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Algorithmic Compositions are a Phenomenon of Electronic Music

Electronic music can be subdivided into a number of varieties. They include music composed for electronic musical instruments; music the basis of which is the transformation by electronic means of sounds surrounding the human being; music created by means of sounds automatically generated by electronic means, as well as music programmed on the computer, or algorithmic music. The present article is devoted to examining an experiment in the sphere of algorithmic music which during the course of a long time is carried out by composer, scholar and writer David Cope – a researcher of musical artificial intellect. Cope is the developer of programs for analysis and creation of musical compositions in the styles of well-known composers. The article applies the method of comparative analysis for comparing a musical composition by Hungarian composer Bela Bartok and its model created by means of algorithmic composition with David Cope's program.

Creation of style according to a model is an enthralling experiment making it possible to perceive in an adequate manner the music of famous masters, to carry out competent interpretations in musicological analyses, to establish the components of a composer's style, observing important components of his mannerisms, and to perfect oneself in computer programming. Nonetheless, a composition created by a master still surpasses the mechanical version by the presence of inimitable creative enlightenment inspiring in its solution of the posed creative goal, which is impossible to recreate automatically.

Keywords: electronic music, algorithmic composition, contemporary music, musical style, David Cope.

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Алгоритмические композиции – феномен электронной музыки

Электронная музыка подразделяется на ряд разновидностей. К ним относятся: музыка, сочинённая для электронных музыкальных инструментов; музыка, в основе которой – преобразованные электронным способом окружающие человека звуки; музыка, созданная из генерированных автоматически электронным способом звуков, а также запрограммированная на компьютере, или – алгоритмическая музыка. Данная статья посвящена рассмотрению

эксперимента в области алгоритмической музыки, на протяжении долгого времени проводимого композитором, учёным, писателем Дэвидом Коупом – исследователем музыкального искусственного интеллекта. Коуп является разработчиком программ для анализа и создания музыкальных сочинений в стилях известных композиторов. В статье применён метод компоративного анализа для сравнения сочинения венгерского композитора Белы Бартока и его модели, созданной алгоритмической композицией по программе Дэвида Коупа.

Создание стиля по модели – увлекательный опыт, позволяющий адекватно воспринимать музыку известных мастеров, осуществлять грамотные интерпретации в музыковедческих анализах, устанавливать компоненты стиля композитора, подмечая важные составляющие его почерка, совершенствоваться в компьютерном программировании. Однако сочинение, созданное мастером, всё же превосходит машинный вариант наличием неповторимого творческого озарения, вдохновляющего при решении поставленной художественной задачи, которое невозможно воссоздать автоматически.

Ключевые слова: электронная музыка, алгоритмическая композиция, современная музыка, музыкальный стиль, Дэвид Коуп.

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The progress of science and technology, having penetrated into art, has influenced the appearance and the subsequent development of algorithmic music. the use of electronic calculative machines began at the end of the previous century. It spread onto sound production in music, its analysis and composition. Generating music is a broadly developed field of research in musicology outside of Russia [6; 7; 9; 10; 11]. Analysis is made of algorithmic compositions modeling the composer's style within the frameworks of the present article.

One of the composers who has studied the potential of modeling style in music was David Cope. His experiments in the domain of musical intellect, or EMI¹, carried out since 1981, have generated numerous compositions in the style of Scarlatti, Bach, Haydn, Mozart, Beethoven, Schubert, Chopin, Gershwin, Joplin, Schoenberg, Bartok, Rachmaninoff and Prokofiev [4; 5].

In describing the process of recreation of musical style with the aid of electronics, Cope makes use of the term of “recombination,” derived from precise or natural sciences and signifying a redistribution of the genetic material of parents in their descendants. The composer considers that the musical processes, just as all processes taking place in the Universe, are based on genetic recombination providing for the preservation of traditions. In Cope's opinion, recombination of pitches and duration presents the building blocks of music which form the basis of musical composition and recreate individual and epochal musical styles [5].

The work of EMI is based on “the 17th century algorithmic principle” of *Musikalisches Würfelspiel* – the game of “musical dice,” i.e. on a random choice from preset parameters. In order to determine the parameters, Cope brings out the concept of the signature, which presumes the specific



elements of the musical language repeating themselves in music which define the composer's individual style. In his search for signatures, Cope provided the EMI with the indispensable data containing information about the composer's set of expressive elements, represented by short musical fragments. The computer chooses the versions set forward by conditions out of a set of parameters. The variable numerical parameters within a computer code, both the ones which detect and those that determine whether or not the potential correlation is satisfactory are called "controllers."

The distribution of the patterns on a compositional level of a musical composition takes place due to the analytical module SPEAC², which coordinates the correlation of the patterns between the various sections of the large-scale thematic structure of a composition, following the logic: from the smaller structures to the larger, i.e., from the motives to the entire composition, according to Heinrich Schenker's method of analysis.

One of the compositions created with the aid of the EMI computer program with the aim of reconstruction of a composer's style was the composition *Bulgarian Dance*, written according to the model of the pieces of the cycle by Hungarian composer Bela Bartok *Six Dances in Bulgarian Rhythm* from the Sixth Book of Piano Pieces *Microcosmos*.

Bartok's *Microcosmos* cycle consists of 153 pieces comprising 6 volumes. "This cycle grew into an enormous collection of pieces, incorporating in themselves – in an extremely economical and vivid form – the entire set of compositional-stylistic means inherent to the music of the Hungarian master," as Izrail' Nestyev, a researcher of Bartok's musical legacy, writes [3, p. 511–512]. Bartok's *Bulgarian Dance* No. 152 concentrates in itself the most typical features of the composer's original style. According to Nestyev, this

composition characterizes "all sorts of harmonic refinements, delicate beauties of melodicism and chordal combinations," which "give way to the irrepressible aggression of rhythms and excess of timbral and dynamic effects. Even the most unsophisticated listener, most likely, would not resist the imperious hypnosis of self-sufficing dynamism" [Ibid., p. 706]. Such a concentration in one composition of expressive elements intrinsic to Bartok, most likely, was the reason for the greatest similarity of particularly this piece with Cope's algorithmic experiment [5, p. 550].

To a significant degree Bartok's style was influenced by the composer's mastery of folk musical traditions, in this case, Bulgarian ones, which had its effect on the melodicism, the texture and the rhythmical language of the pieces. The influence of folk melodies on Bartok's music demonstrated itself in an entire set of modal innovations: due to this connection with folk modes he expands the possibilities of polytonality and atonality [2, p. 71]. Besides this, the composer applies in a systematic way various pitch sets which in music theory have been dubbed with his name. The melodicism of the *Bulgarian Dance* No. 152 is based on a modal coloration which presumes the interaction of various scales upon one basis, presenting the effect of a chromatic glimmering of scale degrees. This phenomenon may be indicated as the "Bartok technique in the conditions of modal intervallics" (see: [1]).

Combining capriciously with ostinato intonational progressions, modal coloration, while permeating various textural strata, is drawn into an intricate contrapuntal interplay, in which imitations, after slipping away from one voice, unexpectedly appear in another.

The influence of folk music on rhythm is characteristic to many works of the Hungarian composer. Thus, researcher A. V. Denisov writes that the meter and

rhythm in Bartok's composition presents the element which defines the inner pulse of a musical composition and conveys a special type of dynamism to it" [2, p. 70]. In *Bulgarian Dance* No. 152 the folk musical element determines the presence of changing and mixed meters and asymmetric rhythmic structures which have received the appellation of "Bulgarian Rhythm:" 2+2+2+2/8. In addition, use is made of syncopated rhythms, which upon interaction with ostinato rhythmic progressions create a humorous "displacement" in the rhythm based on shifting accents. As Nestyev indicates, "The harshness of the sonorities and the uncontainable thrust of the rhythms seem to express a certain 'rusticity' of feelings, an elemental rapture of life, and at times also a rough sneer, salty humor" [3, p. 707].

In the annotation to his algorithmic composition, carried out by means of the EMI, David Cope observes that the program derives from Bartok's *Bulgarian Dances* their changing meter, and its modal and textural peculiarities. Cope acknowledges that during the process of composing music by means of the computer certain deviations from the style of the source composition are permissible. Among them, he names the free interpretation of Bartok's polymodality and avoidance of non-modal chromaticism which is so peculiar to Bartok. At the same time, EMI preserves the changing meter and rhythmical asynchrony, the transfer of texture between hands typical for his piano compositions, as well as the threefold cadences. The diatonic harmony maintained by EMI adds to the mechanical version a sense of stagnation not typical for the music of Bartok [5].

In this connection, the features of the "stile barbaro" inherent to *Bulgarian Dance* No. 152 becomes lost in Cope's algorithmic composition. The resulting *Bulgarian*

Dance sounds intonationally more mellow due to the succession of the ascending and descending motion in the middle voices from scale degree I to scale degree V of the natural major, emphasizing the tonality of *E major* (Example 1).

Example 1

David Cope – EMI.
Bulgarian Dance, mm. 1–2

The acuteness in Bartok's *Bulgarian Dance* No. 152 appears from the very first measure, when the listener perceives, on the one hand, a sense of tonal instability, due to the "glimmering" between the major and minor keys of *A major – E minor*, and, on the other hand, the intensity created by the harmonic contradiction between *d #* and *d* (Example 2).

Example 2

Bela Bartok. *Bulgarian Dance*
No. 152, mm. 1–2

The sonorous peculiarities of the texture of *Bulgarian Dances* No. 151 and No. 152, demonstrated by the "chordal-intervallic parallelism," the "coloristic compression of the melodic voices," and the "acoustically saturated background of instrumental folk music" [1, p. 160–161], become lost in the mechanical version created by Cope. Let us compare the texturally similar fragments of mm. 17–18 of *Bulgarian Dances* Nos. 151 and 152 with mm. 23–24 of the *Bulgarian Dance* by David Cope and EMI (Examples 3, 4 and 5).

Example 3

Bela Bartok. *Bulgarian Dance*
No. 151, mm. 17–18



Example 4 Bela Bartok. *Bulgarian Dance*
No. 152, mm. 17–18



Example 5 David Cope – EMI.
Bulgarian Dance, mm. 23–24



As can be seen from the examples, the “coloristic concentration of the melodic voices” in Bartok’s *Bulgarian Dance* No. 152 takes place as the result of the registral rapprochement of the chromatically sliding voices (m. 17) and the sudden juxtaposition with the contrasting type of texture (m. 18), where functionally contrasting textural strata transfer into one register. In the *Bulgarian Dance* by Cope and EMI the imitations of the voices are carried out in one single texture, at an octave distance between the voices and upon the rhythmic standstill of

one of them, which makes the sound lucid and delicate, which is quite remote from Bartok’s artistic goal in No. 152. While the texture of the mechanical version comes close to the fragment from the *Bulgarian Dance* No. 151 (mm. 17–18), the intonational acuteness of this piece by Bartok outmatches it.

Thus, a comparative analysis of music created by a composer with that generated with the aid of artificial intellect was carried out by the example of two *Bulgarian Dances* from Bela Bartok’s cycle *Microcosmos* and the *Bulgarian Dance* by David Cope and EMI. It demonstrated that the disclosure of a composer’s ideostyle by means of signatures, including a set of the elements of a composer’s language and divided by a program following the rules of musical syntax, presents a curious experiment, presenting a new step in science and art. At the same time, the specific compositional peculiarities which define the composer’s “highlight” inherent to that particular maestro may be recreated only by a person endowed with remarkable talent.

NOTES

¹ According to Cope’s terminology, EMI stands for ‘Experiments in Musical Intelligence.’

² The abbreviation “SPEAC” stands for: ‘Statement, Preparation, Extension, Antecedent, Consequent.’

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