BRAGAGNOLO, B; GUIGUE, D. Analysis of sonority in piano pieces: a performance-based..., p. 219-248, Recebido em: 9 abr. 2020; aprovado em 7 jun. 2020.

Analysis of sonority in piano pieces: a performance-based approach

Bibiana Bragagnolo
UFMT
bibi_bragagnolo@hotmail.com

Didier Guigue
UFPB/UNICAMP
didierguigue@gmail.com

Abstract: This paper presents an analysis of sonority in selected parts of two performances of a piano piece by the Brazilian composer Almeida Prado, extracted from the first volume of his cycle *Cartas Celestes* (1974), and of this piece as a whole. The main goal of this analysis is to present a methodology where the performative decisions are understood as main sources of information, with specific attention to the sonic aspects of the piece. In this context, the musical work is understood as a process, since the score is only one of the elements that will influence the final result (Costa, 2016). The methodology consists of three main steps, and was based on the methodology of analysis of the sonority by Guigue (2009): (1) the first step is the artistic process, which gets up to the construction of two performances of the piece by the same pianist (the first author of this paper), with different and contrasting performative decisions, and their recordings; (2) then, the piece is divided into homogeneous sonic units, always having the performative decisions as guides; and (3) at last, these units are analyzed using the software Spear and Sonic Visualiser for audio files and Open Music for MIDI files. The methodology intends to include the performance in the scope of musical analysis, as performative decisions may lead to dramatic differences in the final perceived sonic layout of a musical work.
Keywords: Performance. Analysis. Piano. Artistic research. Sonority.

Análise da sonoridade em peças para piano: uma abordagem a partir da performance

Resumo: Este artigo apresenta uma análise da sonoridade em partes selecionadas de duas performances das *Cartas Celestes V. I* (1974) de Almeida Prado, para piano solo, e desta peça como um todo. O objetivo principal desta análise é apresentar uma metodologia onde as decisões performáticas são compreendidas como importantes fontes de informação, com atenção especial para os aspectos sonoros da peça. Neste contexto, a obra musical é entendida como processo, uma vez que a partitura é apenas um dos elementos que influenciarão no resultado final (Costa, 2016). A metodologia consistiu em três etapas principais, e se baseou na metodologia de análise da sonoridade de Guigue (2009): (1) a primeira etapa foi o processo artístico, que levou à construção das duas performances da peça pela mesma pianista (a primeira autora deste artigo), com diferentes e contrastantes decisões performáticas, e as gravações destas; (2) então, a peça foi dividida em unidades sonoras homogêneas, sempre tendo as decisões performáticas como guias e; (3) por fim, estas unidades foram analisadas utilizando os softwares *Spear* e *Sonic Visualiser* para os arquivos de áudio e *Open Music* para arquivos MIDI. A metodologia teve como intenção incluir a performance no escopo da análise musical, uma vez que as decisões performáticas podem levar a diferenças dramáticas no resultado sonoro final da obra musical.
Palavras-chave: Performance. Análise. Piano. Pesquisa artística. Sonoridade.

DOI: 10.11606/rm.v20i1.168644

RevistaMúsica, v. 20 n. 1
Universidade de São Paulo, julho de 2020
ISSN 2238-7625

1 Introduction

This paper presents a methodology of analysis of sonority in which the performance and its process are seen as central elements for understanding this parameter in musical work, which is part of a Doctoral Thesis (BRAGAGNOLO, 2019). This methodology was developed using the analysis of sonority by Guigue (2009). However, due to the change in the concept of musical work, other elements apart from scores have been taken into consideration in order to understand the construction of sonority.

For this approach to be theoretically effective, the ontological concept of musical work as the doubling of the score was not taken into consideration. To consider just the textual relation (score) of musical work would not enable the performer to contribute to the music-making process as a critical and active agent. Therefore, this paper is based on the work of Costa (2016), whose view of musical work is broad and morphological.

Subsequently, a methodology of analysis of sonority was developed, examined in detail, and applied in two performances of three selected parts of a piano piece, and by means of a global concept of sonority in a complete performance of the same piece, *Cartas Celestes Volume I*[1] (1974) by the Brazilian composer Almeida Prado (1944-2010). This piece was particularly selected to exemplify the applied analysis methodology, since the central element of its writing and performance is found in sonority.

One of the main characteristics of the analytical procedure is the crucial role played by the performer in this process. The analysis was carried out using recordings of excerpts made by the researcher and first author of this paper, which included the performative decisions regarding sonority. The premise of this methodology is that the performer, with his decisions and idiosyncrasies, has a crucial role in the conformation of the musical work. Thus, each of the three selected excerpts presents an analysis of two different performances in which different decisions were made with the purpose of investigating the interference of these performative decisions in the result. The methodology consists of data analysis of audio and MIDI extracted from these performances using Spear and Open Music.

[1] In English, the title of the piece means “Celestial Letters Volume I”.

The performer's view as someone who plays a critical and crucial role in tandem with the morphological concept of the musical work merge this proposal with the artistic research assumptions (Coessens *et al.*, 2009). Thus, the researcher plays the role of an artist (one who defines the conformation of the work to be analyzed), and of a researcher (one who is aware of his artistic actions and its effects, and who is involved in the subsequent analytical process).

Firstly, the materials and the methods that involve the concept of the musical work and the details of the proposed methodology are presented. Secondly, the results show the applied analysis methodology. Finally, the discussion enables the reflection on the results found.

2 Materials and methods

2.1 The selected concept of musical work

In order for the performance to be incorporated into the musical analysis, the concept of musical work has to be changed, so that a formulation of its identity that encompasses more than the writing register may emerge. To this end, the musical work is seen from a morphological rather than an ontological perspective, mostly based on the work of Costa (2016). Therefore, the present perspective is linked to the perception of music, to the changes in each performance and how these changes occur. In other words, the musical work is not seen as an ideal object represented by the score anymore, but as a process.

The methodology of investigation is based on the observation of favorable conditions for the realization of musical performances, for performance is seen as a crucial element of morphology. The fact that a performance is mutable, unstable and temporary shows characteristics that constitute the musical work, in a sense that these are not finished works to be merely performed. Therefore, there is the idea that the relationship between proposal and result depends on what occurs until the performance is achieved. That is, not only how the performer understands or follows the score, but also other conditions of the environment that may cause them to make devious decisions at any level. A musical proposal is now understood as

RevistaMúsica, v. 20 n. 1
Universidade de São Paulo, julho de 2020
ISSN 2238-7625

> a process in which the relationship between proposal and result depends on decisions, chance and external contingencies, while the score is understood as an item in a variety of objects categorized as strategies of invariance. Thus, it is not the only tool at the performer's disposal in the conformation process of the work (COSTA, 2016, p. 37, translated by the authors).

In this context, the score is the wheel that drives the performance, and enables the recognition of a particular musical work. However, there is a chance that these conformations are not strictly followed. Instead, they could be used with the purpose of constructing a performance, emphasizing that the performance has priority in relation to the obeyance of the score, in an ethic that is not so determined by the concept-work, but by the performance itself as the musical work. By carrying out the analysis from this particular perspective, the decisive role of the score would be relativized and considered from the perspective of the performance itself and of the process from the first contact with the piece to the resultant performance. In this sense, the musical work "does not urge for a central entity represented by the score, considered absolute and categorized by *executions*, but by *situations* in which performers and composer are found" (CARON, 2013, p.19, translated by the authors). Therefore, the process is emphasized rather than any ontological supposition about the being of a musical work in any ideal place that is apart from it.

The emphasis on the process "enables a more flexible attitude towards the *musical notation* that focuses on the performance conditions in order to find results instead of a fixed musical object" (COSTA, 2016, p. 33, translated by the authors), realizing that this result concerns to that particular moment and continuously redefines the identity of the work. Disregarding notation may lead to the concept of the musical work in which elements linked to each of these particular moments are significant for understanding the phenomenon itself, considering performance as a crucial element, since "the work only exists while performed" (COSTA, 2016, p. 10, translated by the authors), depending on someone to recreate it on every execution. Therefore, the musical work can be

> seen as a 'link' whose morphological limits oscillate due to the observation of rules from a project, external irritations and temporal factors. This project could be understood as a whole, whose internal organization, as well as the imprecisions around each musical object, would provide a systemic model. That is, a whole formed by elements and defined by how these elements behave rather than by the sum of these elements. Thus, it would allow differentiating the "system/work" from an environment with diverse behavior, which is merged with it in view of differences in complexity and function (COSTA, 2016, p. 37, translated by the authors).

In an analysis that focuses on the characteristics of individual performances, the variety of results and variants give the chance to observe the impacts of the performative interferences in the musical work. In addition, it is possible to observe how each performance can change the appearance of a particular work. In this case, appearance refers "to the total series of appearances as opposed to a hidden reality that absorbs to itself the being of existence" (SARTRE, 1994, p. 11, translated by the authors). In this sense, a particular performance can refer to the total series of performances even if only one of the aspects of the object appears, since the object is totally found inside and outside of this aspect, that is, "totally found inside it when it appears in this aspect, which refers to itself as the structure of the apparition and the reason for the series. Totally outside, because the series itself will never appear nor can it appear" (SARTRE, 1994, p. 13, translated by the authors). The impossibility of apparition of the total series of the possible appearances also justifies the presence of only one example, which will explain one of the central assumptions of the artistic research. The adoption of this concept of musical work would enable to obtain the results of sonority of each particular musical experience, and investigate the morphological impacts of each element of conformation in that particular existance. The general criteria would be morphological, and the work could be understood as the effect of a performance practice, assuming the concept of cause. This change in the concept of work can contribute to the "emergence of a more resistant and independent performance-based musical science with a new perspective that values the musician/performer as an agent" (COSTA, 2017, p. 15, translated by the authors).

2.2 Analysis methodology

We propose an analysis methodology of sonority considering the previously mentioned concept of musical work. This procedure is based on Guigue's (2009) main concepts regarding methodology, even though a few changes were made. One of the main concepts used is the Compound Sonic Unit (CSU), which is

> formed by the combination and interaction of a variable range of components. However, sonority *a priori* does not have temporal limits, because it can correspond to a short or a long period of time or the entire work (GUIGUE, 2009, p. 47, translated by the authors).

Similar to the concept of *Strukturklang* by Lachenmann, the CSU is understood as an "order consisting of heterogeneous components that create a field of complex

RevistaMúsica, v. 20 n. 1
Universidade de São Paulo, julho de 2020
ISSN 2238-7625

relationships in details" (GUIGUE, 2009, p. 48, translated by the authors). Thus, this unit depends on the existence of elements that are combined to create the content. For that reason, it is referred to as compound, because it simultaneously absorbs the general meaning and the musical sense of the term (GUIGUE, 2009, p. 48). The fact that a compound sonic unit is not an independent element is important to highlight, since it "emerges from a chain created by its combination with other units, and from which its meaning is derived" (GUIGUE, 2009, p. 48, translated by the authors). Therefore, a sonic unit is seen as a temporary synthesis of a certain range of components that act and interact interdependently (GUIGUE, 2009, p. 50).

Taking into account the central idea of this analysis, the methodological procedure consists of four steps: (1) construction of the performances of the piece; (2) recording of the pieces in audio and MIDI formats; (3) segmentation of the pieces in CSU; (4) data analysis of the recordings using computer-based tools.

The first step, which involves construction (and reconstruction in terms of the varied ways a performance can be constructed), evokes the artistic research (COESSENS *et al.*, 2009), considered the place where performative processes are emphasized. The product of the first part of the applied method is inherently artistic. From the contact with the score, having the morphological concept of the musical work as a philosophical basis, emerges an artistic object. That is, a version of the work that will subsequently emerge differently from the making of new decisions and experimentations. Thus, the artistic research provides the object of analysis: it is from this artistic practice that the musical work will arise as real and attainable sonority. In this first moment of the methodology, the first author plays the role of pianist for the interpretation of the works, the decision-making process of the performances, and the construction of a conception of the pieces by always seeking to emphasize and explore the sonority of the piano.

In the second part, the pieces were recorded in audio and MIDI formats after a period of experiments. The MIDI data was extracted from a digital piano Clavinova CP701, whereas the audio data was captured from a Sony HDR-MV1 camera. Even though there was a variety of recordings, the ones that corresponded to the previously made decisions of the performance and the ideal model of sonority sought in the performance were selected for the analysis. The audio data was recorded with a camera

placed two meters away from the piano, so it could be possible to have the same environment in every recording.

The third part corresponds to the segmentation of the works in CSU, which enabled the subsequent analysis using the selected softwares. These sonic units were detected from the experimentation of the pieces from the performer's perspective. In these analyses, the CSUs act delimitating the form of the piece, considering there are particular characteristics of sonority in each section and every section shift is linked to changes in these characteristics, taking into consideration performative decisions as the use of pedals and pianistic touch. In this part, the presence of the performer is indispensable in a sense that this segmentation could not be achieved by an individual that is not involved in the process of the performance. Thus, there is a clear connection between the functions of the performer and the analyst.

Finally, after the pieces were segmented in CSUs, the data of sonority of the piece in audio and MIDI files was analyzed. This part of the process aimed to merge these special elements of the piece's performance to their analysis and verify how the performative decisions responded in terms of interaction with the instrument (using the MIDI data extracted from the performance) and the sonorous results (through the audio data).

Two elements were assessed for the analysis of the MIDI files: *velocity* and sonic basic quality Q. Nonetheless, the SOAL library (*Sonic Object Analysis Library*) was used in order to extract these data from Open Music. The first element, *velocity* (V), was used to analyze the MIDI files and provides an absolute value (between 1 and 127) for the velocity of the touch on every note.

The second parameter weighted in the MIDI files was the sonic basic quality Q, whose value is the result of a calculation that gives a value from 0 to 1 for each note in terms of timbral quality, in which 0 is the least complex and 1 the most complex. The Q value essentially depends on three parameters: (1) the absolute pitches (MIDI *notes*) found in the unit, (2) their relative intensity (MIDI *velocities*), and (3) the use of the right pedal and *una corda* (GUIGUE, 2016, p. 15). The sum of Q considers the relative timbral complexity of a piano object according to the general principle of a decline in the timbral complexity of each note in proportion to the pitch of its fundamental frequency. Thus, the

RevistaMúsica, v. 20 n. 1
Universidade de São Paulo, julho de 2020
ISSN 2238-7625

higher the pitch, the less complex its spectral quality. The three acoustic factors of this decline are: (1) the decreasing number of audible partials for a given fundamental, (2) the decreasing rank in the spectrum of the loudest partial(s), and (3) the shortening of the decay rate of the sound (GUIGUE, 2016, p. 15). The combination of these three values creates the Q value which weights each note in terms of its intrinsic sonic quality. Thus, we can understand that once the piece is analyzed, while V provides specific information about the performer's relation with the instrument, Q gives a value that represents the resonance in the piece, since it takes into consideration velocity, register and pedals. The functions used were developed by the research group *Mus3,* at UFPB, as a complement to the investigation of sonority in Open Music[2]. Data extracted from the analysis of the MIDI files was selected, analyzed and categorized using *Excel*, which generated all the graphics shown in the analysis of the works.

Furthermore, the audio files were analyzed in order to observe the effective differences with respect to the interference of the performer in terms of sonic signal. The audio files were analyzed using *Sonic Visualiser* and *Spear*. *Sonic Visualiser*, which is a software especially designed to analyze audio files, enabling the visualization of different aspects (COOK; LEECH-WILKINSON, 2009, p. 2), showed the values of the spectral centroid, while *Spear* created spectrograms. Analyses were carried out using the spectrogram and the spectral centroid, because the visualization of these sonic elements show relevant information about timbre. The spectrogram consists of data about the harmonics in each onset, and their position and duration throughout time, whereas the spectral centroid shows the position of the center of mass of the spectrum each time.

The spectrogram shows the frequencies (Hz measures) of each onset due to time in the vertical axis (measured in s), represented by the horizontal axis. These frequencies become visible due to the horizontal axis inside the same vertical axis, representing the harmonics found on each onset. However, the darker the color, the more present it is in terms of intensity. These data enables the observation of the sonic quality of each onset with respect to the number of audible partials, as well as its position and intensity.

[2] The Open Music app and SOAL library are available for free download on: http://git.nics.unicamp.br/mus3-OM/soal4/tags. For further information on the functions used for the analysis, check SOAL library available on: https://www.academia.edu/29796175/.

However, the second aspect analyzed using *Sonic Visualiser*, the spectral centroid (SC), indicates where the center of mass of a particular spectrum is. It is calculated as the "center of gravity" of the spectrum of amplitude of the signal frequency components (LOUREIRO *et al.*, 2008, p. 119). The figures show the measure of the centroid on the vertical axis (Hz measure) in progress according to time on the horizontal axis (ms measure). The spectral centroid is a well-known parameter due to its prominent correlation to what was defined as "brightness" of the sound: sounds that have a dark quality tend to have lower frequency content, and those with brighter sounds tend to be predominantly superior in terms of harmonics, which can be measured according to the value of the spectral centroid (LOUREIRO et al. 2008, p. 119). Therefore, the value of the centroid allows to observe timbral differences in regard to the brightness of the resulting sound.

For the data analysis the role played together by the performer and the researcher was found to be potentially important. Given the complexity of data extracted from the MIDI files in terms of quantity (a value is extracted from each note), the awareness of specific intentions of each note made possible to categorize data and verify whether it corresponded to the initial performative project. For example, if there is the intention of playing one pianistic touch with the right hand and another one with left hand, being aware of these decisions hidden in the recorded performance enables their analysis and incorporation to the reflections and to the understanding of the data found. In the audio files, since there is a direct correlation between the sound heard and the figure or graphic shown, the relationship between intention and result can become more evident. However, the role played by the first author as a performer brought the process to light, revealing the conformation potential of the analyzed works morphology.

3 Results

In this section, three examples of the analysis of sonority methodology applied were presented by means of performative decisions description and analysis of sonority in three sonic units of Almeida Prado's *Cartas Celestes I*. Furthermore, two possibilities of performance were explored for each excerpt, which are referred to as performance 1 (P1)

RevistaMúsica, v. 20 n. 1
Universidade de São Paulo, julho de 2020
ISSN 2238-7625

and performance 2 (P2). Subsequently, an analysis of the Q value of a complete performance was provided, including information about the global sonority found.

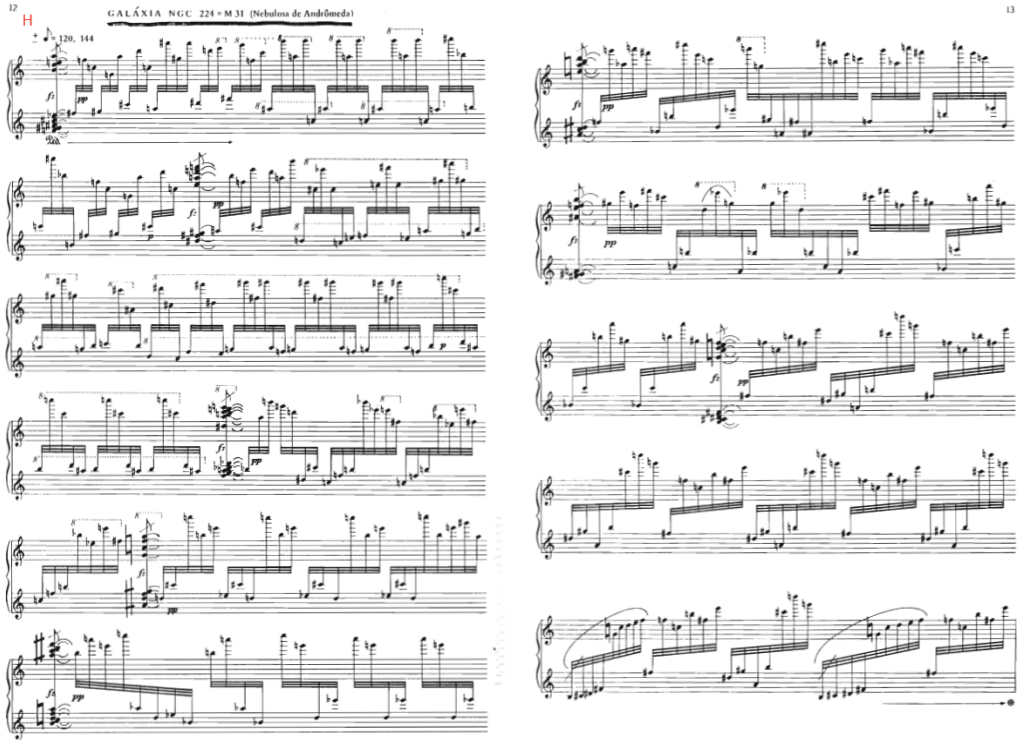
The first piece of *Cartas Celestes*, volume 1 (1974), was written after a request from the São Paulo planetarium. It is based on the view of the Brazilian sky in August and September, period that delimits the end of the winter and the start of spring. The sky view was examined using the Atlas Celeste, by Ronaldo Mourão (2004), enabling the composer to determine which elements, planets and constellations could be seen in the Brazilian sky at that very moment, and picturing "the song of the stars, the sonic speech of the constellations being put in a pentagram" (ALMEIDA PRADO, 1985, p.28, translated by the authors).

For *Cartas Celestes,* the author created and implemented for the first time his system based on the organization of resonance. Also, the composer's choice of the piano for that was due to its great natural power of resonance without amplifiers (ALMEIDA PRADO, 1985, p. 4). Thus, the potential of resonance as a central element for constructing the sonority in the performance is emphasized in this work. The volume I of *Cartas Celestes* (hereinafter called *Cartas Celestes I*) includes a variety of parts clearly named by the composer that either refer to celestial elements or temporal elements, such as: "Constellation I", "Constellation II", "Night", "Sun", "Morning", "Meteors", "Galaxy NGC 224 M31", and etc.

3.1 Example 1

Example 1 of *Cartas Celestes I* corresponds to an excerpt of the sonic unit H in the piece, referred to as "Galaxy NGC 224 = M31" ("Andromeda Nebula"). It consists of 8 chords, which creates 8 sections, followed by fast melodic notes (Fig. 1).

Figure 1- Score of section H in *Cartas Celestes I*.



Source: Almeida Prado, *Cartas Celestes*, for the piano. Score. Darmstadt: Tonos, 1975.

In the first performance, the chords and the melodic notes were understood according to two different pianistic approaches: one for the chords and the other for the melodic series. The chords were played with a high velocity of attack and accent, with the purpose of seeking a bright sound. In the melodic series a lower velocity of attack was experimented in order to make a contrast. In the melodic series the *una corda* pedal was used with the purpose of diminishing the resonance and making a greater difference in their timbre when compared to the chords.

In performance 2 (P2) there was no contrast between the chords and the melodic notes, aiming that the sonority of these notes was the continuation of the sonority of the chords. The velocity of attack was found to be more stable, showing a gradual oscillation. For this performance, the right pedal was used the same way as in P1. However, the *una corda* pedal was not used with the purpose of avoiding changing the timbre. The example 1 of performances 1 and 2 is found in the audio accessible through the QR Code below (Fig. 2):

RevistaMúsica, v. 20 n. 1
Universidade de São Paulo, julho de 2020
ISSN 2238-7625

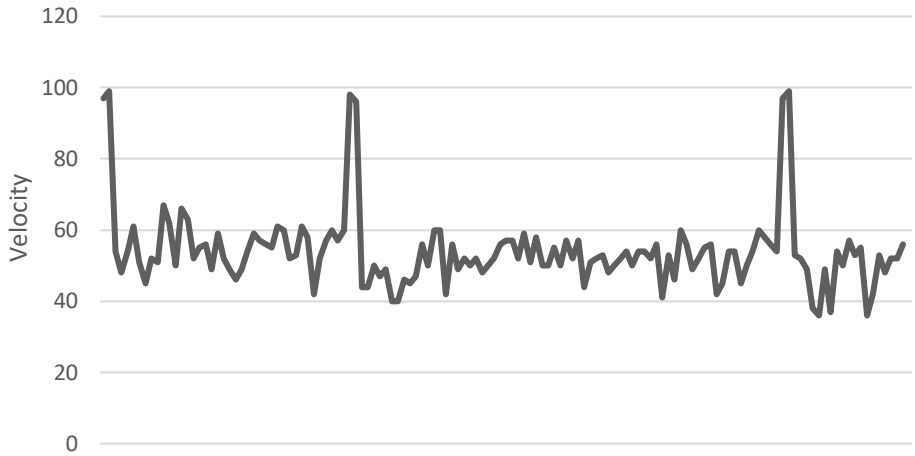
Figure 2 - QR Code of the audio referent to performances 1 and 2 from Example 1 of *Cartas Celestes I*, also available on: https://youtu.be/E_Er1Th0z3E

Authors' production.

This example allows verifying that two separate sonorities can be found in P1, which alternate among themselves and preserve their particularities in terms of timbre. In P2, however, a single sonority is constructed, one in which chords and melodic notes have the same sonic identity.

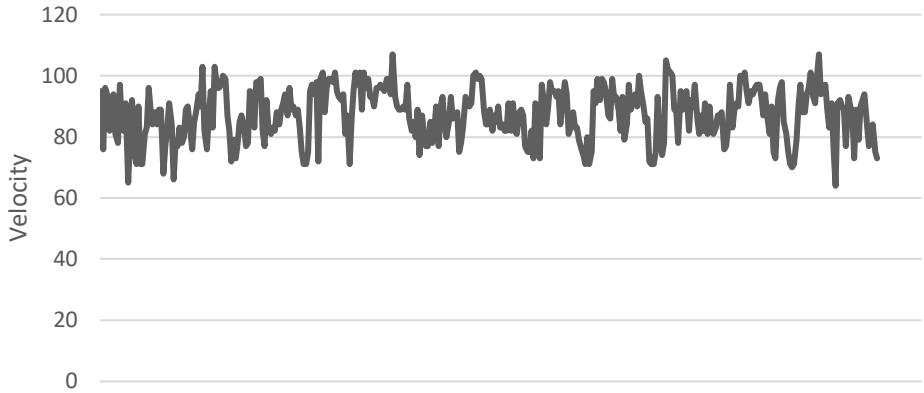
The graphics below (Graph. 1 and Graph. 2) show the evolution of V (velocity) in this example in both performances:

Graphic 1 - Graphic of the evolution of V in P1 from Example 1 of *Cartas Celestes I*.



Authors' production.

Graphic 2 - Graphic of the evolution of the V in P2 from Example 1 of *Cartas Celestes I.*



Authors' production.

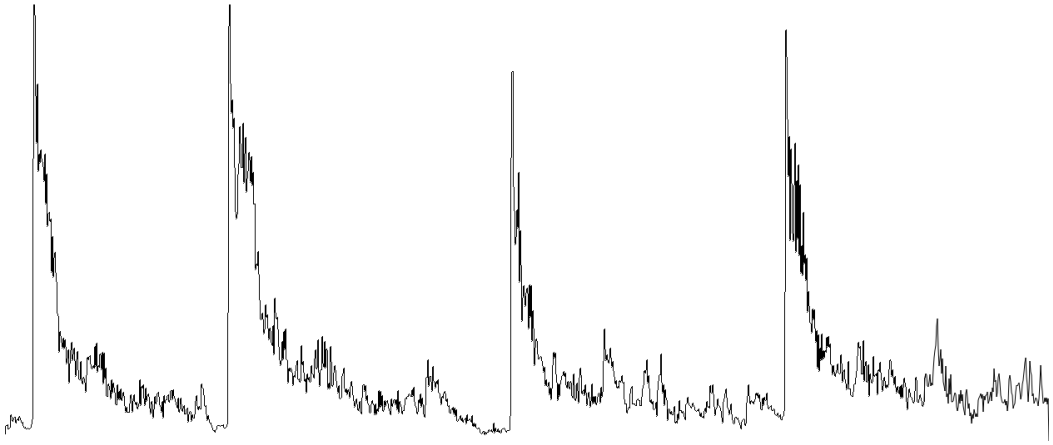
There is a great variation of V in P1 (Graph. 1), from about 40 to 100, showing high peak values when corresponding to the chords. This shows the sonic contrast in terms of the pianistic touch. In the graphic of the second performance (Graph. 2), V is in a more restricted space, from 60 to 100. There is no abrupt oscillation, but gradual changes linked to the dynamic manipulation. In P2, the contrast is eliminated and the continuous lines show more stability of the sound.

According to the figure of the spectral centroid (SC) values, P1 clearly shows the occurrence of the chords and melody notes (Fig, 3). Thus, the chords are represented by the high peaks (suggesting a much bright sound), and the melody notes are represented by low peaks that alternate with the highest peaks, verifying the occurrence of a darker sonority that is reinforced by the *una corda* pedal. Also, the highest peaks of SC that correspond to the chords can be observed in the second figure of P2 (Fig. 4). However, the melodic notes have higher values as opposed to P1. This refers to the sound found to be the most stable one, which created a brighter sonority in the whole excerpt.

DOI: 10.11606/rm.v20i1.168644

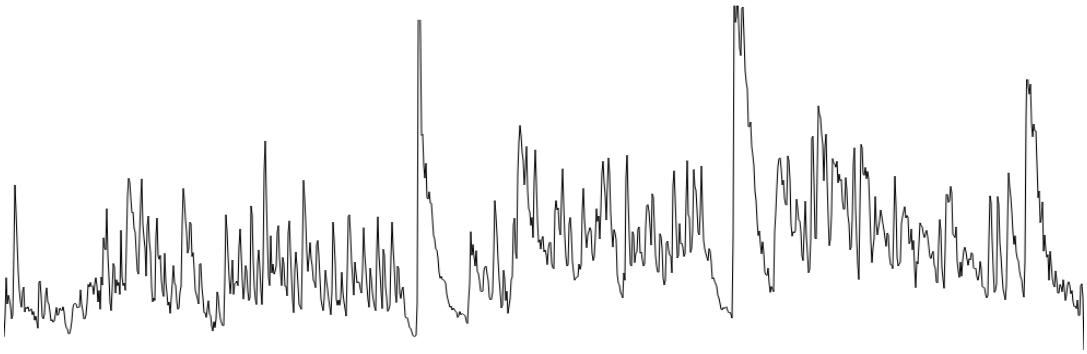
RevistaMúsica, v. 20 n. 1
Universidade de São Paulo, julho de 2020
ISSN 2238-7625

Figure 3 - Values of SC in P1 from Example 1 of *Cartas Celestes I*.



Authors' production.

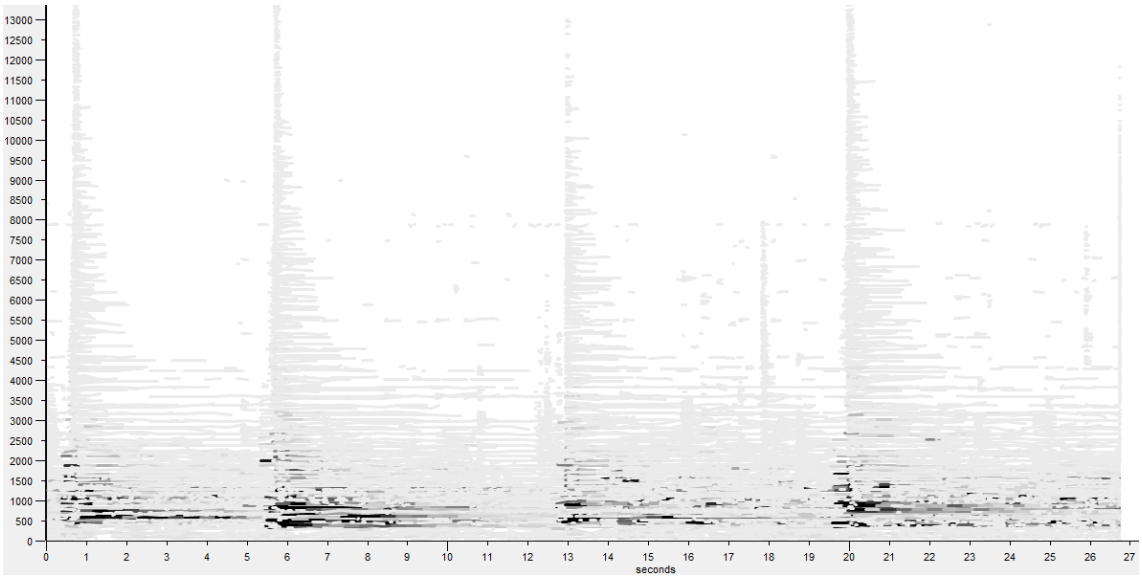
Figure 4 - Values of SC in P2 from Example 1 of *Cartas Celestes I*.



Authors' production.

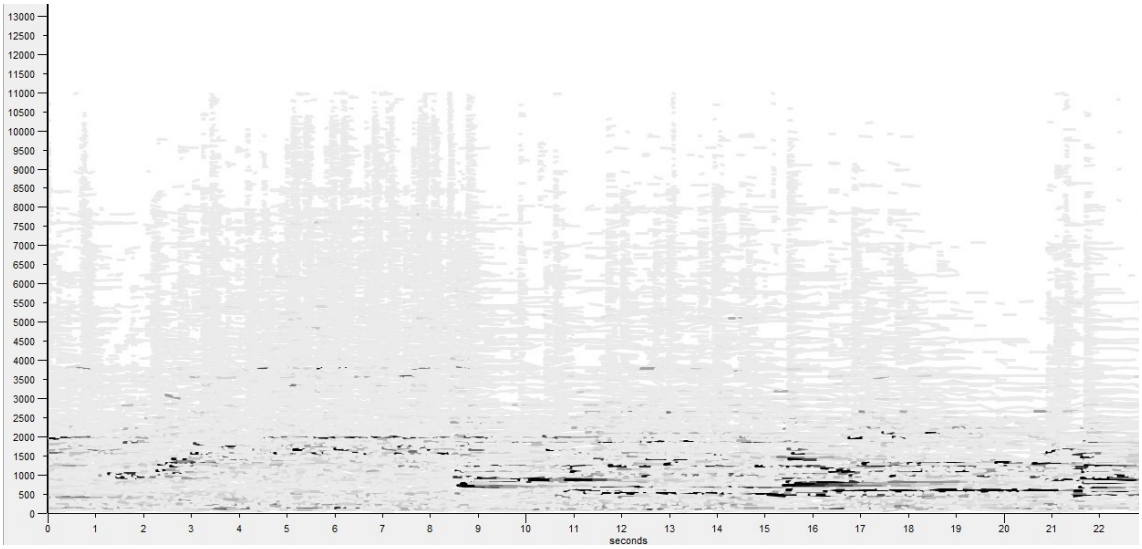
In the spectrograms below, four vertically longer lines can be observed in the first performance (Fig. 5). They correspond to the four chords, showing the difference of their spectrum in comparison to the notes that follow them. The spectrogram of the second performance (Fig. 6) shows that the spectrum is more stable and has more harmonics in average and high regions from beginning to end, corresponding to the decision of a more stable sonority.

Figure 5 - Espectrogram (*Spear*) of P1 from Example 1 of *Cartas Celestes I.*



Authors' production.

Figure 6 - Espectrogram (Spear) of P2 from Example 1 of *Cartas Celestes I.*



Authors' production.

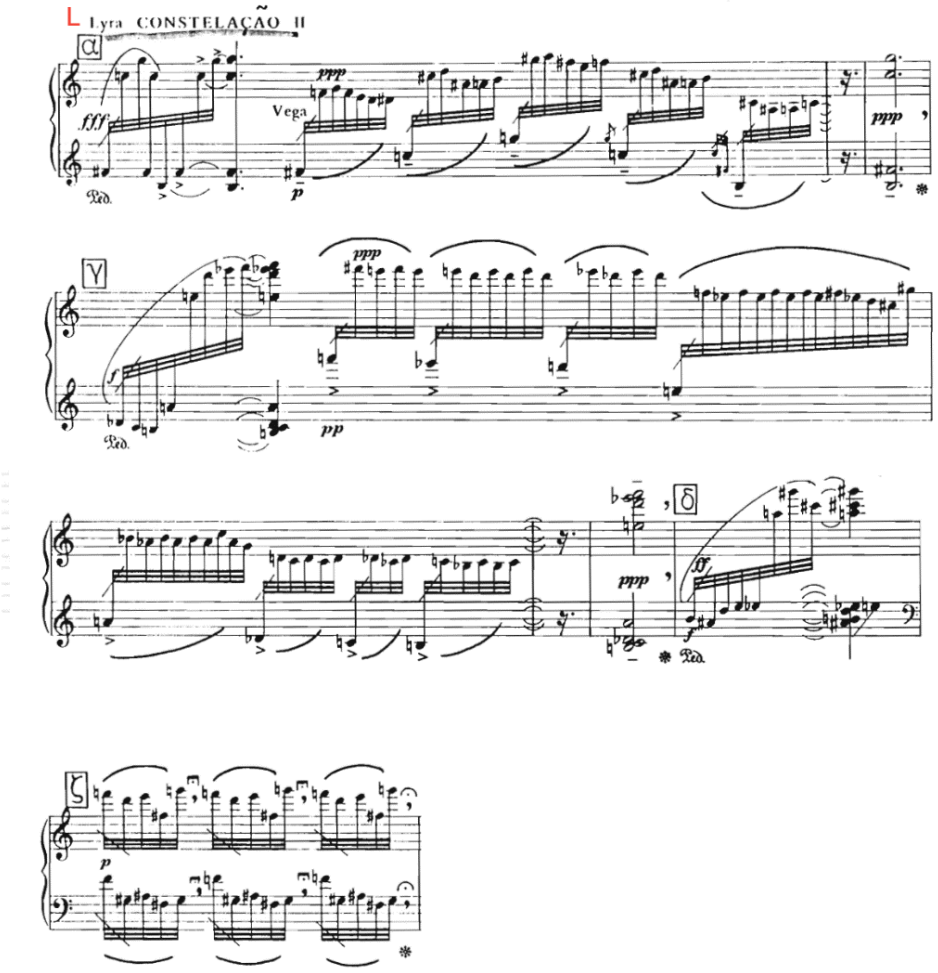
In example 1, two possibilities of understanding and performance of section H in *Cartas Celestes I* are shown. In P1, two different sonorities were identified, whereas in P2 they were performed as only one sonic element.

RevistaMúsica, v. 20 n. 1
Universidade de São Paulo, julho de 2020
ISSN 2238-7625

3.2 Example 2

The second example in the piece corresponds to an excerpt of the sonic unit L, Lyra, whose main characteristic is an arpeggiated melodic fragment followed by its crystallization in a sequence of melodic notes (Fig. 7).

Figure 7 - Score of section L in *Cartas Celestes I.*



Source: ALMEIDA PRADO, 1975.

The purpose of the first performance was to construct a sonority for the notes that followed the arpeggiated melodic fragment, so that it would seem that these sounds were a reverberation of the first sounds. Also, the first notes of these fragments would have more intensity. To this end, all the arpeggiated fragments were played with a high velocity of attack, to produce an energetic sound. The notes understood as melodic notes were included in the remaining resonance of the first sonority by means of a soft sound with

lower velocity of attack and the use of the *una corda* pedal, but emphasizing the first notes of the sequence.

The decisions made in the second performance were similar to the ones in the first performance. The arpeggios were presented the same way, that is, with a bright and energetic sonority. However, the notes that followed were very softly executed. To this end, the first note was finally executed in tandem with the others with a low-velocity of attack, conveying the impression of an aura of resonance in which specific pitches can't be distinguished clearly. In P2 the *una corda* pedal was used with those fast notes. This sonority was heard in both performances as observed in the audio example accessible through the QR Code bellow (Fig. 8):

Figure 8 - QR Code of performances 1 and 2 from Example 2 of *Cartas Celestes I*, also available on: https://youtu.be/UEYPpV33LA8

Authors' production.

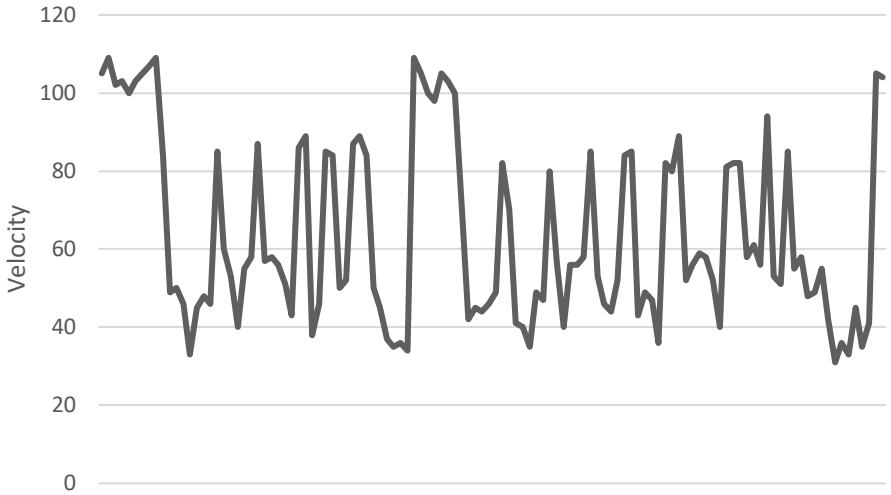
In P1, the audios show that sonority was constructed in three levels: a bright sonority for the arpeggios, an inferior sonority yet clear for the first melodic notes, and a dark sonority for the remaining notes. However, in P2 only two levels remained: the first sonority of arpeggios and the last one, creating the aura of resonance.

In P1, the three levels of sonority can be seen in the graphic of the evolution of V (Graph. 3). The higher peaks correspond to the arpeggios, whereas the subtly lower peaks correspond to the first notes of the melodic sequences. Finally, the lowest values for the remaining notes are found between these points. In P2 (Graph. 4) there is a small increase in the space of V and a great oscillation between a higher value for the arpeggios and an extremely low value for the remaining notes.

DOI: 10.11606/rm.v20i1.168644

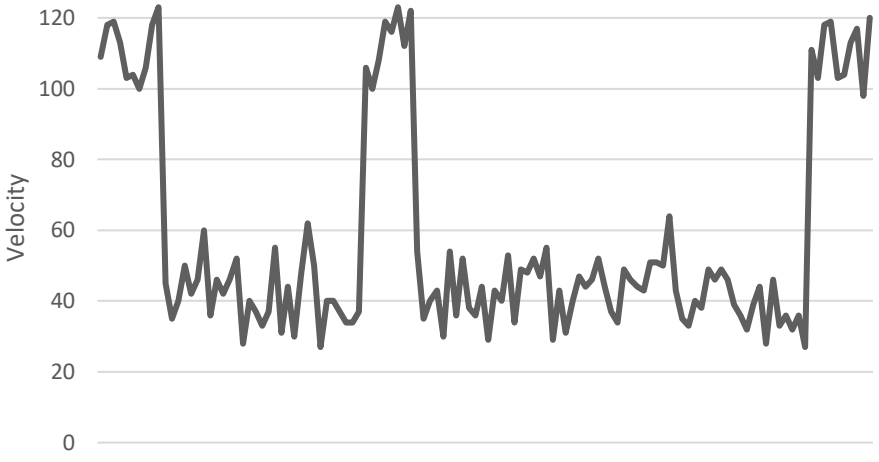
RevistaMúsica, v. 20 n. 1
Universidade de São Paulo, julho de 2020
ISSN 2238-7625

Graphic 3 - Evolution of V in P1 from Example 2 of *Cartas Celestes I.*



Authors' production.

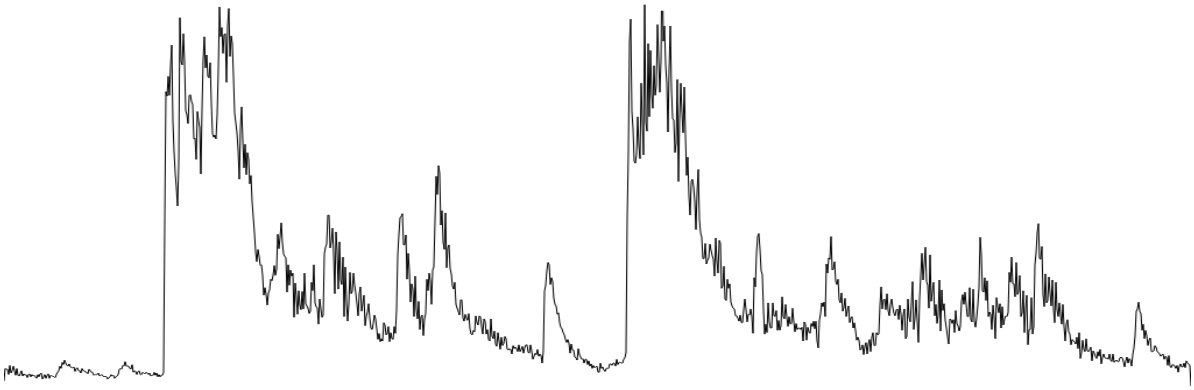
Graphic 4 - Evolution of V in P2 from Example 2 of *Cartas Celestes I.*



Authors' production.

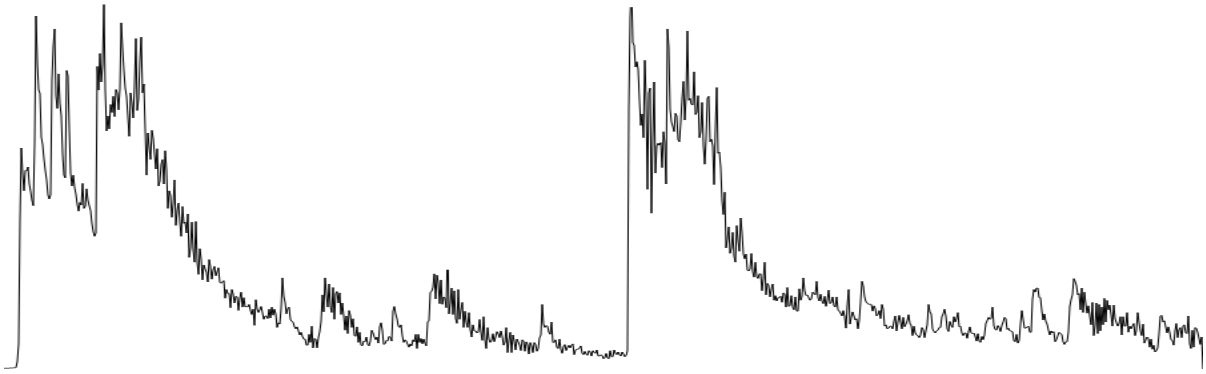
The SC values in both performances correspond to the graphics of V. The three levels of sonority can be seen in P1 (Fig. 9), whereas two levels of sonority can be seen in P2 (Fig. 10). In both performances, due to the high-velocity of attack, the sound corresponding to the arpeggios produced bright sonorities that differed from the others.

Figure 9 - Values of SC in P1 from Example 2 of *Cartas Celestes I*.



Authors' production.

Figure 10 - Values of SC in P2 from Example of 2 of *Cartas Celestes I*.

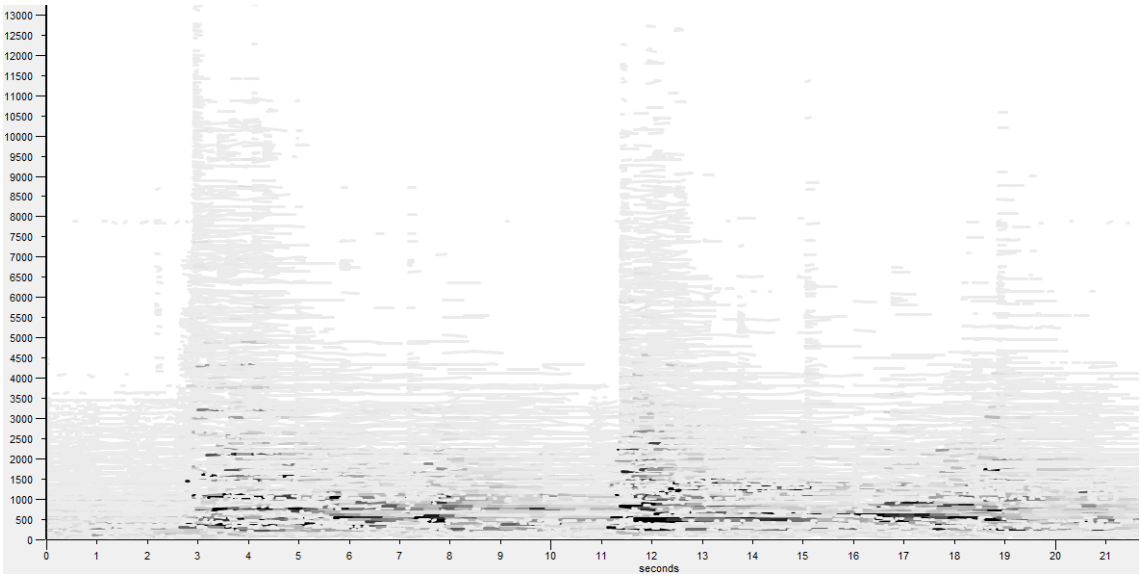


Authors' production.

The spectrograms below clearly show the arpeggio onsets in P1 (Fig. 11) and P2 (Fig. 12), which correspond to the longer vertical lines. Although, the sonorities that merge with these in P1 show more resonance through the presence and intensity of average and high harmonics. In contrast, there is less resonance in P2, because there was only one pianistic touch with low-velocity of attack.

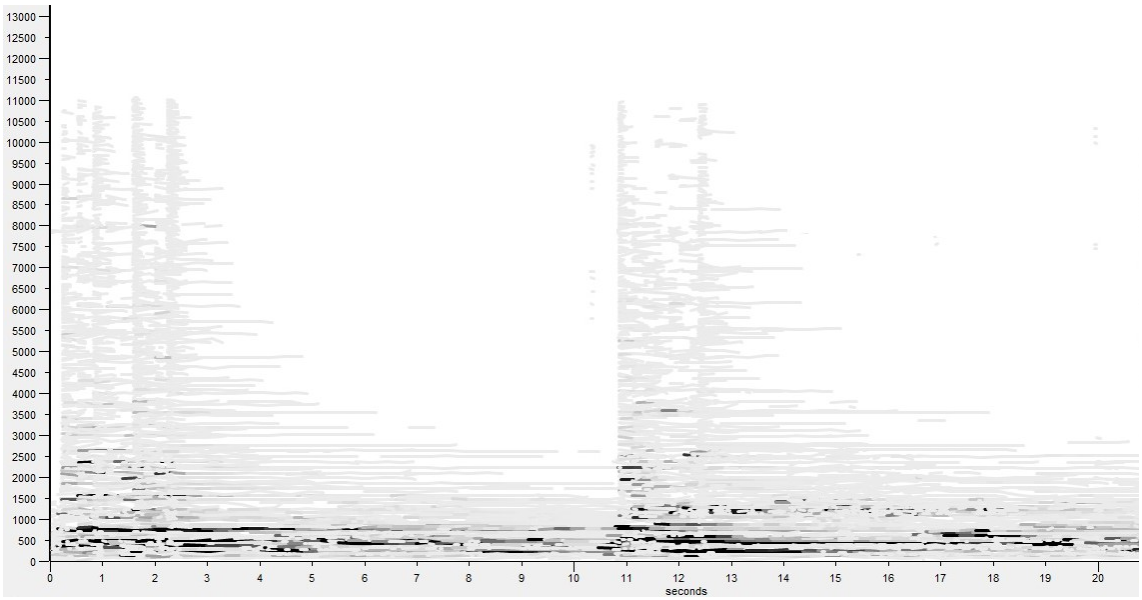
RevistaMúsica, v. 20 n. 1
Universidade de São Paulo, julho de 2020
ISSN 2238-7625

Figure 11 - Spectrogram (*Spear*) of P1 from Example 2 of *Cartas Celestes I*.



Authors' production.

Figure 12 - Spectrogram (*Spear*) of P2 from Example 2 of *Cartas Celestes I*.



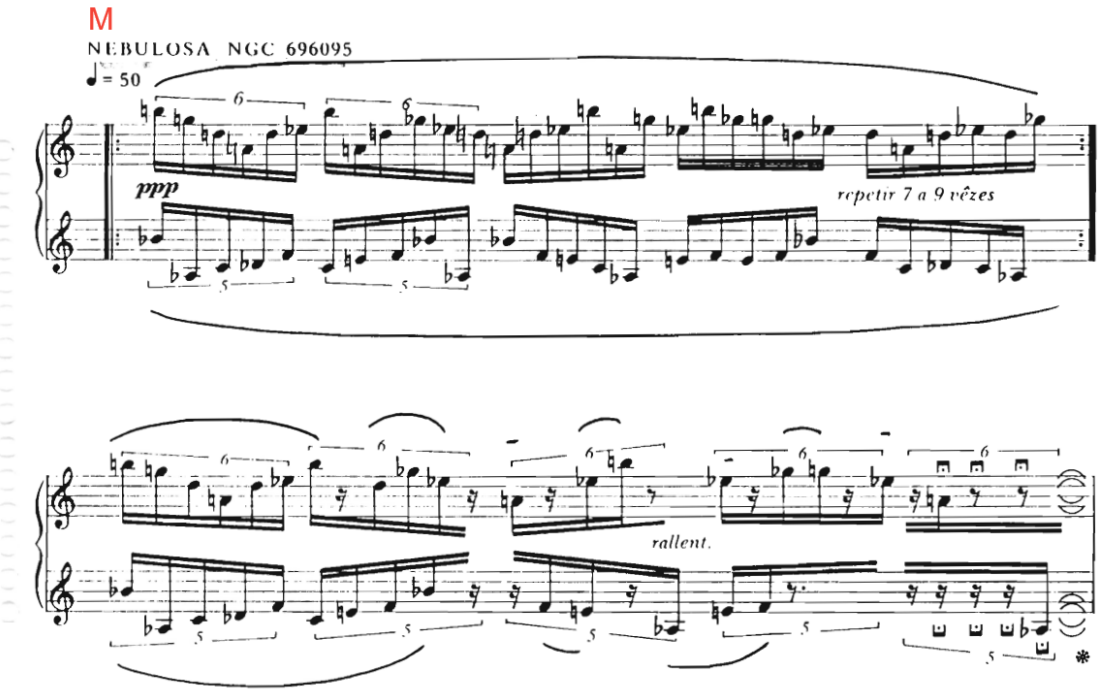
Authors' production.

Two different sonorities were constructed in example 2 by means of a subtle performative decision, which refers to the understanding of the written elements in two or three levels of sonority that characterized each performance.

3.3 Example 3

Example 3 corresponds to some repetitions of the sonic unit M, Nebula NGC 696095, found to be the most contemplative moment, in which a series of 12 sounds irregularly oscillate through a polyrhythm of six sixteenths against five (Fig. 13).

Figure 13 - Score of section M in *Cartas Celestes I.*



Source: ALMEIDA PRADO, 1975.

In order to construct a potentially timeless atmosphere in the first performance, a delicate sonority with the lowest velocity of attack, the use of the *una corda* pedal and no oscillation in the phrasing was sought in an attempt to keep all the notes with the same level of pressure on the key.

After carrying out a few experiments in the second performance, one of the voices was selected to be more emphasized than the other. Thus, the decision made was to create opposite *crescendos* and *diminuendos*, so, while the inferior voice decreased in intensity,

RevistaMúsica, v. 20 n. 1
Universidade de São Paulo, julho de 2020
ISSN 2238-7625

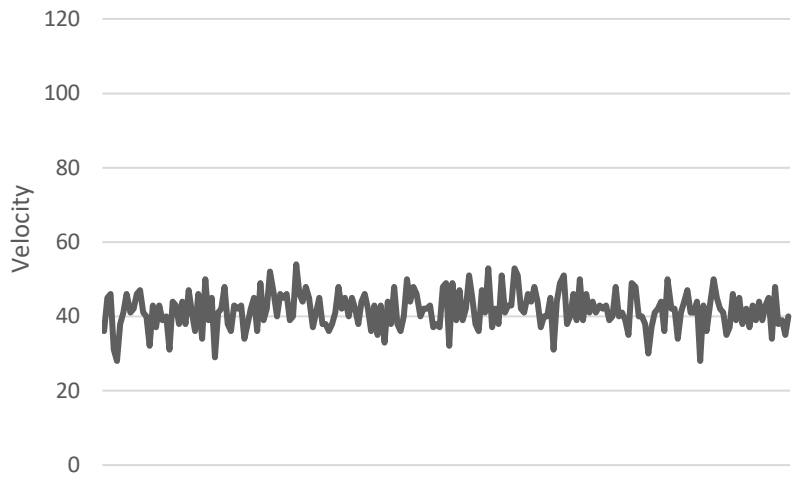
the superior voice increased and was emphasized, and vice versa; that is, one of the voices was stressed each time. The audio of this unit for both performances can be seen in the example accessible through the QR code below (Fig. 14):

Figure 14 - QR Code of performances 1 e 2 from Example 3 of *Cartas Celestes I*, also available on: https://youtu.be/AoDKHwroyQQ

Authors' production.

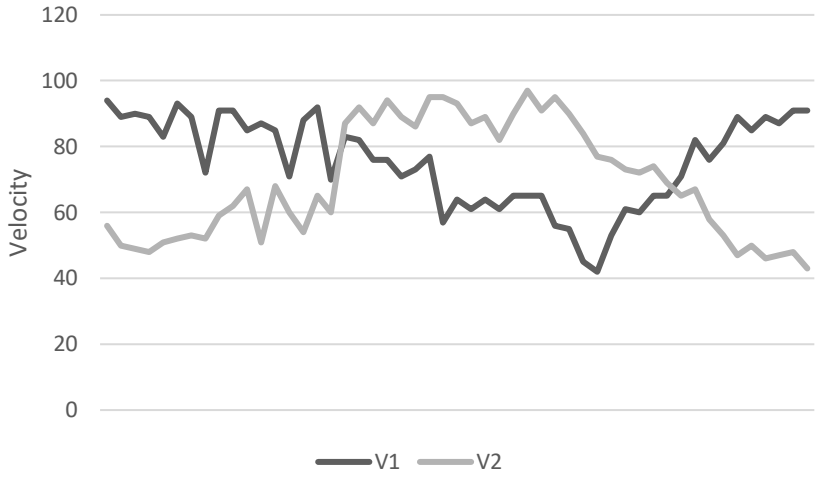
The graphic of the evolution of V in P1 (Graph. 5) shows that the touch is stable, which means that the sound has a stability in its timbre and dynamic. Furthermore, V showed low values, 30 to 50, corresponding to the subtle sonority expected. In the graphic of P2 (Graph. 6) V is divided into two voices (in the performance each voice was played by one hand), and there is an increase of V in voice 1 (inferior) while there is a decrease of voice 2 (superior) and so forth, corresponding to the decision made. In P2 the space of V was between 40 and 100, which enabled that part to have a high amplitude in terms of sonority and the differentiation between both voices.

Graphic 5 - Graphic of the evolution of V in P1 from Example 3 of *Cartas Celestes I*.



Authors' production.

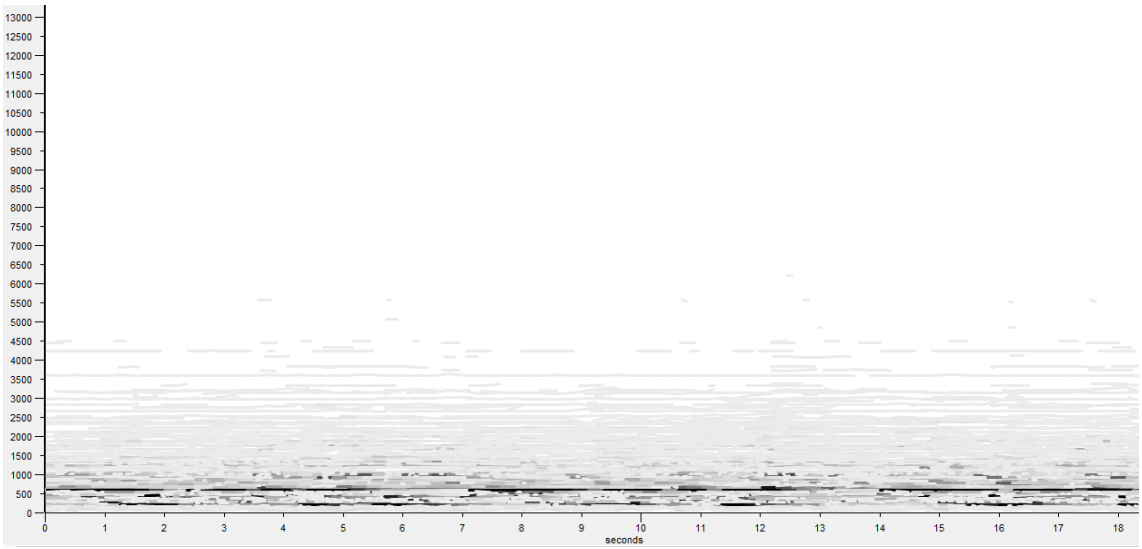
Graphic 6 - Graphic of the evolution of V in P2 from Example 3 of *Cartas Celestes I*.



Authors' production.

The spectrogram of P1 (Fig. 15) shows great stability and the plain sonority of this part, which was intended in the performance. In P2 (Fig. 16), as there is an increase in V, the spectrum becomes richer, with more presence and intensity of harmonics. The alternation of the voices is unclear in the spectrogram, because it occurs simultaneously.

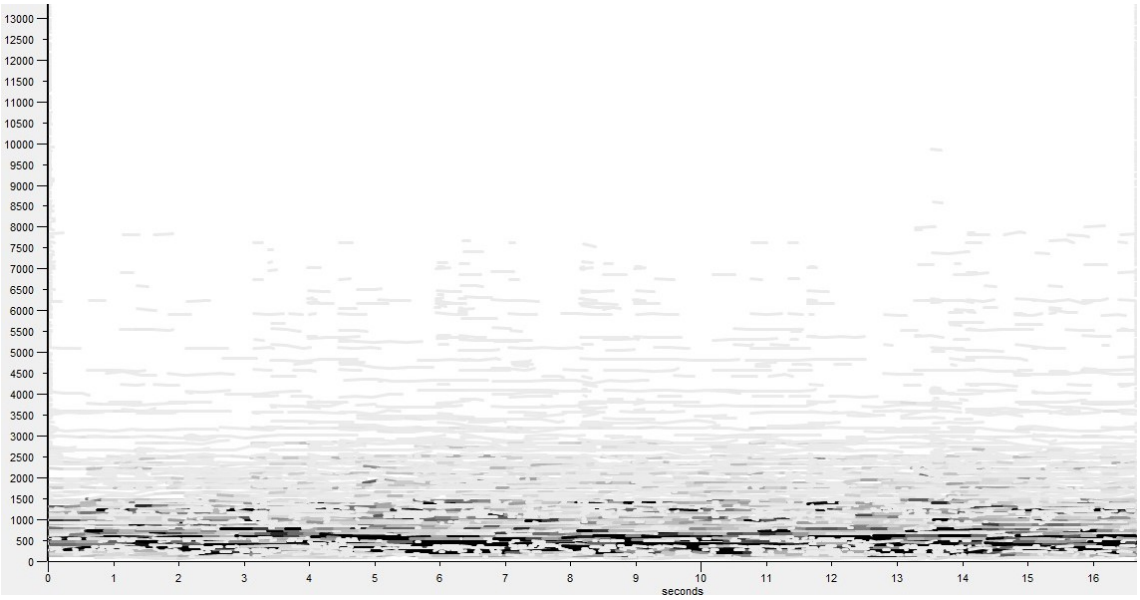
Figure 15 - Espectrogram (*Spear*) of Example 3 of *Cartas Celestes I*.



Authors' production.

RevistaMúsica, v. 20 n. 1
Universidade de São Paulo, julho de 2020
ISSN 2238-7625

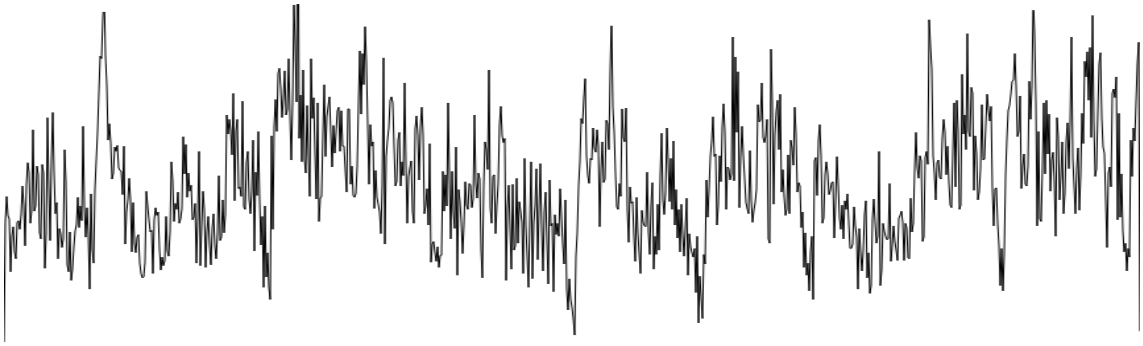
Figure 16 - Espectrogram (*Spear*) from Example 3 of *Cartas Celestes I*.



Authors' production.

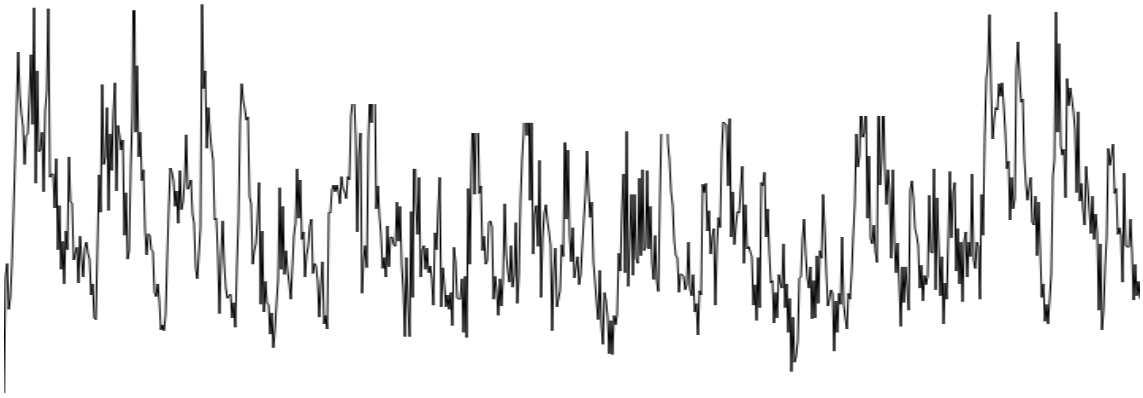
Finally, the values of SC were similar in P1 (Fig. 17) and P2 (Fig. 18). However, there was a small decrease of SC in P2 in the central section followed by an increase. This corresponds to the part where the inferior voice was emphasized, which made the center of mass of the spectrum to have slightly lower frequencies.

Figure 17 - Values of SC in P1 from Example 3 of *Cartas Celestes I*.



Authors' production.

Figure 18 - Values of SC in P2 from Example 3 of *Cartas Celestes I.*



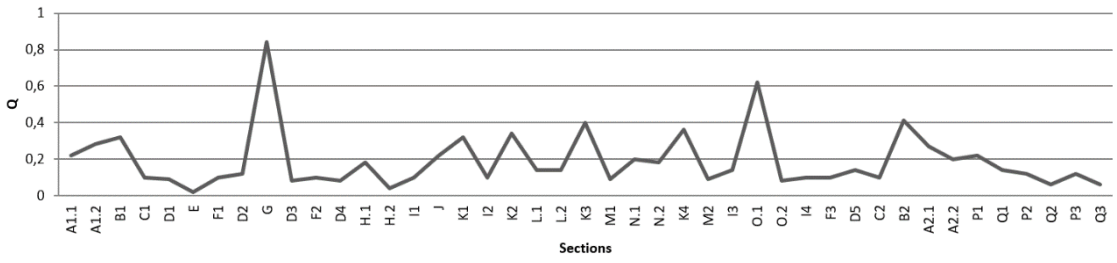
Authors' production.

These two performances of section M demonstrated that, by means of the performative decisions, the excerpt could be understood and executed as though there was a single sonority (P1), a single voice, or two independent voices (P2).

3.4 The factor Q in *Cartas Celestes I*

This last analysis presents the Q value in each section of *Cartas Celestes I.* The values of Q for each section of the piece can be seen in the graphic below (Graph. 7):

Graphic 7 - Graphic of the evolution of Q in the sections of *Cartas Celestes I.*



Authors' production.

RevistaMúsica, v. 20 n. 1
Universidade de São Paulo, julho de 2020
ISSN 2238-7625

The use of the Q value was selected with the purpose of observing a picture of resonance in this performance of the piece. For the last analysis, the piece was divided into sonic units. However, in the sections where there were changes in the *una corda* pedal, the parts with and without the pedal were divided. This decision was made because the changes in the *una corda* pedal are included in the sum of Q. Therefore, the sections are indicated by letters, and the sections in which there are punctuation and segmentation after the dot (for example, A1.1 and A1.2 or L1 and L2) determine that there were changes in the pedals in the section.

In section A1, the pedal *una corda* was used starting from the sonic object 10 in the first page. Even though there were changes in the pedal, the value of Q was 0.22 in A1.1 and 0.28 in A1.2. In spite of using the *una corda* pedal there was a slight increase of Q in A1.2 due to the use of the lower and super lower register of the instrument. In contrast, A1.1 was found in the high and mid register without the use of the *una corda* pedal. If this pedal had not been used, Q would have possibly had a higher value, since *una corda* withdraw timbral values in the sum of Q. Therefore, the performative option enabled the level of resonance to be equal in both moments in A1. In A2, which is similar to A1 yet it recedes, the *una corda* pedal was used from the start to the sonic object 11. From that moment forward, only the right pedal was used. Thus, there was a slight decrease in Q, from 0.27 in A2.1 to 0.2 in A2.2. The lower register helped Q to have a higher value, regardless the use of the *una corda* pedal and the lower values of V.

In H there was another differentiation between H.1, which represents the chords in *fz,* and H.2, which represents the aura of the resonance of these chords in *pp*. The *una corda* pedal was also used. In this case, while the value of Q in the chords was 0.18, the value of Q in the subsequent notes was 0.04. As the registers used are similar in these elements of H, the high value of V and the use of the pedal led to such a differentiation.

In L, there was differentiation in the value of Q in L.1, which corresponds to the appoggiatura in *fff* and *f*, and the notes of resonance in dynamic *p* and *pp*. The *una corda* pedal was also used. In this case, the value of Q remained 0.14 in both situations due to the slightly lower registers used in L2, counterbalancing the elements that withdraw value in the sum of Q.

The N section was also subdivided into N.1 and N.2, and the *una corda* pedal was used. The decrease of the value of Q from 0.2 in N.1 to 0.18 in N2, even though the lower register was used in this second part of N, was due to the lower values of V and to the use of the previously mentioned pedal.

In O there was a subdivision of the chords in the higher and lower extremes with dynamic *fff*, represented by O.1, and the chords around the central region with dynamic *ppp*. The *una corda* pedal was also used. In O.1, where there was a touch with high values of V and lower register, the value of Q was 0.62, whereas in O.2, whose V was significantly lower and the *una corda* pedal was used, the value dropped to 0.08. This difference was observed because in O.1 all the factors for the increase of Q were active, whereas in O.2 all the factors for the decrease of Q were being used.

The triangular aspect of the line demonstrates that there was a change in sonority for every new section, although in some cases there were emphatic (from D2 to G) and subtle changes (from D5 to C2). Q remained stable from L.1 to L.2 (previously analyzed), maintaining the value 0.14, and from I4 to F3, maintaining the value 0.1. In the second case, in the transition from I4 to F3, the same sonority was found in both sonic units, which are executed in the high register with high velocity of attack and without the pedal *una corda*.

The variation in value of Q in the piece was very elevated, starting from 0.02 in E to 0.84 in G. These values are almost similar to the mininum and maximum values of Q. In E, where the minimum value of Q in the piece is found, the two higher octaves of the piano were used with predominant *p* dynamic. The lack in resonance in this region of the piano was the major cause for such a low value. The two lowest octaves on the piano were used in G, with the use of a predominant *f* to *fff* dynamics. Thus, the super lower register that naturally resonates in the piano in tandem with the high values of V and with the use of the *right pedal* determined such a high value of Q. This elevated differentiation, as the different values between these extremes, shows the massive range of sonorities explored and constructed in the piece. Furthermore, the variations in each section showed that the segmentation is linked to the real changes in sonority. Below, the QR Code (Fig. 19) that gives access to the audio with the complete performance of *Cartas Celestes I*:

DOI: 10.11606/rm.v20i1.168644

RevistaMúsica, v. 20 n. 1
Universidade de São Paulo, julho de 2020
ISSN 2238-7625

Figure 19 - QR Code of the complete performance of *Cartas Celestes I*, also available on: https://youtu.be/RbBPr4UGbQc

Authors' production.

The analysis of sonority in this performance of Almeida Prado's *Cartas Celestes I* ensured the observation of performative decisions with respect to the differentiation of their sonority in face of the celestial elements used as a source of inspiration by the composer. The process of analysis enabled to clearly observe that the decisions made have caused an enormous impact in the concept of the musical work and in its conformation. Besides the segmentation, which could be done in various ways, the characteristics of sonority of each unit could be pictured in many different ways too. Also, the examples enabled to explore the possible interferences that can occur in the same excerpt. The elements may be explored in an unconventional way once the score is understood as a guide that prompts a performative action.

4 Discussion

This paper aimed to present a methodology of analysis of the sonority in which the elements of the performance are the main components for understanding sonority in the selected excerpts of the selected piece. To this end, a different concept of the musical work especially based on the concepts of musical work as a morphological entity was adopted (COSTA, 2016). This approach allowed the performer to play a more critical and subjective role, as well as an analysis primarily based on the performative experience with the musical work.

Also, the understanding of form as an element given *a posteriori* was found to be important data about the construction of the performance and its analysis. When one takes responsibility for this kind of manipulation, a wide range of performative possibilities

emerges. Thus, it allows the performer to explore the possibilities that have not been considered. In that sense, the structure is no longer "a fixed form, a substance that shadows the accidents of the performance", but a range of possibilities "that is moving and giving an explanation of the regularities and inconsistencies in the material and concrete updates on the peculiarities of individuality" (ASSIS, 2018, p. 60). Apart from the manipulation of the form, the understanding that musical texture can be seen as a flexible element according to the performative decisions also emerged throughout the process. This evidence, in accordance with the practical experiments, determined that what is considered determined in a musical text is just the most suitable way for executing a particular figuration instead of a fixed musical entity.

The development of the performance of the piece enabled to reflect on important questions beyond the analysis. The creation process that suggested that there is more than one possibility of performance for the same excerpt showed different results of sonority. Although there was no abrupt change regarding the compositional project represented by the score. The decisions made in face of what is absent in the writing enabled to create and experiment with possibilities that are not considered standard in a tradition of performance, especially in relation to simple elements, such as the understanding of texture (or which voices must be emphasized) and the definition of form. When someone understands that the reading of a score is greatly influenced by the listening attached to a particular tradition in performance, an escape plan from this territory can be made with the purpose of dealing with the score in a declassified way in terms of genre, period or style.

In this context, the performer raises his voice and acts with a critical mind. Thus, he is expected to intervene, because he no longer is the object of study, but the artistic researcher, who provides to musicology a knowledge that was absent until then. "The social production of these absences results in the subtraction of the world and in the contraction of the present, therefore, in a waste of experience... Their presence means that options to the prevailing experiences should be considered" (SANTOS, 2002, p. 249, translated by the authors). The applied methodology represents a first step to be taken in order to picture a new concept of musical analysis in which the performance acts in a more decisive way, not understood as the only possibility, but as an alternative that pave the way for other researches.

RevistaMúsica, v. 20 n. 1
Universidade de São Paulo, julho de 2020
ISSN 2238-7625

References

ALMEIDA PRADO, José Antônio Rezende de. *Cartas celestes: uma uranografia sonora geradora de novos processos composicionais*. Doctoral Thesis. Universidade Estadual de Campinas, Instituto de Artes, 1985.

ALMEIDA PRADO. *Cartas Celestes*, for the piano. Score. Darmstadt: Tonos, 1975.

BRAGAGNOLO, Bibiana. *A inclusão da performance na análise musical*: uma perspectiva a partir da construção da sonoridade em peças para piano. Tese de Doutorado. Programa de Pós-Graduação em Música, Universidade Federal da Paraíba, 2019.

CARON, Jean-Pierre C. Regras e indeterminação: ideias para uma morfologia da obra musical. *Claves*, n. 9, p. 16-33, 2013.

COESSENS, Kathleen; CRISPIN, Darla; DOUGLAS, Anne. *The artistic turn:* a manifesto. Ghent: Leuven University Press, 2009.

COOK, Nicholas; LEECH-WILKINSON, Daniel. A Musicologist's Guide to Sonic Visualiser, 2009. Available on: <http://www.charm.rhul.ac.uk/analysing/p9_1.html>. Viewed 10 May 2017.

COSTA, Valério Fiel da. O lugar da performance na música indeterminada cageana. *Música Hodie*, Goiânia, v. 17, n.1, p. 7-18, 2017.

COSTA, Valério Fiel da. *Morfologia da obra aberta*. Curitiba, Prismas, 2016.

GUIGUE, Didier. Soal 4.0, Sonic Object Analysis Library: *OpenMusic* Tools for analyzing musical objects structure. 2016. Available on: https://www.academia.edu/29796175/. Viewed 13 June 2017.

GUIGUE, Didier. *Esthétique de la Sonorité:* L'héritage de Debussy dans la musique pour piano du XXe siècle. L'Harmattan: Paris, 2009.

LOUREIRO, Maurício; MAGALHÃES, Tairone; BORGES, Rodrigo; CAMPOLINA, Thiago; MOTA, Davi; e PAULA, Hugo de. Segmentação e extração de descritores de expressividade em sinais musicais monofônicos. In: *III Seminário Música Ciência e Tecnologia*. São Paulo. Anais do III Seminário Música Ciência e Tecnologia, 2008, pp. 109-125.

MOURÃO, Ronaldo. *Atlas Celeste*. 4 ed. Petrópolis: Vozes, 2004.

SANTOS, Boaventura de Sousa. Para uma sociologia das ausências e uma sociologia das emergências. *Revista Crítica de Ciências Sociais*, n. 63. 2002, p. 237-280.

SARTRE, Jean-Paul. *L'être et le néant*: Essai d'ontologie phénomenologique. Paris: Gallimard, 1994.