

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/358564337>

Some Compositional Approaches in the Practice of live- electronic music from the perspective of technique and technological tools

Article in *Revista Vórtex* · February 2022

DOI: 10.33871/23179937.2021.9.3.8

CITATIONS

2

READS

233

2 authors:



Vinicius Cesar

State University of Campinas (UNICAMP)

14 PUBLICATIONS 2 CITATIONS

[SEE PROFILE](#)



Thales Roel Pessanha

University of Coimbra

8 PUBLICATIONS 7 CITATIONS

[SEE PROFILE](#)

Some Compositional Approaches in the Practice of live-electronic music from the perspective of technique and technological tools

Vinícius Cesar de Oliveira, Thales Roel P. Pessanha

Universidade Estadual de Campinas | Brazil

Resumo: As ferramentas e seus arcabouços técnicos impactam diretamente nos processos composicionais, colocando-se assim como elementos de fundamental importância, seja na concepção de ideias e imagens poéticas, seja na realização técnica de uma obra. Nesse sentido, o presente trabalho tem como objetivo discutir alguns aspectos da correlação entre técnica, poética, estética e escrita musical no contexto da live-electronics e da música interativa. Isso se dá a partir de um diálogo entre ideias de autores e compositores, como Gilbert Simondon e Helmut Lachenmann acerca dos arcabouços técnicos e suas implicações na prática musical. Assim, pretendemos discutir a inter-relação entre imagens poéticas, objetos técnicos e realizações técnico-musicais que se estabelecem no processo composicional. Essas reflexões servirão de campo teórico para apresentar e descrever algumas características gerais do pensamento composicional a partir de alguns exemplos de peças do repertório e de estratégias individuais empregadas em duas peças específicas: “Espasmos” (2017), para trombone e live-electronics, de Vinícius César, e “Caminhos que me Levam” (2018), para clarinete e live-electronics, de Thales Roel.

Palavras-chave: live-electronics, objeto técnico, poética musical, processo composicional.

Abstract: Tools and their technical frameworks impact directly the compositional processes, thus, placing itself as an element of fundamental importance, either in the conception of poetic ideas and images or in the technical realization of a work. In this sense, the present work aims to discuss some aspects of the correlation between technics, poetics, aesthetics, and musical writing in the context of interactive/live-electronics music. This takes place from a dialogue between the ideas of authors and composers, such as Gilbert Simondon, Helmut Lachenmann, and Pierre Boulez about technical frameworks and their implications in musical practice. Thus, we aim to discuss the interrelation between technological devices, musical elements, and poetic images, which are established within the compositional process. These reflections will serve as a theoretical field to introduce and describe some characteristics about compositional thinking of two-piece: “Espasmos” (2017), for trombone and live-electronics, by Vinicius Cesar, and “Caminhos que Levam” (2018), for clarinet and live-electronics, by Thales Roel.

Keywords: live-electronics, technical object, musical poetics, compositional process.

The technologies that emerged and developed throughout the 20th century have decisively transformed musical creation, especially concerning musical practice that somehow uses technological support. In fact, with the insertion of these tools into musical thought – and of course, with the technological changes that have taken place in recent decades –, a decisive influence can be seen not only in aesthetic approaches, compositional strategies, and technical craftsmanship but also in the poetic conception involved in creative processes. Whether in its direct use or in the set of images and poetic possibilities that opened up from then on, devices and technologies such as the microphone, amplification, audio processing, modulation techniques, and the most varied synthesis processes came to influence strongly the creative practices that emerged and developed from the second half of the twentieth century.

At first, these tools contributed so that new ideas about sound, its attributes, and the possibilities of construction and articulation of sounds – hitherto unusual – were incorporated into musical creation at an abstract level. There was a search for a representation, to a certain extent, mimetic of sounds produced by objects and technical devices present in everyday life at the beginning of the 20th century – such as machines, tools, appliances, and the most diverse utensils. An example of this type of approach is the *intonarumori* created by Luigi Russolo. Instruments that sought to recreate in an artisanal way all the variety of sounds and qualifications of the sounds generated by these machines, concretely reflecting an enthusiasm for the new devices (VELLOSO, 2012, p. 217).

In an almost analogous way, technomorphism (CATANZARO, 2018; HOLMES, 2019) is a consequence of this. By seeking to transpose the technical craftsmanship and creative practice used in electroacoustic studios to the context of instrumental writing, it illustrates how technology was decisive in the conception of new creative approaches. With this, loops, grains, spectral attributes, processing like reverb and feedback are no longer just techniques for manipulating the sound on support. They are also images and symbols: possibilities open to poetic imagination that open the way for new ways of thinking about musical creation. Thus, even if specific equipment or technique is not directly applied in a creative process, the set of notions, images, processes, and ideas evoked by its use or study can come to act as a poetic model in creative elaboration.

At the same time, the technical resources employed in electroacoustic music studios began to

integrate new musical approaches and practices in instrumental music more concretely and palpably, but no less inventive and exploratory. All these technological tools – until then only available in major studios – began to be incorporated into the context of live performance. Procedures for manipulating the magnetic tape, hardware for audio reproduction and processing, and techniques aimed at sound synthesis are brought to the stage and started to be used in a performance situation. This approach considerably broadened the compositional possibilities concerning live-electronics, also bringing greater interpretive flexibility to the instrumentalist who, in the context of mixed music – in which the electronic part is fixed on support –, was compelled to submit to the rigid and immutable temporal properties imposed by the previously elaborated sound material.

If in this context, therefore, technologies doubly influenced musical creation – from imagery and technomorphic way and new possibilities materially placed in sound production –, we can still see a similar process today. In fact, from a growing interest, in the field of music computing, in creating models and simulations of cognitive and auditory processes, as well as the use of artificial intelligence, digital audio processing technologies have been transforming the set of tools and concepts poetics available to creative processes, which has been reverberating equally progressively in the context of live-electronics and current interactive music.

In this context, we seek to discuss how technological devices and technical contributions act in the elaboration and technical and poetic conception of pieces within the repertoire of live-electronics and mixed music in general. Therefore, we will contextualize the relationship between art and technology, approaching the creative practices related to the repertoire of our interest in historical continuity, to discern technological-craft phases of its evolution. At the same time, we seek to reflect on the continuity between creation, technology, and technique in perspective to the ideas addressed by Simondon (2005, 2010), Lachenmann (1996) e Velloso (2013). Finally, we will describe some particular characteristics of the compositional processes used in two pieces: *Espasmos* (2017), for trombone and live-electronics, by Vinicius Cesar, and *Caminhos que me Levam* (2018), for clarinet and live-electronics, by Thales Roel.

1. Technical objects and creation

Musical language in the context of mixed music and live-electronics has followed the trajectory of technological progress over the years. Since the first studio experiments in the 1950s, the technique and the compositional *métier* have been transformed and, as technology developed, new tools, technical contributions, and poetic approaches emerged. The different languages explored by the practice of live-electronics are the result of this reciprocal relationship between technological development and the creation of new musical tools and practices. Instrumental virtuosity, together with technology in its various forms of media coverage, influence the composer's creative gesture and thus shape his compositional practice (BOULEZ, 2018, p. 141).

In this sense, we can think of technologies used in creative practice in the context of live-electronics, such as studio hardwares; computers; software; among others, from the idea of technical objects. According to the philosopher Gilbert Simondon, technical object is the result of a process of sedimentation and consolidation of human thought materialized in mechanisms and technical elements aimed at specific purposes (SIMONDON, 2010, p. 139). These technical objects present a genesis that takes place from the abstract object towards the concrete object. In other words, there is, at first, an assembly of individual technical elements that takes place in an abstract and imagery way, based on isolated functionalities. In a second moment, the assembly of these same elements establishes among themselves and among an ecosystem linked to them a stable equilibrium point. Any change or disturbance in one of the constituent elements of this system would compromise the functioning of the object as a whole (VELLOSO, 2013, p. 111).

Certainly, through an exploratory and tactile experience with such devices and tools, the possibilities offered to creation can be greatly expanded and modulated. Technical objects can act in the creative process, not only enabling the technical realization of a work but also transforming and enriching the set of images that populate the processes of invention and imagination. According to Simondon, the mental image is like a relatively independent subset within the living being. When it appears, the image is a set of motor tendencies, long-term anticipation of the object's experience. During the interaction between the organism and the environment, it becomes a system for receiving incident signals and allows the perceptual-motor activity to be carried out progressively.

These images, even when the subject distances himself from these machines and technical resources, start to favor new cognitive contributions and, “integrating the affective-emotive resonance of the experience, become a symbol. From the universe of symbols organized internally, tending to saturation, the invention may arise” (SIMONDON, 2005, p. 275).

Another thought that may eventually find resonance in Simondon's ideas exposed here is addressed by Helmut Lachenmann in the text *Über Komponieren* (LACHENMANN, 1996). In this text, the composer generally makes some reflections on the practice of composition based on three propositions: (1) “composing is reflecting on the means”, (2) “composing is building an instrument” and, (3) “composing it is not to go, but to let oneself arrive” (LACHENMANN, 1996, p. 73). The three notions are interconnected in a way that one idea leads to another, there is continuity between each of these statements. In this work, we will focus only on the first two propositions.

The first says that the practice of composition already takes place in the act of reflecting on the means. Here, Lachenmann refers to means as all aspects related to musical and sound material, from the most varied timbres and instruments, technical resources, equipment, modes of sound production, notation of ideas and their realizations (LACHENMANN, 1996, p. 74). In short, any musical possibilities permeate the composer's imagination.

This reflection broadly encompasses all these resources from different approaches, i.e.: “identify, recognize, perceive, study, be aware of the relationships that such means bring from the beginning, reacting to them intellectually, intuitively, spontaneously or in a highly calculated” (LACHENMANN, 1996, p. 74, authors' translation). Although this first statement by Lachenmann turns to reasoning, to a certain extent, intellectual, it also encompasses reflective/contemplative aspects strongly guided by intuition and sensibility, therefore, far from the aptitude of a rational register. In an attempt to bring these ideas closer to Simondon's thought, we can say that the means to which Lachenmann refers are constituted and strongly influenced by symbols and images resulting from the contact and experience provided by technical objects.

It is from this imaginative, reflective, and contemplative moment on the musical/sound possibilities brought by this collection of images and abstract ideas that populate the composer's imagination that Lachenmann develops the second proposition. This gives rise to a creative process

whose essence is a tactile exploration to bring the compositional process closer to the conception of an instrument. “Perhaps my second observation would sound more obvious like this: Composing is building an instrument, and then playing it” (LACHENMANN, 1996, p. 79, authors' translation). For this, there is a need for a reciprocal relationship between articulation in time and articulation of sound, which are a function of this “imaginary instrument” (LACHENMANN, 1996, p. 80, authors' translation). Thus, it involves an interrelationship between articulation in time and articulation of sound, in which both relations –sound and movement – are presented as a function of this “imaginary instrument”.

It is evident that the *imaginary instrument* does not concern only instruments as finished and cataloged/classified products, but rather as *technical objects* materially given or that emerge as images, and that from their technical components, mechanisms, and processes of generation, transduction, and resonance, allow themselves to be explored poetic, soundly and tactically when – in the broadest sense – we touch them (VELLOSO, 2017, p. 2).

To invent is to make your thinking work, just as the machine could work. This does not happen through causality or purpose, “but according to the dynamism of the lived functioning, apprehended by what it produces, following its genesis” (SIMONDON, 2010, p. 167). The machine is a functioning organism, and its mechanisms embody a coherent dynamism that initially existed in thought. The dynamism of thought, as an invention, has been converted into functional forms.

In the context of live-electronics writing, the notion of building an instrument, as enunciated by Lachenmann, is already present in the very idea of coupling an instrument to certain computational processes. The mechanisms of this imaginary instrument obey the rules established by the processes of sound transformation and instrumental gestures that are at play, which in turn reflect the properties of the collection of images and symbols that permeate the composer's imagination before and during the compositional process.

2. Technical apparatus, poetic and aesthetic in creation: from mixed music to live-electronics interactive music

The term mixed music is directly linked to musical practices aimed at combining sounds from acoustic/mechanical sources (traditional instruments/voice) and sounds of electroacoustic origin (generated/manipulated in studios) recorded on a fixed support, such as magnetic tape, CD, HD or any type of storage.

This type of approach is eventually related to creation as a process that manipulates in a parallel way – although it presents a certain interrelation –, (1) writing supports and symbolic representation, such as musical score or any type of support that allow a representation of events distributed in time and, (2) generation, manipulation, and recording of sounds mediated by technical resources. Therefore, the “mixed” here leads us to the notion that parallel to the events noted in the instrumental score, coexist and mix – both in the creation and in performance – sound events conceived and recorded through technological devices such as microphones, recorders, computers, and synthesizers.

The emergence of mixed music dates back to the late 1950s and early 1960s. During this period, the rapid advances in technology resulting from the Second World War, the increased interest of many sectors in new solid techniques and the expansionist economic climate provided sufficient support for the establishment of studios as major centers of research and creation (MANNING, 2004, p. 19), thus providing a favorable environment for the insertion of these tools in the context of creative exploration.

It was during these years, with the continuous activity of studios such as those in Cologne, Paris, and Milan, that significant pieces began to emerge, combining the “live” sounds of musical instruments with those previously conceived and recorded tapes (MANNING, 2004, p. 135). Pieces like *Musica sue due Dimensioni* (1952-58), for flute and tape by Bruno Maderna – considered the first piece of the genre –; *Rimes pour Différentes Sources Sonores* (1958), for orchestra and tape, by Henri Pousseur; *Kontakte* (1958-60), for piano, percussion and tape, by Karlheinz Stockhausen; *La fabbrica illuminata* (1964), for soprano and tape, by Luigi Nono, and *Laborintus II* (1965), for two sopranos, contralto, narrator, choir, chamber group and tape, by Luciano Berio

are some of the works that illustrate the first compositional attempts involving sounds conceived in the studio combined with instrumental writing.

The constant creative exploration made possible by the technologies and apparatus available in the studios at this time, in addition to resulting in a vast musical production, ended up generating a set of tools and technical frameworks that are widely used in the most diverse creative contexts. Techniques such as cuts, echo, reverberation, loops, delay, reverse sounds, and manipulations in the speed of reproduction of the magnetic tape were constantly transposed and adapted to other situations, boosting new creative practices.

The first forays into the field of live-electronics emerge from this context of technological adaptation that dates back to the late 1950s. Motivated by this desire to transfer analog procedures from the studio to the stage situation and incorporate them into performances live, the first experiments on the use of synthesis and processing devices to generate/transform audio in real-time appear (MANNING, 2004, p. 157) – ie, without the primordial intermediation of fixed support, such as in mixed music practices.

By coupling these devices and devices to traditional instruments, live-electronics incorporates in its creative practice the idea of technical instrumental extension, a notion that was explored compositionally and poetically on a large scale in productions from that period on. This series of technical and poetic processes make it possible to expand, deform and/or transform the sonic possibilities of musical instruments associated with the most diverse processes of transformation/sound generation.

Transición II (1959), for piano, percussion, and two tape recorders, by Mauricio Kagel is considered the first work to explore these new approaches. In this piece, while a recorder reproduces pre-recorded material, another records excerpts from the performance and reproduces loops of the instrumental gestures played live, allowing the pianist to play with his echoes from the past. Processes like these aroused great interest during the 1960s, and several composers involved in electroacoustic music began to explore these new possibilities.

Pieces such as *Mikrophonie I* (1964), *Mixtur* (1964) and *Mikrophonie II* (1965), by Karlheinz Stockhausen, are remarkable in terms of the use of these devices and techniques to create temporal processes (delay and feedback), modulatory (ring modulation) and timbristic (ring modulation,

filtering), simultaneously stimulating the search for new poetic, creative and technical contributions.

It is equally notable that a piece like *Solo* (1966), also by Stockhausen, explores temporal processes of delay and feedback, from the reading and recording of magnetic tapes during a performance, to at the same time it seeks a very flexible and open structuring of form. The possibilities opened by live-electronics regarding the reproduction and temporal displacement of the material recorded during the performance, and its feedback, seem to have influenced the very conception of the temporal structure of the piece, stimulating the search for a compositional syntax that comes to dialogue in a way analogous to the technical procedure explored, with time and form.

In the late 1980s and early 1990s, with the development of MIDI (Musical Instrument Digital Interface) is a communication protocol to control and interconnect synthesizers, samplers, and processing modules, the possibilities placed on live-electronics were considerably transformed (HOLMES, 2008, p. 227). Working with the parametric information of the sound, which can be processed in real-time to control the sound processes more finely and contextually, the use of the MIDI protocol marked the development of musical computing in real-time by introducing the first methods of Machine Listening.

The use of MIDI associated with machine listening techniques contributes to the emergence and development of interactive musical systems. These systems are software specially designed to interact with live musical performances and are characterized by the ability to change their behavior in response to musical input (CHADABE, 1984).

Through controller devices originally designed to send numerical control data or from the use of sensors coupled to traditional instruments, it became possible to capture the player's actions in real-time, structuring processes whose nature is directly linked to performance characteristics, both of notable music and in the context of improvisation (ROWE, 1993). This approach brought to the creative practice of music mediated by technologies the possibility of conceiving interactive systems/technical sets, which have a certain autonomy about the instrument attached to them, often approaching the behavior of a performer.

Rowe (1993) classifies *interactive musical systems* from three perspectives that characterize and differentiate them as to their musical purposes: (1) systems that respond to musical events

prescribed in a score/script, or to more general parameters related to performance, as density and regularity; (2) systems aimed at the transformation, generation and sequencing of sound/musical material, and (3) systems that in some way extend the characteristics of traditional instruments or that seek to approximate their behavior to that of an instrumentalist.

In addition to contributing with reflections on the use of interactive musical systems in the context of improvisation (LEWIS, 1999), George Lewis raises important questions regarding the conception and structuring of these technical systems/sets. Describing the processes employed in his improvisational interactive musical environment – *Voyager* (1986-88) –, Lewis discusses how political debates about the nature and function of music and bodies are inevitably embedded in the structure of these software. In the particular case of *Voyager*, the Afro-American cultural origin of the composition corroborates an identification of *multidominance*¹ at the levels of both the system's logical structure and its performative articulation (LEWIS, 2000, p. 34).

Philippe Manoury was one of the pioneer composers to incorporate interactive musical systems into his compositions. *Jupiter* (1987), for flute and live-electronics², and *Pluton* (1988), for piano and live-electronics are emblematic in this respect. In these pieces, through instruments originally built to extract and send MIDI data – and later with the aid of sensors that capture the instruments' signal and convert pitch, attack, and dynamics into a symbolic representation (MIDI) –, it was possible to develop procedures aimed at score following, in which computational processes are automatically controlled and triggered in response to the performance.

Important pieces from the same period that also make use of these strategies are *Rhizomes* (1993), for two pianos, percussion and electronic, by Michael Jarrell; *D'un geste apprivoisé...* (1995), for bassoon and electronics, by José-Luis Campana, and *Anthèmes II* (1997), for violin and electronics, by Pierre Boulez (LEMOUTON; MANOURY, 1998, p.2). Many of the processes developed in pieces composed in this period with the technical collaboration of Miller Puckette, at IRCAM (Institut de Recherche et Coordination Acoustique/Musique), led to the maturation of musical programming environments aimed at digital signal processing in real-time (CONT, 2011,

¹ The notion of multidominance is present in Douglas (1991), and search formalize an Afro-American aesthetic to integrate visual and musical elements.

² Although these pieces present strong characteristics of the use of interactive musical systems the composer uses the term live-electronics to refer to them

p. 2).

The possibilities opened by technological advances that have taken place in the last two decades have led to the development of a set of new computational tools that have been constantly being transformed and integrated with new compositional practices. Software such as Max/MSP, Pure Data (PUCKETTE, 2002) and SuperCollider emerged from the second half of the 1990s, driven by the expansion of digital audio processing methods, and with the popularization of personal computers. According to (MANNING, 2004, p. 221), this is a consequence of the microprocessor revolution that began in the 1970s, as well as the emergence of a domestic market and the large-scale development and production of 16-bits processors in the following decade.

The diffusion of these softwares and hardwares boosted the practice of live-electronics on a large scale, as it allowed the musical community greater access to these tools – which until then were very restricted to artists linked to large centers such as IRCAM and GRM Groupe de musical recherches) –, at the same time, in environments based on visual programmings such as Max/MSP and Pure Data allowed exploration by artists without specialization in computer programming practices.

The development of these tools opened up new possibilities, leading to the conception of more elaborate techniques for extracting/measuring sound information developed by the Music Information Retrieval field from the 2000s onwards. If the Machine Listening processes even depended on then from the conversion of the extracted information into symbolic data, the tools aimed at Music Information Retrieval start to allow the extraction and analysis of data and information directly from the audio signal. This information can be related to the signal behavior itself, or psychoacoustic models.

The incorporation of these new tools to musical practices in the context of interactive musical systems points towards a creative approach that increasingly seeks an extensive use of the computer, to allow greater complexity and refinement of strategies in what it says respect to the integration between instrumental/vocal writing, performance and computational procedures.

In recent decades, new techniques involving artificial intelligence have gained greater notoriety in the context of interactive musical systems. Through these processes, it is possible to train the computer in order to generate sound/musical structures that will establish more complex

and elaborated relationships with the live musician, from the analysis of information generated by the human performance itself or from pre-analyzed data. In the context of its integration with Machine Listening and Music Information Retrieval techniques, machine learning and artificial intelligence processes may enable the structuring of more complex audio data processing systems, enabling strategies and compositional processes with characteristics still little explored.

3. Technical and poetic features in two-pieces for solo instrument and live-electronics

The ideas discussed in this text are diffusely and conceptually interconnected with the pieces that will be discussed below. *Technical object* and *imaginary instrument* are not procedures or compositional techniques, they are concepts and ways of thinking about musical creation that correlate with other creative conceptions. In view of the above ideas, we seek to present general characteristics of two pieces for instrument and live-electronics. We consider it relevant for this text to highlight a certain continuity between conceptual and poetic conception, and the technical-musical realization in the two pieces. Therefore, it is not in our interest to investigate them exhaustively from the perspective of musical analysis, or even from a perspective that explores specific compositional techniques and procedures. Our intention is to circumscribe the role that technological tools as technical objects play in the elaboration of a poetic conception, and how they reverberate in technical solutions.

3.1 *Espasmos* (2017)

In *Espasmos* (2017), for trombone and live-electronics, the phenomenon of spasm brought to light the idea of sudden contractions and movements that propagate in various directions. This image present in the plane of ideas was employed as a poetic and aesthetic concept that guided the conception of trombone-electronics relations as an instrument. The characteristics, mechanisms, and modes of operation of this instrument reflect the properties present in the technical object, which served as a trigger for the creative process. Processing such as pitch shifter, time stretch, spectral delay, granular processes, and sound spatialization associated with instrumental gestures

were the strategies adopted to mimic and evoke the metaphor of jerky movements.

The principal aspect of the compositional process of *Espamos* that we want to highlight here is related to the conception of an “imaginary instrument” built from the conceptual image of disordered movements materialized through the coupling of the trombone to computational processes. This process took place through a tactile exploration that interconnects with Lachenmann's propositions exposed here. As it is a creative process that demands a more concrete and exploratory apprehension of the sound/musical structures which emerge from the gestural interaction of the trombone with the sound transformation processes, there was a need to create a chain of processes that would make contact possible concrete with this “instrument” and which allowed an empirical experience.

FIGURE 1 – First page of *Espamos* (2017), for trombone and live-electronics.

Espamos

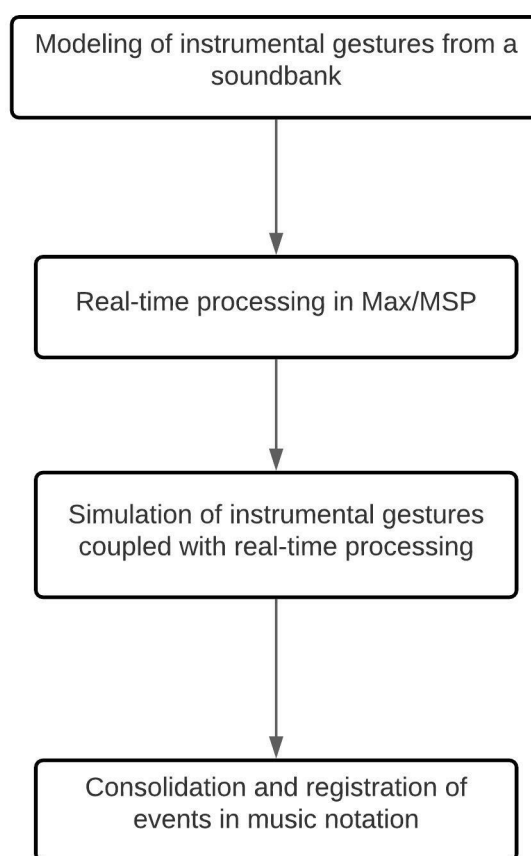
Vinicius Cesar

The musical score for *Espamos* is presented in two systems, A and B. System A begins with a 'Plunger' graphic showing a series of peaks and valleys, indicating a specific sound effect. The tempo is marked as $\text{♩} = 75$. The Trombone part starts with a series of notes, some marked with accents and slurs, and dynamics ranging from *mf* to *ff*. The Live Electronics part is represented by a series of numbered boxes (1-6) that correspond to specific sound samples. System B continues the musical narrative, with a tempo change to $\text{♩} = 78$. It features more complex rhythmic patterns and dynamics, including *cresc. dim. ad libitum*. The Live Electronics part continues with more numbered boxes and a final section marked 'staccatissimo molto rall.'.

In this sense, were used sound samples from a sound bank to model various instrumental gestures performed by the trombone --- for example, *crescendo* and *diminuendo*; *glissando*; use of different types of mutes, etc. These gestures were sent to a patch created in Max/MSP, which in

turn allowed for the control of sound processing parameters to generate a simulation of the sound structures that emerge from the instrument's coupling to real-time processes. This allowed us to intuitively intervene in the systems and mechanisms of this "instrument". Thus, while the experiments gave rise to more delineated and sedimented ideas, the musical choices were consolidated and these musical proto-ideas – instrumental and electronic – were better worked and consolidated through the musical writing. The figure 2 shows the connection chain of this process.

FIGURE 2 – Schematic of steps and processes in the simulation and design of the electronic trombone coupling.



It is important to highlight the balance of forces present in this process of exploration and empirical experimentation of sound and gestural potential. On the one hand, there is an approach that is, to some extent, quite systematized and intellectualized, which ends up reverberating in the notion of *solfege of models*. This notion consists of knowledge, intellectual and cognitive skills acquired by the composer when conceiving certain processes. These skills allow controlling and

mastering both the musical structures resulting from generative models, as well as associating graphic and textual representations of certain software or musical systems to a final musical result (MALT, 2004, p. 1).

On the other hand, coexists with this systematized relationship, a more intuitive approach. This “imaginary luthiery” brings with it the creation of unforeseen causal relationships between the actions produced through the transformation of instrumental gestures by real-time processing. These new causal relationships that emerge from the intuitive and exploratory making can create situations in which the sounds produced are sometimes close to those we previously thought and sometimes allow the creation of relationships that would usually be unthinkable (OLIVEIRA, VELLOSO, 2019, p. 3).

Behind this entirely rational speculation about thinking about means and constructing the instrument – as the intellectual efforts of the first two observations seemed to dominate – lies the opposite of this intellectual abuse of intuitive forces. Namely, the certainty that we can only reach those regions of ourselves through work like a soothsayer. Regions where our true expressive possibilities are (LACHENMANN, 1996, p. 81, authors' translation)³.

3.2 *Caminhos que me Levam* (2018)

In *Caminhos que me Levam* (2018), for clarinet and live-electronics, the artistic conception started from the notion of the expansion provided by sound materials, whose the extended and traditional techniques produced by the clarinet were combined with the use of electronic resources, more specifically by the use of processes such as frequency shifter, transposer, and delay.

The combination of acoustic and digital resources also allowed the articulation of a musical discourse that develops from processes of densification, rarefaction, and also the agency of timbre, in which, sometimes there is a total amalgamation of timbristic characteristics, and sometimes they are opposed. This happens throughout the play and appears at different levels of complexity.

³ Und so steht hinter dem ganzen rational beschriebenen Spekulieren mit Reflexion der Mittel und Konstruktion des Instruments, so wie es in den beiden ersten Beobachtungen offensichtlich als intellektuelle Anstrengung zu dominieren schien, das Gegenteil von intellektueller Vergewaltigung der intuitiven Kräfte, nämlich die Gewißheit, daß wir erst über solche Arbeit wie Wünschelrutengänger an jene Zonen in uns herankommen, wo unsere wahren Ausdrucksmöglichkeiten sind.

The musical ideas were worked through an excerpt from the *Adagio* contained in the *Concerto for Clarinet in A Major* by W.A. Mozart (1756 – 1791). This material was restructured to gain a greater temporal distribution, which refers to the idea of time stretch. This musical manipulation process enabled the emergence of a new material, which despite being structured differently, still maintains characteristics of the starting one.

This procedure is reiterated by electronic processes in real-time, once that it is through them that certain aspects of clarinet writing arise or are emphasized. This guides the musical discourse through several moments and helps in the elaboration and the expansion of the acoustic sound of the instrument, allowing the creation of relationships that traditional writing for the instrument normally would not.

FIGURE 3 – Excerpt from Mozart's Concerto used to design Caminhos que me Levam, and restructured excerpt that provided a new language and new creative processes.



Furthermore, the sound trails, triggered by the electronic part, allow an interaction between the interpreter and the real-time synthesis, that trigger “footprints” in which the accumulation generates new materials that emerge from the paths traced by the choices of the Markovian structures, which also was worked in this piece.

FIGURE 4 – Series of musical pitches generated from the series of random numbers provided by Markov chains.



Source: author's figure

The series of musical pitches, which were generated by the Markov chain, was worked through processes of rhythmic addition and tempo alternation, seeking to explore the processes of detachment, lag, and concatenation of all the initial musical material, as shown in the following example:

FIGURE 5 – Series of pitches after being worked on in various processes of rhythmic and temporal structuring.



All these footprints lead the piece to a moment of greater density and high rhythmic direction, in which, together with the electronic part, create a more dynamic and concise texture, seeking to reach a final contrast, in which it passes to a moment of lesser density and more spatiality of gestures.

Thus, we can observe that the entire process of musical writing consolidation, in this piece, started from the exploration and experimentation of the technical objects and sound palette made possible by this unique instrument composed by the clarinet/electronics ratio.

Moreover, the symbols and images created by elements drawn from the work of Mozart, as well as the influence that exerted on the way of working their materials, were the motto of the technical conception, aesthetic, and poetic of this piece.

Such images allowed to conceive new concepts and poetic/musical approaches that are not commonly present in the “traditional” repertoire for the clarinet. This imaginary instrument, when going through a tactile ritual, as Lachenmann mentions, made possible the apprehension of its sonic possibilities, and thus expand the sound of the acoustic instrument of the way that, in the context of human performance without the resources of the electronic processes, would not be possible.

FIGURE 6 – Final moments of the piece in which the alternation of textures and musical gestures ends up creating a contrast.

The musical score for Figure 6 is composed of six staves. The first four staves (measures 68-70) feature a dense, rhythmic texture with eighth and sixteenth notes, marked with '5' and '12' indicating fingerings. The fifth staff (measures 71-73) shows a transition to a more sparse texture with long notes and rests, marked with 'p', 'mp', and 'mf'. The sixth staff (measures 74-81) continues this sparse texture, marked with 'pp', 'mf', 'Cresc.', 'pp subito', and 'ff'. The score includes dynamic markings, crescendo/decrescendo markings, and event markers 'evento 5' and 'evento 6'.

4. Considerations

The ideas discussed in this text served as a theoretical field that allowed us to reflect on the continuity between creation, technology, and technique. From this, we were able to recognize the general transformations that creative practices within the scope of live-electronics have undergone since the 1950s, with music for tape, until the insertion of more robust computational tools in contemporaneity. The identification of these different technological/creative phases highlights the fundamental role of technological devices and their technical frameworks in poetic conception and technical achievements in such a way that they are responsible for shaping the musical language.

In an attempt to bring Simondon's concepts closer to the ideas discussed by Lachenmann in his text *Über das Komponieren*, we saw that it is through a tactile experience that these tools enrich the palet of possibilities offered for creation, thus favoring new technical and poetic contributions, and consequently transforming the creative practice in the context of live-electronic music as a whole.

The observations about Espamos and Caminhos que me levam allowed us to glimpse ways of thinking (poetic conceptions) and ways/modes of performing (technical frameworks) while pointing to a more particular job and individual techniques and technological tools at play in the compositional process. Contact with technical apparatus influenced and shaped the compositional gesture. The creative practice observed from the perspective of Simondon and Lachenman's ideas (among others) points to an activity that involves the creation and manipulation of an instrument from the materially available mechanisms or evoked by the poetic images involved in the conception of the work.

In future works, we intend to carry out more in-depth notes addressing specific techniques, aesthetics and creative practices. When discussing the role of technology in more circumscribed compositional practices, we will seek to map typical strategies and procedures of works from a certain period. We believe that there can be an important contribution to the understanding of the various technical and aesthetic approaches present in the compositional practice of live-electronics.

REFERENCES

- BOULEZ, Pierre. *MusicLessons: The Collège de France Lectures*. [S.l.]: Faber&Faber, 2018.
- CATANZARO, Tatiana. *Transformações na linguagem musical contemporânea instrumental e vocal sob a influência da Música Eletroacústica entre as décadas de 1950-70*. 1. ed. [S.l.]: 7 letras, 2018.
- CHADABE, Joel. *InteractiveComposing: Na Overview*. *Computer Music Journal*, The MIT Press, v.8, n.1, p.22–27, 1984. ISSN 0148-9267.
- CONT, Arshia. On the creative use of score following and its impact on research. *Proceedings of the 8th Sound and Music Computing Conference, SMC 2011*, jul.2011.
- DOUGLAS, Robert L. Formalizing na African-American aesthetic. *New art examiner.*, p.18–24, 1991. OCLC:39965335.
- HOLMES, Bryan. Tecnomorfismo em música: uma visão teórica e prática. jan. 2019. Accepted: 2019-06-17T21:46:00Z. Disponível em: <http://www.repositorio-bc.unirio.br:8080/xmlui/handle/unirio/12855>
- LACHENMANN, Helmut. Über das Komponieren. In: *Musik Als Existentielle Erfahrung: Schriften 1966-1995*. Wiesbaden: Breitkopf&Härtel, 1996. p.73–82.
- LEMOUTON, Serge; MANOURY, Philippe. Suivi de partition, reconnaissance d'événements musicaux. *Journées d'Informatiquemusical*, v.98, p.1–9, maio 1998.
- LEWIS, George E. Interacting with latter-day musical automata. *Contemporary Music Review*, Routledge, v. 18, n.3, p.99–112, jan.1999. ISSN0749-4467.
- LEWIS, George E. Too Many Notes: Computers, Complexity and Culture in Voyager. *Leonardo MusicJ ournal*, v.10, p.33–39, dez.2000. ISSN 0961-1215.
- MALT, M. Khorwa: A musical experience with « autonomous agents ». In: *ICMC*. [S.l.: s.n.], 2004.
- MANNING, Peter. *Electronic and Computer Music*. [S.l.]: Oxford University Press, 2004. Google-Books-ID: P2dCIS4LdPQC. ISBN 978-0-19-514484-0.
- PADOVANI, José Henrique. O instrumento imaginário: o paradigma instrumental na criação musical. XXVII Congresso da Associação Nacional de Pesquisa e Pós-Graduação em Música. Campinas, 2017.
- PUCKETTE, Miller. Max at Seventeen. *Computer Music Journal*, MIT Press, v.26, n.4, p.31–43, dez.2002. ISSN0148-9267.
- ROWE, Robert. *Interactive Music Systems: Machine Listening and Composing*. Cambridge: MIT Press, 1993.
- SIMONDON, Gilbert. *Do modo de existência dos objetos técnicos*. [S.l.]: PROMETEO LIBROS, 2010. ISBN978-987-574-197-3.

SIMONDON, Gilbert. L' invention dans les techniques: cours et conférences. Paris: Seuil, 2005. ISBN 978-2-02-056337-6.

VELLOSO, José Henrique Padovani. Música e técnica: reflexão conceitual, mecanologia e criação musical. Tese (Doutorado) — Universidade Estadual de Campinas, 2013. Accepted: 2018-08-24T04:43:20Z Publisher: [s.n.]. Disponível em: <http://repositorio.unicamp.br/jspui/handle/REPOSIP/284497>

ABOUT THE AUTHORS

Vinícius Cesar de Oliveira holds a bachelor's degree in music composition (2018) and a master's degree in creative processes (2022) from Unicamp. Currently, he is studying for a doctorate's degree in music at the Arts Institute (Unicamp), where he researches compositional strategies in the use of machine listening and music information retrieval associated with machine learning in the context of live-electronic music under the supervision of Prof. Dr. José Henrique Padovani. ORCID: <https://orcid.org/0000-0002-7711-3949>. E-mail: oviniciuscesar@gmail.com

Thales Roel holds a bachelor's degree in music composition (2021) and specialization in Sound Engineering (2021) at State University of Campinas. He is co-founder of the multimodal art group Grupo Corpo Generativo, whose main proposal is the expansion of creative processes in the areas of Dance, Music, Media Science, Performing and Visual Arts, Computer Engineering and Electrical Engineering, as well as contributing to the discussion of themes such as dialogues, collaborative creation, generative processes, among others, that currently occur in the arts through the use of technological supports. ORCID: <https://orcid.org/0000-0002-3046-9710>. E-mail: thalesroel@hotmail.com