

# SOUND SYNTHESIS NOTATION APPLIED TO PERFORMANCE: TWO CASE STUDIES.

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## ABSTRACT

This article investigates the specificities of music writing and interpretation on the modular synthesizer. Based on two musical notation experiments, it will discuss the issues first from the point of view of the composer and then from that of the performer. This article will begin by presenting the notation approach in the composition of Pierre-Luc Lecours's piece *Poussière de soleil* (2022) performed by Ensemble d'oscillateurs. Then it will analyze the stages involved in creating an interpretation of Nicolas Bernier's composition *Transfer for 10 monophonic synthesizers* (2022).

These two experiences revealed issues and strategies used when writing and interpreting a piece with modular synthesizers, pointing toward a notation framework for this instrument.

## 1. INTRODUCTION

While performance on modular synthesizers is common in contemporary electronic music, the notation conventions of complex parameters (such as timbres or modulations) for this form of performance are still rare. After more than 60 years since the advent of the synthesizer, transmitting musical indications for this kind of instrument is still problematic. Commonly, artists who perform on modular synthesizers also act as composers (Suzanne Ciani, Caterina Barbieri, Alessandro Cortini to name a few). Their notation (if any) is commonly intended for personal use, not for communicating the piece to other performers.

In this article, 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 synthesized 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 analog and digital circuits, excluding sounds from conventional acoustic instruments. This definition therefore also

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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 synthesizers). This definition would typically involve building a synthesis system to meet the interpretation needs of the piece to be played.

This article looks at some of the specific features in writing for modular sound synthesis instruments, examining the issues first from the point of view of the composer and then from that of the performer. These two positions are illustrated by two experiments in the notation for the performance of modular sound synthesis.

The first case explores the challenges of notation for modular synthesis from a composer's perspective. This section emphasizes the strategies utilized in the notation of sound synthesis systems. These strategies encompass a combination of conceptual and systemic approaches, the merits and drawbacks of which will be evaluated. Additionally, we will examine how the communication of ideas and musical actions to be executed by performers also involves a blend of descriptive and prescriptive methods.

The second case is the first part of a study in which we sought to determine the learning stages and strategies used in the creation of an interpretation of a piece written for analog synthesizers. The aim is to begin to establish points of convergence and divergence between modular synthesizer performance and more traditional instrumental practice, in order to highlight certain specificities.

These two experiments highlight specific features to be taken into account when writing music for the modular sound synthesis, and these will be presented in the discussion section.

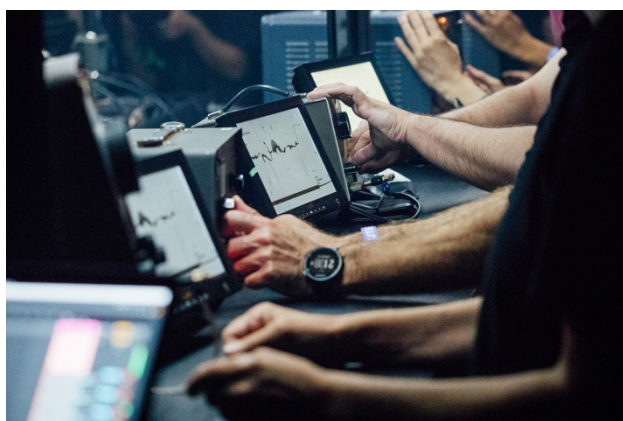
## 2. CASE 1: NOTATION APPROACH FOR MODULAR SYNTHESIS ENSEMBLE IN PIERRE-LUC LECOURE COMPOSITION *POUSSIÈRE DE SOLEIL*

The piece *Poussière de soleil* was composed in the autumn of 2022 for Ensemble d'oscillateurs. Directed by Nicolas Bernier, the ensemble consists of ten musicians playing on different electronic instruments, 10 Moog Mother-32 synthesizers in this case. The ensemble developed its own way

of writing and reading scores which are commonly made of large graphics scrolling from right to left on a screen.<sup>1</sup>

The ensemble created a vectorial graphic model that can be adapted according to the composer's compositional needs while standardizing the transmission of the three main performative parameters of the oscillators: frequencies, amplitudes, and human-made modulations [1].

The ensemble notation was initially specifically created for sine wave interpretations as the ensemble's first instruments were sine wave generators. The scores are shown on small screens placed in front of each musician (Fig. 1). A first attempt at more complex timbre notation has been made for the ensemble with Nicolas Bernier's composition *Transfer for 10 monophonic synthesizers* using a hybrid approach between prescriptive abstraction (prescriptive indication referring to a hypothetical synthesizer) and instrument-specific notations (the Moog Mother-32 in this case).



**Figure 1.** Ensemble d'oscillateurs with their screens and sine wave generators.

While starting from the ensemble notation methodology for the pitches, durations, and intensity, Lecours in his composition *Poussière de soleil* choose to notate the synthesis system and its manipulation with a systemic conceptual abstraction approach. This method implies the notation of the synthesizer patch and its manipulations to be not specific to a particular instrument configuration. Instead, it referred to a conceptual modular synthesis system, meant to be reinterpreted by performers using their instruments.

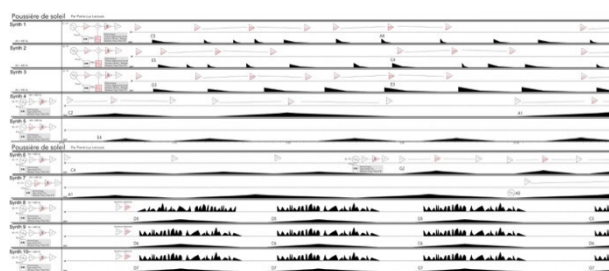
When composing his piece, Lecours intentionally avoided studying the specifics of the Mother-32 synthesizer. His goal was to write the playing instructions that could be interpreted on any modular or semi-modular synthesis system. These systems needed to include at least an oscillator (with a choice of basic waveform), a noise generator, a filter, an envelope generator, and a chromatic controller. The composition process occurred in two stages, revealing several distinctive features in the approach.

<sup>1</sup> Several ensembles use this approach like the Decibel New Music Ensemble with the Scorerreader software they develop (Decibel Score Player).

## 2.1. Composition and Notation System

To compose his piece, Lecours created most of the musical material with his own modular synthesizer. He designed a synthesis system with which he recorded different ideas. These recordings were then segmented into ten voices, which he transcribed onto a score<sup>2</sup> (Fig. 2). The segmentation was based on the three modular synthesis systems distributed over the 10 voices as follows: First system: synthesizers voices 1 to 3, second system: synthesizers voices 4 to 7, third system: synthesizers voices 8 to 10

This division was designed to allow sectional playing by the ensemble, with the performers playing similar musical material to the others in their groups.



**Figure 2.** Score of the first minute of *Poussière de soleil*.

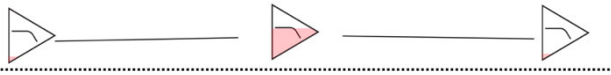
There are three types of indication on the score. The first is located in the lower part (Fig. 3) of each voice and represents: pitch (indicated by a letter plus its octave), duration (indicated by the black shape horizontally), and intensity (indicated by the black shape vertically from ppp to fff).



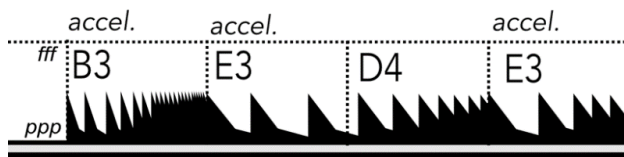
**Figure 3.** The first type of indication (pitch, duration, intensity).

The second type of indication is located in the upper part of each voice (Fig. 4) and indicates the manipulations to be performed (e.g. sound filtering) or general indications like acceleration or deceleration (Fig. 5). The activation of the parameter to be manipulated is indicated by the amount of *red* present in the symbol; in the example in Figure 4, the low-pass filter will be almost closed at the start of the manipulation, opening to 2/3 at the moment when the sound intensity is at its highest, and finally returning to the initial state at the end of the note.

<sup>2</sup> The scrolling score along with the recording can be accessed on Vimeo: synthesizer voices 1–5 (<https://vimeo.com/923558953/527aead017>) and synthesizer voices 6–10 (<https://vimeo.com/923569353/75e9775256>).

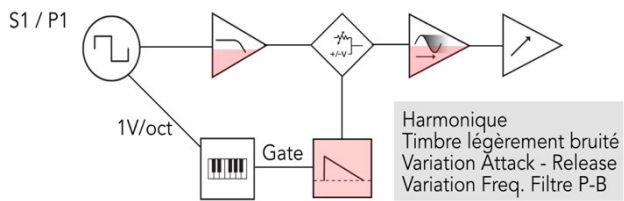


**Figure 4.** The second type of indication (parameters manipulations).



**Figure 5.** The second type of indication (general indications).

The third type of indication represents the sound synthesis systems to be created (Fig. 6). These indications are designed to convey maximum information using a minimal number of symbols. The parameters to be manipulated are indicated in the text box. The symbol system used is the one proposed by the book *Patch and Tweak* [2]. In Figure 6, the performer should be able to play chromatic notes on a controller that will give the pitch information to an oscillator outputting a square wave. The square wave signal then passes through a low-pass filter whose output is modulated by an envelope triggered by a gate whose attack and resonance must be adjustable. The modulated signal then passes through a reverb effect activated at 50% and finally goes to the sound console. The graphical indications are supplemented by text that adds details, as in the example “Timbre légèrement bruité” (Slightly noisy timbre), which can be interpreted more freely by the performer.



**Figure 6.** The third type of indication represents the sound synthesis systems to be created.

This approach seeks to represent the most important elements of the system for interpretation in order to optimize the readability in a performance context and its realization on different synthesis systems (we will discuss these issues in the discussion section). The performer then has to find idiomatic solutions for their instrument to respond to the score’s indications. It is interesting to note that during the rehearsals with the ensemble, the musicians generally devised different playing systems based on the same indications, with very similar sound results, but with enough timbral differences that it did enrich the sound image of the piece.

## 2.2. Working With the Ensemble

Following the ensemble’s first rehearsal, Lecours finalized the composition of the piece. He attended most of the re-

hearsals with the ensemble and its conductor, which enabled him to imagine new ways of bringing the musical material into dialogue with the playing of the performers and ultimately that of the conductor. For example, in the last section of the piece, where this dialog led to musical material in which the scrolling score format did not allow the notation of rhythmic metrical material with synchronized acceleration. It resulted in the conductor beating time and directing the acceleration as well as indicating the crescendos and decrescendos.

This back-and-forth between the score and the ensemble’s performance enabled Lecours to make necessary adjustments and corrections in the notation. It was interesting to observe the performers’ relative independence concerning the conception of their sounds; they found their own solutions on their instruments to interpret their respective parts.

## 3. CASE 2: SOUND SYNTHESIS (RE)PERFORMANCE APPROACH OF NICOLAS BERNIER’S *TRANSFER FOR 10 MONOPHONIC SYNTHESIZERS*.

The first case study discussed in the previous section presented notation strategies used in a composition by Pierre-Luc Lecours. In this section, Pierre-Luc Lecours is acting as a performer, interpreting a piece Nicolas Bernier originally wrote for 10 synthesizers.

A few elements must be specified about the choice of this piece before discussing the performance issues and strategies. The score was not written *specifically* for the modular synthesizer. Indeed, the piece required translating indications originally intended for the Mother-32 synthesizer into the modular synthesis instrument used for this reperformance. Ideally, the study would have been based on a composition specifically tailored for the modular synthesizer. Although such compositions do exist, they are rarely notated in a score format. When they are, these compositions are often written for a specific modular sound synthesis system, making it difficult to perform without a specific combination of modules. Another limitation was that Bernier’s piece was composed for ten performers and thus intended to be played by an ensemble. While this characteristic did not hinder the study’s objectives, the musical material was not crafted for solo performance, thus influencing Lecours’s understanding of the piece’s nuances and development.

### 3.1. Methodology

Our methodological approach to modular synthesizer performance was largely based Héroux and Fortier’s [3] study of the interpretation creation process while also borrowing from Chaffin et al.’s [4] study of the different stages involved in the learning of a new piece.

Elements from grounded theory [5] were used to analyze the interpretation process: based on interviews and infused by the notions of ‘explicitation’ interview [6] with the composer and self-confrontation [7]. From grounded theory, we retained the creation of concepts (in our case a new stage in the learning process defined by Chaffin and the

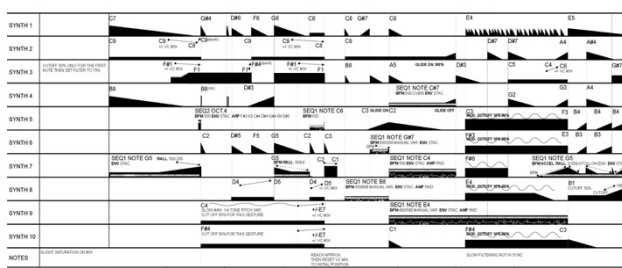
double reading of the score) in response to the analysis of the data obtained. Two approaches were adopted to obtain the data, and these are based on the experiment presented in Héroux and Fortier [3].

Firstly, Lecours filmed himself rehearsing the first synthesizer part, commenting on his actions and reflections aloud. Reviewing these recordings allowed him to comprehend his approach at various stages of the interpretation creation of the first voice. Secondly, Lecours maintained a practice diary for all the rehearsals, describing in detail the actions performed, the progress of the work, and the relevant observations made during the rehearsals. This approach facilitated monitoring his progress and adjusting his practice methods accordingly.

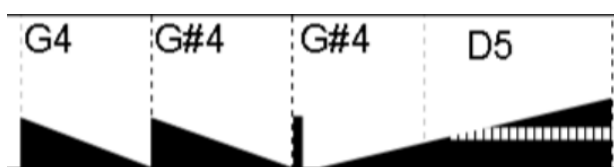
Once satisfactory interpretations of the different parts were achieved, Lecours recorded the ten voices of the piece in a studio setting. This recorded version was then shared with the composer for feedback on the interpretation. In parallel, weekly interviews with composer Nicolas Bernier took place, where discussions about the work conducted during the practice sessions occurred. These interactions provided valuable insights and feedback on the progress made during the rehearsal process.

### 3.2. The Interpretation Process

The process of creating this interpretation spanned four work sessions, each lasting approximately three hours. In these rehearsals, the ten voices were learned sequentially, rehearsed, and then recorded individually. Like in the previous case, the score was also based on the ensemble notation convention (Fig. 7)<sup>3</sup> where the upper half of the staff of each instrument shows pitches and other indications and the lower half of the staff shows the envelope and amplitude (Fig. 8).



**Figure 7.** The beginning of the *Transfer for 10 monophonic synthesizers* score.



**Figure 8.** An isolated voice with indications of notes and intensities.

For this piece, Lecours opted for an instrument configuration that allowed him to work with most of his synthesis

modules. He used the two-octave keyboard of his Arturia Minibrute 2 synthesizer. It should be noted that the modular synthesizer was not pre-configured; it had to be organized into a system with cables that met the requirements of musical interpretation with each new voice. The configuration of modules used allowed great versatility in terms of interpretation and possible aesthetics, enabling him to interpret the indications in the score.

### 3.3. Organization of Work Sessions

Lecours began the first session by doing an overview of the score to understand the types of sounds and controls he needed to implement for the performance. This stage aligns with Chaffin’s “scouting-it-out” phase [4]. While reviewing the video recording of the session, his comments revolved around two main aspects: the specific actions to be executed (such as notes, octave changes, rhythmic patterns, etc.) and how to configure his modular system to respond to these musical instructions.

At this point, there was a dual interpretation of the score: one from the performer’s perspective and another from the sonic system designer’s viewpoint. The sonic system designer’s reading is one in which the performer thinks about how to organize the instrument’s synthesis system to execute the musical indications expressively on the one hand, but also in such a way that it is possible to execute the different indications through the piece without radically reconfiguring the synthesizer.

With modular synthesizers, generally analog, the configuration of the synthesizer requires a balance between the search for timbre and the expressiveness of the sound, with the resources available for setting up the different systems needed to execute a part. These considerations stem from the limitations of each modular instrument in terms of connections and modules.

After completing the initial overview, Lecours proceeded to study the composer’s instructions on programming sounds for the Mother-32 synthesizers. He used these guidelines to configure the sound synthesis system on his instrument. Lecours had to adapt the instructions provided by Bernier to apply them to his synthesizer. As some instructions were specific to the Mother-32, he modified certain control approaches and disregarded instructions that were too specific to convert for his instrument. Nonetheless, Lecours managed to establish a fundamental playing system, allowing for an initial reading of the piece.

This stage of the process was akin to what Chaffin [4] refers to as “section-by-section.” Lecours focused on the first synthesizer part, breaking it down into short sections played in loops. This approach highlighted the piece’s structure, providing him with a deeper understanding of its different sections and allowing him to pinpoint specific technical challenges.

At this stage, there was also a dual reading of the score, with the performer on one side and the system sound designer on the other. This dual reading created a feedback

<sup>3</sup> The scrolling score along with the recording can be accessed on Vimeo: <https://vimeo.com/923571511/8941f2ae15>.

loop between the performance work and the system sound design where, during the rehearsal, he would perform a section, optimize the synthesis system, then perform again, move on to the next one, make changes to the connections, adjust the parameters, etc. It was also at this stage that he was able to identify some of the technical issues and, that he began to take liberties in the sound system conception to make certain sounds more interesting and expressive.

In the second work session, Lecours began with a swift overview and focused on short sections of the second synthesizer part. He then revisited the first part, refining transitions and performing a complete run-through before proceeding to record the performance. These final stages of work on the first voice align with what Chaffin et al. refer to as the “gray stages” and “maintenance.” The dual effort of interpretation and sound design persisted until the recording phase.

During the third and fourth working sessions, the same approach was applied to parts three through ten, and no significant issues were encountered. It should be noted that as Lecours advanced in the process of learning and recording the various voices of the piece, his understanding of the ideas and functions of each section deepened. Consequently, the artistic appropriation, as mentioned in Héroux and Fortier’s 2014 article [3], developed relatively late in the process, which may be attributed to the nature of the piece, which is originally for ten performers.

### 3.4. Variation on Stages of Chaffin et al. (2003)

One of the most interesting aspects of this research was to observe the similarities and differences in relation to the four-stage model of instrument work during the creation of an interpretation proposed by Chaffin et al. [4]: 1 – scouting-it-out, 2 – section-by-section, 3 – gray stage, 4 – maintenance.

By analyzing the data collected, we can observe, first of all, an additional stage which we call “creation of the sound synthesis system.” This stage involves structuring the performance system of the modular synthesizer to execute the specified musical instructions and produce sounds in alignment with the timbral requirements outlined in the score. In this study, this stage was positioned between the first and second phases of the process.

Another aspect that came to our attention in analyzing the data from this research was the notion of a double reading of the score in the learning stages, involving a constant oscillation between interpretation and system sound design. It appeared that the emphasis of this dual interpretation shifted throughout the process of learning the piece. Initially, there was a significant focus on the role of the sound designer, aligning with the first two stages outlined by Chaffin et al. [4]. However, as the learning process progressed, the focus gradually shifted towards a more pronounced emphasis on interpretation during the last two stages.

The similarities and differences observed can be visualized in Figure 3. It is essential to mention that these results reflect the specific context of the present experiment. To validate this analysis comprehensively, it will be crucial to replicate a similar experiment with multiple subjects.

Learning stages proposed by Chaffin et al. (2003)	
1 ) Scouting-it-out 2 ) Section-by-section 3 ) Gray stage 4 ) Maintenance.	
Variation on stages observed during the study	
1 ) Scouting-it-out 2 ) Creation of the sound synthesis system 3 ) Section-by-section 4 ) Gray stage 5 ) Maintenance.	
Working on the sound synthesis system	

**Figure 9.** Similarities and differences with the learning stages proposed by Chaffin et al. (2003).

### 3.5. Specific Features of *Transfer for 10 monophonic synthesizers* Music Notation

This study has highlighted specific characteristics and challenges related to Bernier’s piece notation. The first specificity of the score is that it is a scrolling score, which is a format that is suitable for pieces requiring proportional temporal representation [8]. In the case of Bernier’s work, the score format was well suited to the musical material, as the piece was not based on a traditional metrical structure, it would probably have been more difficult to read with a traditional writing style.

The second element to be discussed concerns the indications for creating the synthesis and playing system, which here were partly written for Mother-32. Some of Bernier’s musical indications had to be abstracted and conceptualized for a system other than the Mother-32. This process of abstracting and conceptualizing Bernier’s indications led to liberties being taken in the design of the synthesis systems and to certain sounds being adjusted to suit certain personal aesthetic tastes.

That said, the clarity of the indications in Bernier’s piece made for a relatively fluid reading.

### 3.6. Towards a Definition of the Stages Involved in Creating an Interpretation With a Modular Synthesis System

The results of this research work should be seen as the beginning of a larger research project, that said, certain observations and reflections can be drawn from it.

Firstly, the recorded version was well received by the composer when he listened to it; he was surprised by the match between his intentions and the interpretation. This can be interpreted as a writing success on the part of the composer, but also that this process, i.e. writing a piece for a modular sound synthesis interpreter via a score without accompanying sound support, is possible.

Secondly, there are certain points of convergence and divergence in the stages of creating a musical performance. Based on the stages proposed by Chaffin et al. [4], it is possible to observe that Lecours went through the same process as those mentioned above, except for an additional stage that we have named *Creation of the sound synthesis system*. Additionally, there was a dynamic interaction between sound design and performance system design throughout each phase of performance creation.

There are several aspects of this study that would merit further investigation. One of these is the concept of the *Technical image* that emerged during the process. We de-

fine this category as the construction of a coherent representation between the synthesis system put in place and the performance needs of the piece. This idea will require a much more serious analysis of the different strategies and stages involved in the creation of the sound synthesis and playing system. For the moment, the data collection that we carried out during the experiment was not sufficient to fully monitor the process.

## 4. DISCUSSIONS AROUND WRITING AND INTERPRETING NOTATED SOUND SYNTHESIS PIECE

These two experiments made possible the observation of specific aspects linked to performance and composition for modular sound synthesis instruments. These particularities have led to the use of specific writing strategies, which will be discussed here.

The discussions will revolve around the two levels of notation explored in this article: the one governing the creation of the sound synthesis system (how to configure one's modular sound synthesis system) and the other concerning the sound manipulations to be performed (producing sounds (with or without pitches), timbral and rhythmic variation).

### 4.1. Creation of the Sound Synthesis System

Interpreting a musical idea with a modular synthesis system requires the design of a connection network on the instrument that allows the required manipulations to be carried out. As we saw in the study of the interpretation of *Transfer for 10 monophonic synthesizers*, the design of a sound synthesis system to respond to the musical indications in the score is a fundamental stage in the process. The notation must therefore take into account several parameters in order to achieve the desired result.

#### 4.1.1. Variability of Modular Sound Synthesis Instruments

One of the many features of this instrument is its versatility. Performers of modular sound synthesis build their instruments by choosing modules or programs that specifically meet their musical needs. Some opt for hybrid analog/digital or modular/semi-modular approaches, leading to virtually endless combinations.

This diversity implies that each performer becomes an expert in their unique system configuration. Due to the absence of standardization (except for electrical control and communication in the case of the Eurorack format and electronic protocols), approaching notation in a highly specific manner becomes challenging without mandating a precise system configuration. Moreover, an overly hardware-specific notation approach is not sustainable, given that synthesizer and digital program modules have a limited lifespan. It also appears incompatible to us with the culture of modular sound synthesis performance.

#### 4.1.2. Modular Sound Synthesis Performance Culture

A second particularity of this instrument comes from its performance culture. We consider that there is a form of expressiveness specific to the performance of a modular synthesizer that comes from the design of the system itself. The personalization of each modular synthesis system is often the result of a search for possibilities of sound generation and modification that are specific to each musician. This personalization creates a sound identity specific to each performer. Moreover, performers develop a set of strategies to craft sound systems that align with their aesthetic preferences and musical ideas, utilizing the available modules and connections. This set of strategies thus becomes highly personal to the performer and his system.

Given this distinctiveness, we propose that creative expression through the construction of a modular sound synthesis system should be taken into account when writing the score.

#### 4.1.3. Notation of a Sound Synthesis System: Opting for a Systemic Abstraction

The variability of modular sound synthesis systems and the intricacies involved in their construction led us to approach this type of 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 (in red in the score of *Poussière de soleil* in Fig. 8, for example). Additionally, textual indications complement this iconographic representation, providing performers with interpretative freedom. This systemic abstraction approach allows the musicians to build a system using different tools from those used by the composer, and to choose how they will carry out the manipulations indicated.

For instance, a performer instructed to filter a sound (as shown in Fig. 6) might opt to use their own CV controller to manipulate the cutoff frequency of the low-pass filter instead of the module's designated knob, especially if this choice accommodates other necessary interventions. While such specific directions may not be explicitly mentioned in the score, this more abstract form of notation provides freedom and flexibility in system design that, we believe, aligns with the unique characteristics of modular sound synthesis performance outlined earlier.

### 4.2. Sound Manipulation Notation

The instructions for sound manipulations, including sound production (with or without pitches) and timbral and rhythmic variations, are intricately tied to the modular sound synthesis system producing them.

In the notation experiment for *Poussière de soleil* presented in this article, two types of indications are utilized: one for pitches, duration, and intensity, and another for specific parameter manipulations (such as filtering, LFO oscillation speed, etc.).

In the first case, the approach used is the one generally employed by the Ensemble d'oscillateurs. However, for this piece, a more conventional method of notating pitches, durations, and intensities could have been considered.

In the second case, the instructions for manipulating precise parameters pertain to specific aspects of the performer's synthesis system setup. A symbol from the sound synthesis system construction guide (depicted in Fig. 8) is used to denote the manipulation to be performed. This approach allows the performer to make a correlation between his system and what he has associated with a given symbol and the manipulation he has to perform.

### 4.3. Sound Manipulation and Systemic Patch Notation, Between Prescriptive, Descriptive, and Conceptual Approach

These specific features of the instrument and its performance make it difficult to adopt an exclusively prescriptive or descriptive approach to notation, more traditionally observed in contemporary notation. In the piece *Poussière de Soleil* presented in this article, the way the instructions are notated falls somewhere between the descriptive, prescriptive [9], and conceptual model approaches.

The descriptive approach was employed to indicate pitches, durations, and intensities in the notation of *Poussière de Soleil*. This strategy proved to be effective and unambiguous during rehearsals of the piece and is similar to the traditional ways of representing these parameters.

Then, for the notation of sound synthesis systems, a conceptual approach representing the relations between entities was used. The conceptual approach means that we abstract a specific sound synthesis system in order to extract its fundamental logic and represent it in the form of global diagrams that allow the relationships between the different elements to be understood quickly. This strategy was chosen because it simplifies comprehension in a reading situation, the representation is clearer, and it allows the represented concepts to be applicable to various modular sound synthesis systems.

In the notation for manipulating precise parameters (Fig. 6), the approach used falls somewhere between conceptual and prescriptive representation. In this figure, the instructions are generally prescriptive (e.g., “vary the cut-off frequency of a low-pass filter”) but refer to a conceptual representation of the previously constructed sound synthesis system.

For instance, considering the sound filtering indication, if the approach had been purely prescriptive, it would require specifying the manipulation of a potentiometer on a specific system.

To address the variability inherent in modular sound synthesis systems and the idiosyncratic approaches of their performers, we propose that indications for manipulating specific parameters should be prescriptive while referencing the conceptual representation of the system. This hybrid approach accommodates the unique features of modular setups and provides clarity to performers.

### 4.4. Limitations of the Proposed Strategies

It is important to acknowledge certain limitations to the strategies proposed here. The two pieces whose notations have been presented propose relatively simple sound synthesis systems. It would be valuable to test these proposals in the composition of pieces where synthesis and timbre work are more complex.

Additionally, *Poussière de Soleil* was played in December 2022 and November 2023, the composer was present at the rehearsals and directed the first performance. This involvement might have facilitated the transmission and execution of the sound synthesis systems and the performance of the piece.

## 5. CONCLUSIONS

Notation for modular sound synthesis remains a relatively underexplored topic, and its interpretation is still an emerging practice. This article has identified important specificities related to composition and the interpretation for and with the modular synthesizer, as well as unique challenges associated with it. The proposals derived from the two experiments presented were explained and contextualized.

Several follow-ups to this research project are planned. Firstly, a series of studies for solo performers or small ensembles is currently in development and will be presented in the upcoming year. Secondly, the strategies outlined in this article will be tested in a composition featuring much more complex synthesis systems. This will enable the examination of the limitations of the proposals outlined in this article and provide valuable insights into the evolving field of modular sound synthesis notation and interpretation.

### Acknowledgments

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