DOI: 10.2478/ajm-2021-0008

Discovering music cryptograms in the works of Viorel Munteanu through computer aided methods

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Abstract: This analytical approach aims to demonstrate the connection between music and technology in the creation of composer Viorel Munteanu. The purpose of this paper is to identify and analyse the music cryptograms in *Symphony No. 1 "Glossa"* using digital analysis tools. Viorel Munteanu is a modern composer characterised by avangardist tendencies, but with a desire to revive the past. In his creations, the composer uses folkloric themes and byzantine chant, while evoking important personalities of Romanian culture. In *Symphony No. 1 "Glossa"*, Munteanu uses the music cryptogram of poet Mihai Eminescu and composer George Enescu, these structures being used as thematic material and cyclic motifs. For graphical illustration of the music cryptograms we used the digital library *LibRosa* and for the identification process we use a musical software which identifies these structures in a MIDI score. Also, we would be analysing the cryptograms' functions, rhetorics and aspects influencing the form and genre of the symphony.

Keywords: Music cryptograms, digital analysis, *Symphony no. 1 "Glossa"*, Viorel Munteanu.

1. Introduction

One of the greatest contemporary challenges is to integrate technology in our daily activities.

The following analytical approach aims to demonstrate the connection between music and technology in one of Viorel Munteanu's works. The purpose of this paper is to identify and analyse the music cryptograms in *Symphony No. 1 "Glossa"* using digital analysis tools.

Research centers from western Europe developed digital tools through which music analysis became more accessible and accurate.

These tools process data extracted from audio or MIDI format, segmenting the received signals which are operated in an informatic language.

Music software create graphic statistics (*Chroma*, *LibRosa*), chord recognition (*Clam*, *Charles*, *Harmonia*), the analysis of rhythmic systems (*Music21, iAnalyse*), analysis of musical syntax (*Fugue*) or define stylistic aspects.

2. Methods of analysis

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The characteristics of these musical apps allowed us to discover their advantages and challenges.

Viorel Munteanu is a modern composer characterised by avangardist tendencies, with a desire to revive the past. In his creations, the composer uses folkloric themes and byzantine chant, while evoking important personalities of Romanian culture.

In his creations, the composer used the cryptogram of Mihai Eminescu and George Enescu (*Symphony no. I "Gloss"*) Lucian Blaga (*Return to Blaga – seven poems for soprano, flute, oboe, bassoon and piano*) the cryptogram of Saint Parascheva (Oratory *Calls to Salvation. Pilgrims to Saint Parascheva*), Dorel Baicu (Concerto for Flute and Piano *Shadows and Genesis*), Adrian Berescu (*Lamento* for solo violin) and the famous cyclic structure BACH (*Concerto per archi*).

The composer defined the laborious process of discovering the music cryptogram of his first symphonic creation: "Trying to pay homage to Mihai Eminescu, the whole creation is based on a modal structure which has been named the Eminescu cryptogram: **E–E flat–C–B–A**. "Using this cryptogram, in 1977 the madrigal *From the valley of Rovine* was created. After doing extensive research, I discovered that the melody which contained the Enescu cryptogram (**E–E flat–C**) represented an emblem of the archaic culture of Bucovina. The melody was found in ballads from Wallachia and Oltenia, an archetype that emphasized the ethos of the Eminescu's *Glossa.*" (Apostu, 2019, p. 27)

In *Symphony No. 1 "Glossa"*, Munteanu used the music cryptograms of poet Mihai Eminescu and composer George Enescu. These structures were used as thematic material and cyclic motifs.

The first symphonic work is one of the most important creations of Viorel Munteanu in which he integrates his passion for poetry, culture and art. It has the structure of the sonata genre, having three contrasting parts. The composer was willing to merge the symphony genre with the structure of the glossa.

The composer developed the melodic motif through a variation process. The metamorphosis of the sonic material was realized through the addition of modal structures "with sacred or profane origins" (Apostu, 2019, p. 27). Also, the composer Ștefan Angi noticed „(...) an intelligent exploitation of thematic cells transformed through rhythmic and melodic division or by augmentation broadening the range and sound palette." (Angi, 2019, p. 106)

The musicologist Gheorghe Duțică in the study *The glossa-archetype and the rhetoric of a bivalent melogram. Symphony no. 1 "Glossa"* by Viorel Munteanu realized a synthesis of this work. Describing the main elements which had formed the musical discourse, he observed the evolution of the cryptogram in different parts of the symphony.

Monody, counterpoint, modern polyphony, heterophony and musical textures are the main musical syntaxes used in the symphonical discourse. The choir and the soloist, who have a complex and an expressive role, have an important function, being the lyrical voices of the symphony.

2.1. Graphical representation - *LibRosa*

Graphical representation of the scores is realized through data synthesis in a visual format (graphs or charts) for analysis or interpretation and to discover functions or relevant structures.

LibRosa is the digital library we used for our research. We made graphical illustrations of *Symphony no. 1 "Glossa"* by Viorel Munteanu, that analysed the structural analysis of this creation. This library generated musical chromograms that included pitch class and time information of the analysed parts.

The challenge of the digital analysis in music consists of identifying different types of structural features, which include repetitions, contrasts, variations and homogeneity of voices.

Recurrent patterns can be identified using histograms and they can be rhythmical, harmonic or melodic. Also, the contrasts between the sections can be highlighted by the differences in the graphic structure.

Through graphic representation of the symphony's first part we highlighted the structure, the architecture inspired from a sonata without a development part. We can observe from the chromogram the central place of the second theme – which has the development role in the context of the sonata – and the diminution of the recapitulation part.

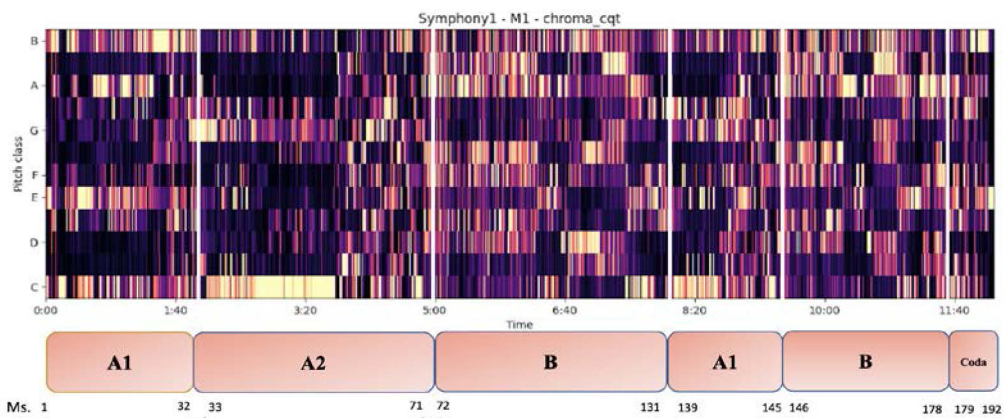


Fig. 1 Viorel Munteanu, *Symphony no. 1 "Glossa"*, I[st] movement, Music chromogram

In the second and third part of the symphony strophic forms, which included themes from the first part, were used. Through a compared analysis of the chromograms we observed root notes and acceleration/deceleration of the musical discourse.

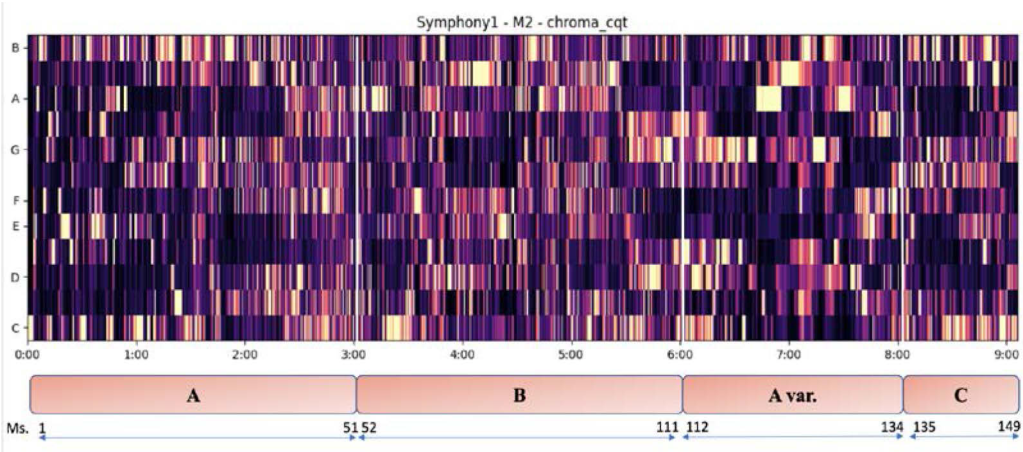


Fig. 2 Viorel Munteanu, *Symphony no. 1 "Glossa"*, I[st] movement, Music chromogram

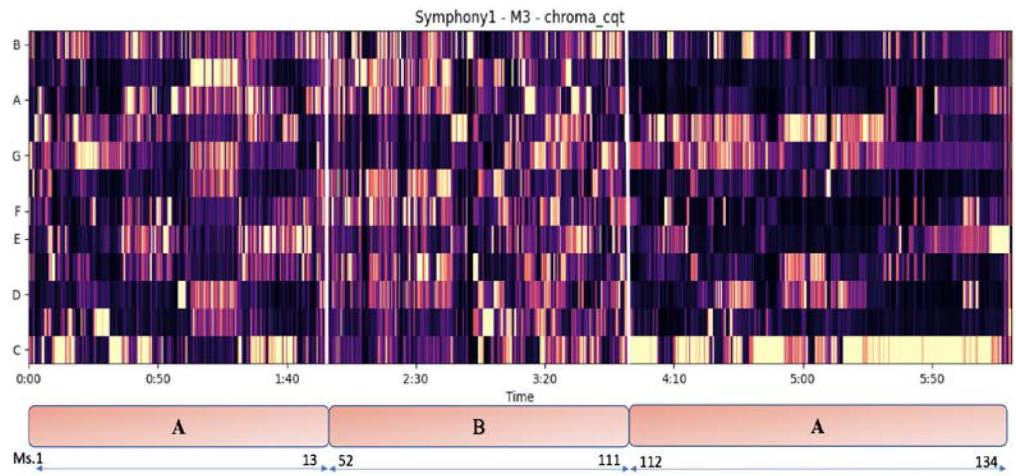
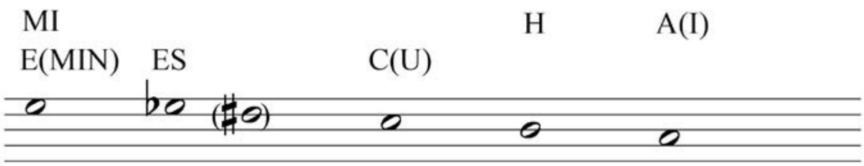


Fig. 3 Viorel Munteanu, *Symphony no. 1 "Glossa"*, I[st] movement, Music chromogram

2.2. Digital analysis – identifying the cryptograms in *Symphony no. 1 "Glossa"* by Viorel Munteanu

Through the second method of analysis we wanted to discover the cryptograms through digital methods. We created a musical software which identifies the musical motifs in the MIDI format. The music cryptogram of Symphony no. 1 "Gloss" has a pentatonic structure based on these notes: **E–D#–C–B–A**.

Our digital tool parses data and identifies the motif sequence and indicates the following characteristics of a MIDI structure: note name, time signature, duration and numbers of ticks[1] (Müller, 2015, p. 15).



Ex. 1 Music cryptogram

We started with the information that motif **E-D#-C-B-A** is supposed to be present in Viorel Munteanu's *Symphony no. 1*. Since it is a fairly large work, and we wanted to be able to search motifs in other compositions, we developed a software tool that searches for motifs in the MIDI representation of the score.

For this, we took the Sibelius version of the score and exported MIDI. We found that the Sibelius-exported MIDI tended to have errors (such as a 35/32 time signature change), so we imported it into *Cubase* to clean it up, and re-exported the MIDI as type 0 (each instrument on a different channel).

The tool was developed using Python and the popular MIDI library "*Mido*". We constructed a matrix of time events, one row per instrument, each element from the matrix holding an array of NOTE_ON[2] and NOTE_OFF events happening at that time. The size of the matrix was determined by reading the MIDI once and selecting the highest number of events from the channels (instruments).

In order to analyze the MIDI data, we read the MIDI once per instrument, keeping track of the time signature changes. Here it is important to use the same tick value that was exported from *Cubase* (in our case 480) since there is no mention of such value in the MIDI file. The number of ticks is useful for determining relative time positioning of MIDI events and is unrelated to tempo. For example, 480 tick resolution means one beat (quarter, denominator 4) takes

[1] "Ticks are an integer value that represents how many clock pulses or ticks to wait before the respective note-on or note-off command is executed."

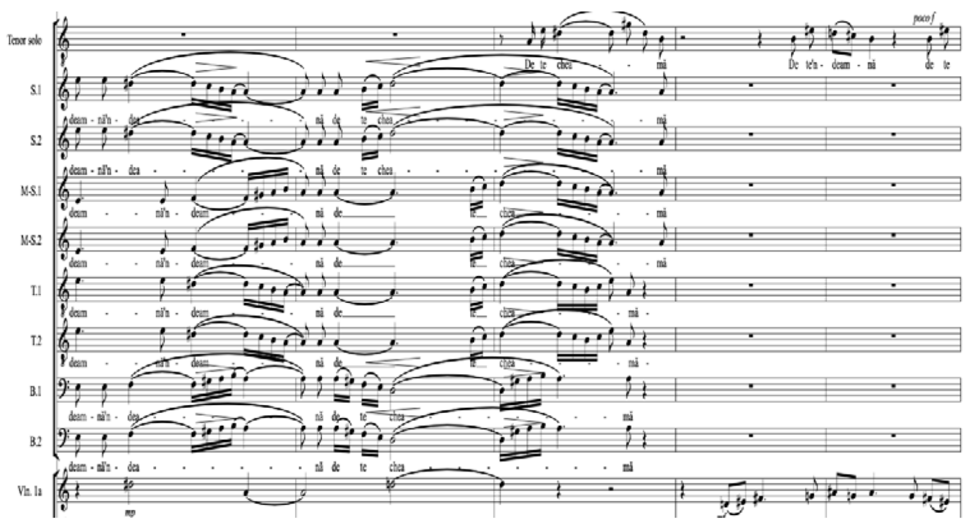
[2] "Transmitting suitable MIDI messages, which encode the note-on, the velocity, the note-off, and other information. These MIDI messages may be automatically generated by some other electronic instrument or may be provided by a computer. It is an important fact that MIDI does not represent musical sound directly, but only represents performance information encoding the instructions about how an instrument has been played or how music is to be produced." (Müller, 2015, p. 13)

480 ticks. One 4/4 bar would have 4*480 ticks, one 6/8 bar would have 6*240 ticks etc.

For each time event (element in the matrix) we launch a recursive method[3] for searching for the next MIDI NOTE_ON or NOTE_OFF event that can be an element of the searched motif. We search for the NOTE_OFF event for the first note of the motif. At that position we expect a NOTE_ON for the next element of the motif. Future versions of the algorithm can allow empty space between elements of the motif or allow for variations of the motif to be detected by choosing an acceptable distance between the MIDI value searched and the ones present in the matrix.

When we find a solution, we convert the total number of ticks for every note to temporal information that can be easily understood, with the tick displayed being the difference from the start of the bar, such as:

Solution 1:
Note:76(E) Bar:102 Beat:1 Tick:240
Note:75(D#) Bar:102 Beat:2 Tick:480
Note:72(C) Bar:102 Beat:3 Tick:1080
Note:71(B) Bar:102 Beat:3 Tick:1200
Note:69(A) Bar:102 Beat:3 Tick:1320



Ex. 2 *Symphony no. I „Glossa"* by Viorel Munteanu, I[st] movement , mm. 103-107

[3] "A notion is defined recursively, if in its definition appears the very notion that is defined. In computer science we call direct recursion, the property of functions to call themselves." (http://info.tm.edu.ro:8080/~junea/cls%2010/recursivitate/recursivitate.pdf accessed on 6.11.2020)

Running the algorithm took about 1 minute for the entire symphony, without any special code optimizations. Future improvements can include MIDI implementations of any of the following substring search algorithms using finite-state-automaton-based search: Rabin–Karp, Knuth–Morris–Pratt, Boyer–Moore.

3. Conclusions

In conclusion, to improve the results, before running the algorithm we quantified the start events and lengths of notes to 1/32, in *Cubase*.

We found MIDI type 0 to be easier to parse than type 1, where a dedicated track has the time signature and other tracks lack time signature (computing the time signature for the events would make the code unnecessarily complex).

This method is not perfect. Different music writing software (Score or DAWs) export the MIDI with tiny differences in the notes order (for example overlapping notes, which we decide to ignore for the motif search). Having lots of rules for the possible frequency variations of the motif or for allowing search of partial segments of the motif would result in the code being messy, therefore a neural-network based approach would probably be more effective if we decide to run this on very large MIDI databases.

In conclusion, digital tools offer a modern and quick method of musical analysis on large data sets, which determines another point of view (another prism) on the understanding of the contemporary musical phenomenon.

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Webography

http://info.tm.edu.ro:8080/~junea/cls%2010/recursivitate/recursivitate.pdf

https://ro.wikipedia.org/wiki/Automat_finit

Appendix

The results of the digital analysis algorithm in *Symphony no. 1 "Glossa"* by Viorel Munteanu (extract):

Index	The instrument	Solution discovered
30	First soprano	
31	Second soprano	
34	First tenor	
35	Second tenor	
38	Violin 1