Composition of Two Works for Woodwind Quintet based on the Systemic Modelling of Guarnieri's *Ponteio No. 25*

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Abstract: In this article we discuss a compositional-analytical methodology called systemic modeling, in order to identify a hypothetical compositional system that would have given rise to Camargo Guarnieri's *Ponteio No.25*, which was analyzed from the perspective of its harmonic and melodic structure. The resulting model allowed us to create two applications in MATLAB, which helped us during the compositional planning of two new works that are distinct from the original but still similar from the point of view of the selected parameters.

Keywords: Ponteio. Systemic Modelling. Compositional Planning. Camargo Guarnieri.

Composição de duas obras para quinteto de sopros a partir da modelagem sistêmica do Ponteio N.25 de Camargo Guarnieri

Resumo: Neste artigo discutimos uma metodologia analítico-composicional denominada modelagem sistêmica, com a finalidade de identificar um sistema composicional hipotético que teria dado origem ao *Ponteio N.25* de Camargo Guarnieri, que foi analisado sob a perspectiva de sua estrutura harmônica e melódica. O modelo resultante nos permitiu criar dois aplicativos em MATLAB, que nos auxiliaram durante o planejamento composicional de duas novas obras distintas da original, mas similares do ponto de vista dos parâmetros selecionados.

Palavras-chave: Ponteio. Modelagem sistêmica. Planejamento composicional. Camargo Guarnieri.

1. Introduction

This paper proposes the systemic modeling of *Ponteio No.25*, from the Third Book of *Ponteios* by Camargo Guarnieri, through the analysis and the survey of the structural principles of the work, as well as the observation of the behavior of certain musical parameters. As a result of the analysis, it will be offered a compositional system model that hypothetically would have generated the work, without, however, the historical interest of revealing the creative procedures of the composer or assuming that Guarnieri started his composition from the development of a system. The compositional system arising from this methodology will then serve as a starting point for the composition of two new works for woodwind quintet (flute, oboe, clarinet, horn and bassoon). Thus, the contribution of systemic modeling, in the framework of this paper, is twofold: the generation of a compositional apparatus capable of generating original works and the examination of the compositional language of Camargo Guarnieri, within the domain of his Ponteios for piano.

Systemic modelling is an analytical-compositional methodology inspired in the homonymous technique practiced in the field of engineering that incorporates theoretical frameworks from other two areas: the theory of compositional systems and the theory of intertextuality. Mororó (2008:87) states, "a model can be defined as a simplified representation of a real system with the purpose of studying this system". Usually, a model consists of a physical model, called a prototype, and a mathematical model, which provides essential information about input and output. In addition, the mathematical model may help us to foresee situations not immediately perceived in the real model, which is useful to establish the limits of the system.

The theory of compositional systems is derived from Bertalanffy's theory of general systems, in which the author describes a system as "sets of elements standing in interaction" (BERTALANFFY, 1968:38). The field of music is particularly categorized as a symbolic system, which is coordinated by the "rules of the game" (BERTALANFFY, 1968:29). To another important author in this field, Georg Klir (1991:5-9), a system is a set of objects and relations. Meadows (2008:11) adds the component of functionality to this system definition. After these definitions, which refer to a general theory of systems, Lima (2011:62) proposes that: "a compositional system is a set of guidelines to form a coherent whole that coordinates the use of musical parameters and their interconnection, in order to produce musical works".

The theory of intertextuality is another important component of systemic modelling. Kristeva (2005:68) states, "all text is constructed as a mosaic of quotations, every text is absorption and transformation of another text". Furthermore, Kristeva (1969) emphasizes the connections between language and music, thus bringing the intertextual thinking to the domain of music composition, a resource already employed in the past, as clearly demonstrated by Korsyn (1991) and Klein (2005). The methodology of system modelling employs intertextuality in a more abstract manner. As Lima (2011:33) observed, the theoretical and artistic references in this field reveal that "the production of new texts can be obtained both through the literal use of intertext as through modified version of them". This latter can be called abstract intertextuality (LIMA, 2011:41) and parametric intertextualization (LIMA, 2011:43), when applied to a set of specific musical parameters.

The effectiveness and functioning of methodology of systemic modelling can already be observed in the studies of Pedro Miguel de Moraes, Gustavo de Castro, and Liduino Pitombeira (2011, 2012, 2013a and 2013b) on the composition of three *Ponteios* by Pedro Miguel from the modeling of three works of Guarnieri's Second Book of *Ponteios* in which the first part of this work bases its methodology. About the compositional application of systemic modelling, the authors state that “the result of modeling is made by defining a system that describes, in a general way, the application of these parameters and their internal relations” (MORAES, PITOMBEIRA, 2013:9).

An important step in the systemic modelling is what we call parametric generalization, which consists primarily of disregarding particular values for a given parameter and focuses only on the relations between the elements. The analysis, along with the parametric generalization allows us to reach the hypothetical structure we call compositional system. We emphasize three important aspects of this methodology: (1) the compositional system resulting from the systemic modelling of Guarnieri`s *Ponteio N.25* obviously does not intend, from this single case, to provide a universal proposition that reveals Guarnieri’s language as a whole; (2) systemic modeling with compositional purposes, unlike the one applied in engineering, is intentionally partial, focusing exclusively on the evolution of certain parameters as it does not intend to reconstruct the original work - that is already made - but simply to capture one of its many facets, so that new texts related to the original can be proposed. In other words, we are dealing with a sort of abstract intertextuality, in order to distinguish it from a literal intertextuality, in which the text of the surface is revealed literally; (3) the resulting compositional system can either consist of a set of definitions textually declared or a computational algorithm. We will use in this study both procedures.

2. Analysis of Guarnieri’s *Ponteio No.25*

Guarnieri's *Ponteio No.25*, whose initial bars are shown in Fig.1, can be understood as a consequence of the concomitant action of two layers. The melodic layer corresponds to the right hand of the piano and consists of a line with constant rhythm, using just one figure (sixteenth note) for the entire work. The harmonic layer corresponds to the left hand of the piano and is constructed from pentachords in the form of arpeggios with uniform rhythmic figuration, consisting only of eighth notes, which generate a metric organization of five beats, causing a disparity between the metric suggested by the melodic layer and the time signatures determined by the composer.

An examination of the rhythmic and harmonic structures can provide indications regarding the macro-structure of the work. Tab.1 provides a list of the pitch classes for all the chords, observed after temporal compression of the *arpeggios*. In the first section (A), the chords are built over a chromatic descending bass line, concluding in a cadential-like movement (F-Bb) between the seventh and eighth chords. The latter chord has a high degree of similarity with the starting chord: 60% identical pitch classes (3). The pitches of the *arpeggios* in section A present the following contour <0 2 4 1 3>, where 0 is associated to the lowest pitch, 4 to the highest pitch, and so on. The second section (B) is divided into two parts: one with a pedal in Bb (chords 9-12) — the lowest pitch of the initial chord — and the same contour of section A, and the other with the bass performing a "Phrygian-like cadence" movement toward F, with a different contour <0 1 2 3 4>. The last section (B') has a pedal in F sustained until the end of the piece and has predominantly the same contour of section A.

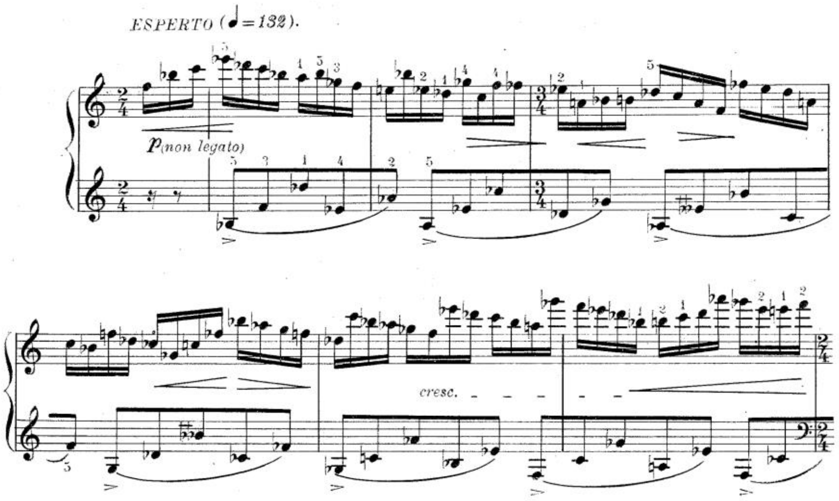

Figure 1: Initial bars of Guarnieri's *Ponteio No.25*.

#	Chord	Structure	Features
1.	A3581	A	Chromatic descending bass line that resolves in a chord 60% similar to the initial chord with respect to identical pitch classes (3). The *arpeggios*' contour is <0 2 4 1 3>.
2.	9136B		
3.	8025A		
4.	7B149		
5.	6A038		
6.	59036		
7.	59B15		
8.	A45A1		
9.	A3580	B	Pedal in the lowest pitch of the initial pentachord, ending with a progression that resembles a Phrygian cadence. The four first *arpeggios* have the contour <0 2 4 1 3> and the remaining have the contour <0 1 2 3 4>.
10.	A348B		
11.	A346A		
12.	A1348		
13.	A015A		
14.	8136B		
15.	63581		
16.	556A1		
17.	5B369	B'	Pedal in the third lowest pitch of the initial pentachord. The contour of the *arpeggios* is, except for the last one, <0 2 4 1 3>.
18.	5B358		
19.	5036B		
20.	5B36A		
21.	5A158		
22.	5A036		
23.	5AB45		
24.	5AB23		
25.	5AB35		

Table 1: Structural division of Guarnieri's *Ponteio No.25* based on the features of the harmonic layer.

The metric structure suggested by the *arpeggios* (see Tab. 2), compared to the time signatures set by the composer invites us to segment the structure as ABA. Section A presents a palindrome 3333 22 22 and section B a palindrome 222 323 222. It would be likely to call the last section A' as it presents the same palindromic principle of section A, but expanded in the central part: 22 33333 22. However, as much as the rhythmic structure suggests an ABA' form, the principle of pedal note, being more superficial, and therefore more salient, convinces us to adopt a formal scheme ABB'.

Table 2: Structural division of Guarnieri's *Ponteio No.25* based on the rhythmic structure.

An important aspect in the modelling of the harmonic layer is the mapping of the parsimonious relations between the chords. The result of this mapping, shown in Tab. 3, will be the basis for creating a function in MATLAB called *ponteio25.m*, which will incorporate, in a generalized way, all the relations between the chords in order to generate a new chain of chords, when a completelly different inicial pentacord is inserted. These new chords are different from the chords of the *Ponteio No.25* on the surface level, even though they share the same intrinsic relations.

Regarding the melodic layer, we present two modeling solutions. The first solution is to assume that the melody could have been created separately, from a tonal harmony standpoint. Then, considering the melodic layer only, we empirically suggest a hypothetical harmony to the melody, whose opening bars are shown in Fig. 2. During the compositional planning of the new work, we will discard the original melody and compose a new one from that same harmony.

The second solution is to treat the melodic line as a First Order Markov Chain (where the current state depends on the previous one only) and determine a probability transition matrix that describes all the movements among the pitches (registers considered). In other words, we map how many times certain pitch moves toward the other. The result is a probability quantification; for example, in the case of Guarnieri's *Ponteio No.25*, the C4 (middle C) moves toward G3 in 50% of the cases, toward C#4 in 25% of cases, and toward Bb4 in 25% of the cases. This process was automated by the function *markov_1.m* in MATLAB, which reads the melody in MIDI format through the Midi Toolbox library and generates infinite possibilities for the melody, all with the same probabilistic profile as the original one.

A												B						B'					
1	A	3	5	8	1	1	A	3	5	8	1	1	A	3	5	8	1	1	A	3	5	8	1
	-1	-2	-2	-2	-2								0	0	0	0	-1		-5	-4	-2	-2	-4
2	9	1	3	6	B							9	A	3	5	8	0	17	5	B	3	6	9
	-1	-1	-1	-1	-1								0	0	-1	0	-1		0	0	0	-1	-1
3	8	0	2	5	A							A	A	3	4	8	B	18	5	B	3	5	8
	-1	-1	-1	-1	-1								0	0	0	-2	-1		0	1	0	1	3
4	7	B	1	4	9							B	A	3	4	6	A	19	5	0	3	6	B
	-1	-1	-1	-1	-1								0	-2	-1	-2	-2		0	-1	0	0	-1
5	6	A	0	3	8							12	A	1	3	4	8	20	5	B	3	6	A
	-1	-1	0	0	-2								0	-1	-2	1	2		0	-1	-2	-1	-2
6	5	9	0	3	6							13	A	0	1	5	A	21	5	A	1	5	8
	0	0	-1	-2	-1								-2	1	2	1	1		0	0	-1	-2	-2
7	5	9	B	1	5							14	8	1	3	6	B	22	5	A	0	3	6
							0	1	0	2	0		-2	2	2	2	2		0	0	-1	1	-1
						8	A	4	5	A	1	15	6	3	5	8	1	23	5	A	B	4	5
													-1	2	1	2	0		0	0	0	-2	-2
												16	5	5	6	A	1	24	5	A	B	2	3
																			0	0	0	1	2
																		25	5	A	B	3	5

Table 3: Quantification of parsimonious relations between chords in Guarnieri’s *Ponteio No.25.*

Figure 2: Initial bars of the suggested harmony for the melody in Guarnieri’s *Ponteio No.25*.

In summary, Guarnieri's *Ponteio No.25* has an ABB' structure and is divided into two layers. The harmonic layer (bottom) consists of *arpeggios* of chords in uniform rhythm with two types of contour: <1 4 0 2 3> and <0 1 2 3 4>. The first contour is found in all of the section A, part of the section B, and all of the section B'. The second contour is found only in the second half of the section B. It is assumed that all the harmonic structure is generated from an initial pentachord, to which predominantly parsimonious intervals are applied in order to generate the other chords. This harmonic behavior was automated by the MATLAB function *ponteio25.m*, which will offer us plenty of possibilities during the compositional planning phase. The melodic layer consists of a line with uniform rhythm that will be modeled in two manners (considering that two different works will be composed). For the first one, a melody will be created from a hypothetical harmony we have determined in the analysis. For the second one, we will describe the melodic line paths through a probability transition matrix. With this matrix data, we will create the MATLAB function *markov_1.m*, which produces infinite melodic lines probabilistically related to the original melody.

In the following paragraphs we will describe the compositional planning of two works for woodwind quintet (flute, oboe, clarinet, horn and bassoon), based on the systemic modeling of Guarnieri's *Ponteio N.25*.

3. Compositional Planning of *Choro Nervoso*

For the compositional planning of *Choro Nervoso* (first movement of *Brazilian Landscapes No.14,* by Liduino Pitombeira), we will start by choosing a new starting pentachord that, applied to the *ponteio25.m* function, will generate the rest of the chords to be used. In addition to it, we will generate through the *markov_1.m* function, two melodic lines. The new chords will be associated with a layer that will be responsible for sustaining the harmony of the work and will be restricted to longer rhythmic figurations when compared to the melodic layer rhythm, consisting predominantly of sixteenth notes. We will call the melodic lines generated by the function *markov_1.m* Line 1 and Line 2.

We have chosen the pentachord {2605A} and applied this value to the *ponteio25.m* function that generated the entire series of chords for the new piece (Tab.4). The new form, ABB'CA', is an expansion of the macro-structure of *Ponteio No.25*, ABB'. Thus, we have added two more sections to the structure of the original work (see Tab.1).

A	B	B’	C	A’
2605A	26059	92A36		2605A
14A38	26B58	92A25	Solo	14A38
03927	26B37	93A38	Hn	03927
B2816	24A15	92A37	+	B2816
A1705	23827	91825	End.	A1705
90703	04A38	91703	Harm.	90703
906A2	A605A	91612	+	906A2
2707A	9817A	916B0	Ress.	2707A
		91602		
Line 1			Line 2	

Table 4: Chords generated by the *ponteio25.m* function for the first work (*Choro Nervoso*).

Section C consists basically of a French horn solo, to which the other instruments performing a predominantly endogenous harmony are attached, that is, a harmony extracted from the pitch classes of the melodic line. This harmony also works as a resonance layer. Section A' has the same harmony of section A, but the melodic line is different (Line 2). One could see in Tab.4 that, Line 1 is found in sections A, B and B' and line 2 on sections C and A'. Another important detail is that in section C it is given a different rhythmic treatment for the melodic line compared to the treatment given in the other sections, which are all uniform. Fig.3 shows the opening bars of the resultant work of this compositional planning (score in C).

Figure 3: Initial bars of *Choro Nervoso* (first movement of *Brazilian Landscapes No.14)*, by Liduino Pitombeira, generated from the systemic modelling of Guarnieri's *Ponteio N.25*.

4. Compositional Planning of *Ponteio*

For the compositional planning of *Ponteio* (first movement of *Três Miniaturas*, by Marcel Castro Lima) we also started by determining the initial pentachord: {9127B}. As in the planning of the first work, this pentachord was also applied to the function *ponteio25.m* in order to generate all the harmonic structure of the work, which is shown in Tab.5, corresponding to the harmonic layer. Next, we have created a new melodic line to the hypothetical harmony of the original melody of *Ponteio No.25* (Fig 2). An initial section of the new melody is shown in Fig.4. To the macrostructure of *Ponteio No.25*, it was added a varied repetition of the third section, B'. In the new work, the third section is now formed only by seven of the nine pentachords generated by the function *ponteio25.m*, leaving the remaining two pentachords to develop a small *coda* (Tab.5).

A	B	B'		CODA
9127B	9127A	49057	49057	48811
8B059	91179	49046	49046	48823
7AB48	91158	4A059	4A059	
69A37	9B036	49059	49059	
58926	9AA48	48A46	48A46	
47924	7B059	48924	48924	
47803	5127B	48833	48833	
9229B	4339B			

Table 5: Chords generated by ponteio25.m function for the second work (*Ponteio*).

We divided the harmonic layer into two different "voices" in the form of an ostinato where all the pitches of each pentachord were used. The melody composed from the hypothetical harmony kept the uniform rhythmic character and the original metric of *Ponteio No.25's* melodic layer. The new melody was remetrified to suit the metric of the new harmonic layer (5/8), as shown in the opening bars of the new work (Fig.5, Score in C).

Figure 4: New melody, composed from the hypothetical harmony of *Ponteio No.25*.

Figure 5: Initial measures of *Ponteio* (first movement of *Três Miniaturas*), by Marcel Castro Lima, generated from the systemic modelling of Guarnieris's *Ponteio No.25*.

5. Concluding remarks

The application of the methodology of systemic modeling has proven itself effective, concerning the purpose of generating a consistent compositional apparatus and contributing to the comprehension of the compositional language employed in the analyzed work. The two new works composed presented quite distinct results, despite the same compositional system modelling. This reveals that even though both works kept structural features in common with the *Ponteio* of Guarnieri, the role of the composer was decisive in the manipulation of parameters producing different aesthetic results.

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