particularly the sequencing of two voices (voices 2 and 3) that have a different number of steps. To successfully perform the study, the synthesiser must include three sawtooth wave oscillators (one per voice and could be replaced if needed by a square wave), three envelope generators, and three VCAs, a master clock that generates triggers, a low-pass filter, a reverb, and a delay (master clock synced).

Voice 3 can be played with a keyboard or controller to allow manual note changes. This provides an alternative if the musician cannot sequence a second voice with their system.

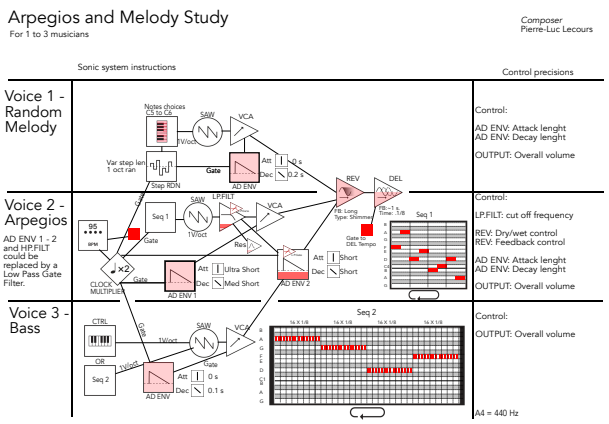

Figure 8. Instruction page for the construction of the synthesis system for the *Arpeggios and Melody Study*. © Pierre-Luc Lecours

Once the synthesis patch is set up, the performer's manipulations focus on changes of voice 1 and 2 envelope release, dry/wet reverb mix on the sound, and the volume levels of each voice (Figure 9).

The challenge of interpreting this study is to make parameter changes smoothly while staying highly focused on the effects these manipulations produce.

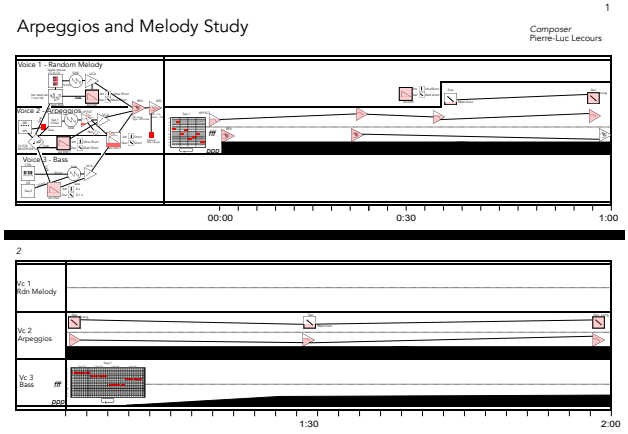

Figure 9. First page of *Arpeggios and Melody Study*. © Pierre-Luc Lecours

3.1.3. Noise, Rhythm and Articulation Study *no.3*

Noise, Rhythm and Articulation Study explore sound articulation, rhythm, and noisy sounds. This study presents several challenges in both patch design and the manipulations required to perform the piece.

For the realisation of this study, it is necessary to have controllers capable of sending triggers/gates and control voltage values. It is required to have a few envelope generators, an oscillator capable of FM synthesis, and another oscillator to create a sound similar to an electronic kick (Figure 10).

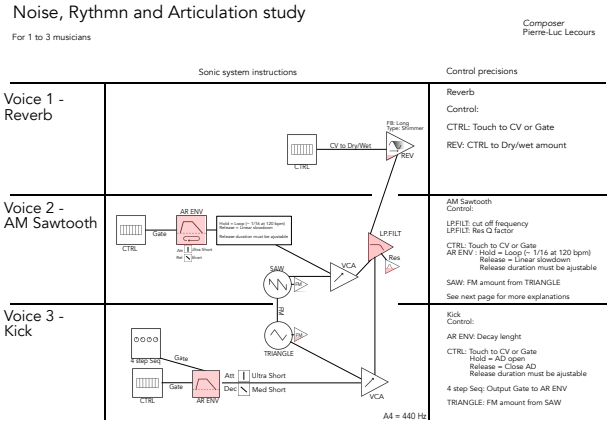

Figure 10. First page of instructions for the construction of the synthesis system for the *Noise, Rhythm and Articulation Study*. © Pierre-Luc Lecours

The first voice involves activating the dry/wet parameter of the reverb using a control surface. The second voice presents certain challenges, as it requires an iterative sound to be triggered by a controller and for the iteration to gradually slow down. There are several ways to achieve this, but a solution is specified on the second page of instructions for the patch construction (Figure 11).

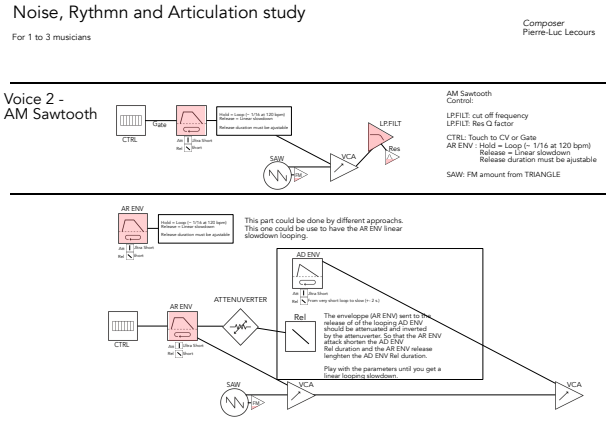

Figure 11. Second page of instructions for the construction of the second voice of the synthesis system for the *Noise, Rhythm and Articulation Study*. © Pierre-Luc Lecours

The third voice is an electronic kick, which needs to be controlled alternatively by a 4-step sequencer and a controller. The *Control Precisions* section (Figure 10) provides more details on how to configure each voice to be able to play the piece.

Interpreting this study focus on direct interaction with the sound material. The piece begins with the slowing down of noisy and low-pitched iterations (Figure 12). These interventions vary in length, so it is necessary to be able to adjust the duration of the slowing down. Then, the slowing down combines with a very low kick (~41 Hz), which is sometimes modified by a long reverb. When activated, the reverb should create a wall of sound.

At 1m30, the kick is controlled by a sequencer that plays every two pulses at a speed of 100 bpm. This section requires the performer to play the slowing down iteration (voice2) and reverb triggers (voice 1) on certain beats

while changing the pitch of the oscillator. It allows the performer to practice syncing up rhythmic intervention with a clocked process on the modular synthesizer.

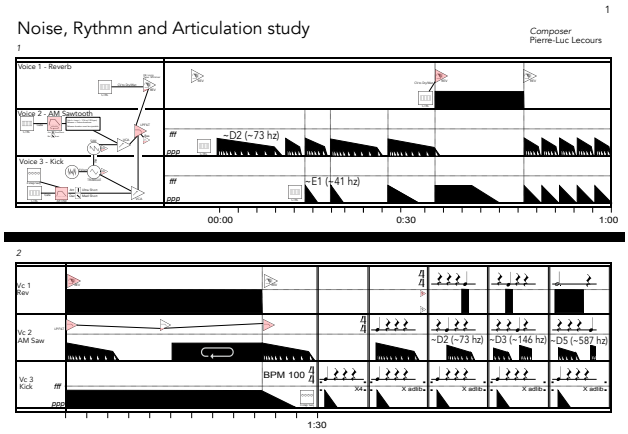

Figure 12. First page of *Noise, Rhythm and Articulation Study*. © Pierre-Luc Lecours

This third study thus explores other paradigms of synthesis interpretation. We will return to certain aspects of the interpretation of these studies in the discussion section of the article.

4. THE PROCESS OF INTERPRETATING THE STUDIES.

The composer-interpret dynamic has evolved in several steps and processes that will be described in this section. One of the first steps, at the core of the project, was the development of an appropriate system by the performer. In order to celebrate the tradition of modular synthesis performance, the performer constructed her own synthesizer by choosing modules suited for the three studies, under the guidance of composer Lecours. Building the synthesizer helped the performer to have a closer relationship with her instrument and to understand better the function of each module. The system (figure 13) that was used for the apprenticeship of the studies was designed to be portable, and as minimalist as possible, while allowing for a wide range of artistic expression.

Before composing the studies and producing scores, the collaborators divided the target competencies of the studies into general categories to judge how to organize them in a progressive manner, thus identifying the different skills to develop through the performance of each piece.

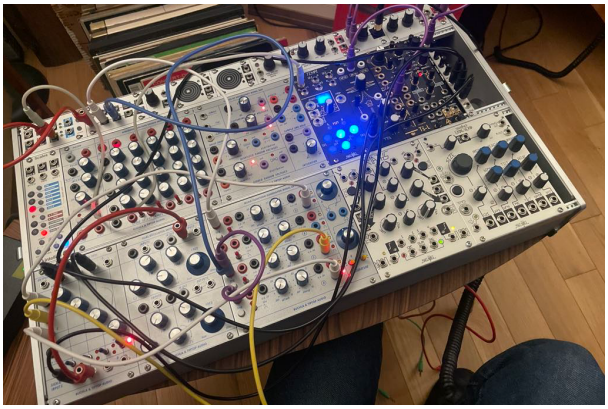

Figure 13. Legault's modular synthesiser. © Maryse Legault

During the first meeting, a first exploration of the instrument was made by the performer as directed by the composer, who gave inceptive oral directions in the context of an overview of each module of the system. Once the instrument was more familiar to Legault, it was possible to start working on the studies themselves. During a subsequent meeting, Lecours submitted to Legault a first draft of the first study, for which Legault imagined an appropriate patch. Benefiting from real-time feedback, the meeting allowed for quick adjustment of the score to clarify the intentions of the composer, but also to test the feasibility of the piece for a beginner. Some of the issues encountered were the lack of transparency of the symbols, the amount of different commands to perform in a short lapse of time for an unexperienced performer, and the insufficient details in the directives to help build an effective patch. Lecours was able to produce a second, then a third version of the first study thanks to the feedback of Legault, but also by observing the limitations and struggles of the performer while reading the score and performing the study. A part of each workshop was dedicated to guiding the performer into creating the most effective patch, so that her personal practice included not only the performance of the score, but also the conception of the patch. A similar approach was done for the completion of studies 2 and 3.

Once every study was finished and mastered, Lecours and Legault tried to transpose the performance on different systems. The studies were thus played on Legault's personal synthesizer, but also on a *Synthesiser.com* custom *Studio-66* Moog inspired system, a *Shared System* by Make Noise, and on Lecours's personal system. The type of comprehension generated by the function-focussed notation allowed the performer to be able to translate the score easily to a new system, once she understood the role of each newly encountered module.

At the end of the project, and after less than a year of modular synthesizer apprenticeship, Legault performed the three studies at the LFestival d'Ondes in Montreal, in 2024. Because of the impossibility to repatch between each piece, the performer used two connected synthesizers. However, it should be underlined that each study had been entirely patched and played on Legault's personal system.

5. DISCUSSION

The process of creating and interpreting these studies has generated numerous reflections, which we will discuss in this section. To begin, we will cover aspects related to the creation of the studies, particularly those concerning notation. Then, we will address the challenges related to their interpretation and finally lack of literature around the subject.

5.1. Writing studies for Modular Synthesizer

The writing of the three studies for modular synthesiser raised several issues. The first is the question of the system required for their interpretation. We discussed this aspect in previous sections, but the issue of transferring instruc-

tions from one system to another was central to the creation of the studies and also at the heart of several previous notation initiatives presented in the historical context.

Despite the work on inter-system transferability considered during the writing of the studies, they still require from the musician to have access to a modular system configuration oriented towards the production of synthesised sounds with certain effect modules (delay and reverb).

While it is necessary to establish a specific base of operators for the interpretation of the studies and to explore certain specifics of synthesis and its interpretation, these choices could limit access to certain studies for musicians with modular systems designed differently.

5.2. Patch creation for the studies

Despite the simplicity of most synthesis systems when approached one voice at a time, combining multiple voices can become complicated to coexist on a single system. Indeed, while working on the studies, Legault and Lecours sometimes had to devise complex solutions to successfully integrate all three voices of each study, occasionally requiring the use of advanced functions of the modules used. This could make their adoption by a broader group of musicians prohibitive, as some performers might find the difficulty too great.

That been said, the aspect of the systemic affordability of a given modular system is intrinsic to the practice of this instrument. We believe it is important to be accustomed to it at every stage of learning modular synthesis. When preparing the performance of the studies in concert, Legault could not simply reproduce the original three patches and then interpret the score. A new approach to the three systems had to be devised to allow the interpretation of the three studies without requiring too lengthy reconfigurations between studies (reconfiguring the entire system between each study would have taken too much time in a public concert setting). As such, since the interpretation of the three studies required more resources in modules and connections on the modular synthesiser and the systemic affordability it allows remains the same, despite all efforts from Legault to optimise the patches, it was impossible to play the three studies consecutively without adding another system. For the occasion, Lecours lent his system to address this challenge of interpretation and system design.

Thus, there was an initial patch conceptualisation for the instrument when the studies were approached separately and a second system design to integrate, as much as possible, the three studies on one system.

5.3. Interpretation of the studies

The interpretation of the studies raised multiple reflexions. One point highlighted during the joint work of the two authors was the difficulty of executing all the manipulations required by the score. At times, there were too many actions to perform simultaneously, making some sections impossible to play. There was thus a discrepancy between what the composer considered possible and what was achievable by the performer.

Additionally, the rehearsal of each study individually allowed for the repetition of a precise sequence of manipulations on the synthesiser. It has allowed to master each study separately but when played on other system some problems arose. We saw that the notation of the studies was approached in a way that the instructions could be transposed from one system to another and that the annotation of the manipulations to be performed uses the symbols employed in the section with the instructions for the patch construction. As such, the performer must transition from an abstract representation (the symbols referring to an abstraction of the patch) to concrete elements of the modular synthesiser. This approach allows the performer to correlate their system with what they have associated with a given symbol and the manipulation they need to perform. Although we consider this notation approach necessary to facilitate the possibility of playing the pieces on different systems, mastering the manipulations or sequences on the instrument through repetition becomes laborious. In the sense that rehearsing the studies that is linked to a specific patch system, which, when changed, requires relearning certain sequences and manipulations.

We experienced this issue when testing the studies on other systems. It required an adaptation period for each new system to be able to reinterpret the study. Since each module is often parameterised differently, we had to go through an exploration phase to create new reference points on the instrument. For example, the frequency distribution on a filter's control can vary greatly between modules, as can the operation of a filter. Another instance where this issue arose was during the concert setup. The sequence of the three studies required reconfiguring the patches to coexist within Legault's system and the one lent by Lecours. This reconfiguration required the performer to renew the reference points established when rehearsing of the studies separately.

5.4. Lack of literature

The ubiquitousness of the synthesizer in the musical landscape since the second half of the twentieth century makes in an unavoidable instrument for all types of musical production alike. However, we can observe a lack of literature to ensure the solidification of the modular synthesizer as a serious object of study. This lack has been identified by authors, such as Jeff Pressing, who dedicated a whole book to the apprenticeship of synthesizer performance [8]. He underlines that “skilled performance on the synthesizer, as on any instrument, demands an appropriate technique – a set of physical skills used by the performer to produce the desired sounds. Technique I the crucial link in the chain from musical conception to musical production and expression; through it, internally heard sounds become external. Obviously, technique must be both comprehensive and well-founded if it is to allow the full detail and precision of the performer’s musical conception to be expressed.” [7] Although Pressing identifies the importance of developing a technical practice in synthesizer performance, we can notice the absence of any mention of modular synthesizer performance technique in his comprehensive 1992 book Synthesizer performance, in which he does not include guidance for synthesizers not resembling other

acoustic instruments, be the keyboard, the guitar, wind instruments or percussions.

The growing interest for modular synthesizers has the potential to make space to develop this much-needed instrumental technique, and this specific set of studies aims to contribute to the scarcity of synthesizer performance literature.

5.5. Studies as pedological tools

The studies have been used in two teaching contexts since their creation. During tutoring sessions on modular synthesis, Lecours used these three studies as exercises for learning the basics of modular synthesis, system creation, and interpretation with the instrument.

The pedagogical contribution of the studies was remarkable, allowing students to have exercises to practice and eventually pieces to play.

6. CONCLUSIONS

The creation of modular synthesizer studies has confirmed both the potential and challenges inherent to this musical practice. The process of creating and interpreting these pieces has revealed several insights about the interaction between notation, system configuration, and performance practice.

As we saw in this paper, the integration of multiple voices within a single system often necessitates unusual solutions that can be challenging for performers. This aspect underscores the importance of familiarity with one's patches, allowing musicians to navigate their systems intuitively during performances.

Moreover, the lack of comprehensive literature on modular synthesizers remains a notable gap in the field. While synthesizers have become ubiquitous in contemporary music production, their study has not yet achieved the academic presence seen with other instruments. We suggest that this absence could eventually be resolved by the development of a standardized approach to performance and notation, which provide better and more effective communication among musicians.

The challenges faced during rehearsals and performances also point to the need for adaptable notation systems that facilitate transitions between different modular setups. The process of relearning sequences when switching systems can be particularly demanding, emphasizing the need for a more unified approach to synthesizer pedagogy.

We are planning to create new studies in the future to explore various forms of synthesis and interpretation. We also intend to publish these works once the research cycle is completed.

As modular synthesis continues to evolve, we do think that is this essential for scholars and practitioners alike to advocate for more structured research and documentation. By doing so, we can deepen our understanding of this unique instrument's capabilities and ensure that its rich sonic possibilities are accessible to a wider audience of musicians. The journey through the creation of these studies not only enhanced our technical skills but also enriched our artistic expression, opening to future electronic music composition and performance.

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