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Metricity and Polyrhythm: A perceptual and performance-practice-based study on *Fanfares* from *Étude pour piano* by György Ligeti

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Abstract

Piano étude No. 4, *Fanfares* is one of most frequently played étude among the cycle of eighteen études composed by Hungarian-Austrian composer György Ligeti (1928–2006). The recurring rhythmic ostinato and the polyrhythmic structure are two major component that post great challenges not only to the listeners to perceive the rhythmic complexity, but also to the performers to coordinate bimanually. Therefore, a perceptual and performance-practice-based study is needed to establish a thorough understanding of rhythmic phenomena in the étude. From the perceptual perspective, the article aims to examine the characteristics of the rhythmic ostinato, and uncover its potential metric function. From the physical perspective, the examination of the perceptual issues of the polyrhythmic features leads to the discussion on kinetic patterns resulted by the polyrhythmic conflicts. Furthermore, rhythmic graph, which based on the elementary pulsation, should offer a visualization of the polyrhythmic structure, and serve as practice material for tackling the difficulties in bimanual coordination.

Keyword: Ligeti, polyrhythm, metricity, African timeline, bimanual coordination

Introduction

Heinrich Christoph Koch questions the term "*imbroglio*" in his 1802 *musikalisch Lexikon*, which applies to the simultaneous conflict of perceived meters and the notated meters. Ever since then, the metrical issues become a realm frequently discussed. With the development of compositional concept, contemporary musical works has more free room for the utilization of metrical complexity, and therefore plays a frontier role in the field of meter. Under influence from Conlon Nancarrow (1912–1997), György Ligeti (1928–2003) has composed *Étude pour piano* (1985), a cycle of 18 etudes in his last decades, it became one of the most significant sets of piano studies in 20th century. Ligeti generates in the late period not only inspiration from his origin, western common practice music and avant-garde, but also his exploration of the cultural "otherness", namely the polyrhythm in Central African music. As a result, the cycle is challenging in both technical and perceptional context. Among them, the étude No. 4, *Fanfares* is one of the most frequently played etudes in the cycle. One salient rhythmic phenomenon is the recurring rhythmic ostinato. Because the rhythmic ostinato appears ongoingly in most part of the étude with another rhythmic layer synchronizes or desynchronizes with it, assumption on whether the rhythmic ostinato functions as potential metrical framework in *Fanfares* arises. At the same time, the rhythmic layer that opposed to the rhythmic ostinato creates polyrhythmic features. To address the metrical issues and the polyrhythmic features in the piece, I will examine the recurring rhythmic ostinato in its characteristics and its potential metricity, as well as the polyrhythmic features and its kinetic pattern in bimanual coordination. Also, a cultural study is in need to understand the metricity in *Fanfares* from the theoretical perspective, whilst a performance-practice-based discussion on the polyrhythmic features should help performers finding kinetic pattern in playing the polyrhythmic conflicts. Lastly, rhythmic graph, which based on the isochronous pulsation, aims to provide the performers a visualization of the polyrhythmic structure in *Fanfares*, and it serves as first-hand material for practicing on the polyrhythmic features.

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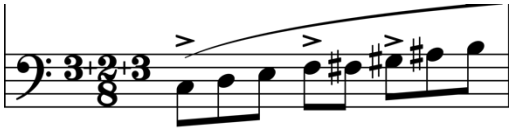
1. Potential Metricity

1.1 Compositional intention regarding meter

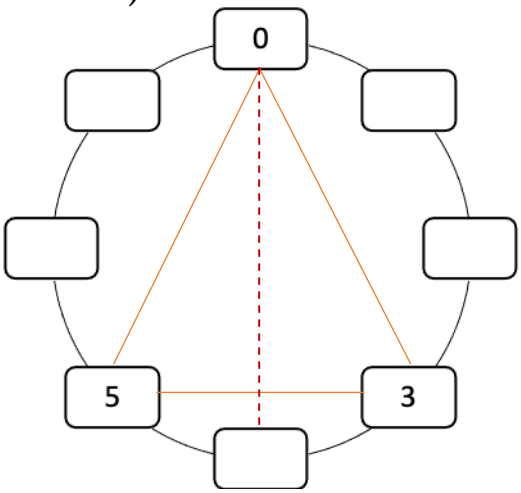
Ligeti marks the meter 3+2+3/8 at the beginning of the piece (Example 1) The time signature adapts itself in an ostinato figure that remains consistent almost throughout the piece. The ostinato figure enters in the first place and bears a noticeable function as meter framework. Ligeti indicates from the beginning a clear borderline between different levels of musical surfaces: the isochronous ostinato forms a metrically extreme stabile surface, while there are motif lines construct the other.

The 3+2+3 pattern appears in different music cultures with different names. Toussaint identifies the pattern as a rotation of tresillo timeline in his book *the Geometry of Musical rhythm*, while Arom categorizes it as an aksak timeline. According to the Simha Arom's categorization of aksak rhythm, the 3+2+3 pattern is a variant of pseudo-aksak pattern, which has an even number of 8 onsets (figure 1). In despite of its typology, aksak rhythm is a timeline that combines both the binary and ternary grouping of subdivision. In the specific pseudo-aksak, there is also a combination of symmetry and asymmetry that complementize the binary-ternary quality. The even number of 8 onsets can divide itself symmetrically to 4+4. With the same number of onsets, the pseudo-aksak timeline is irregular with the beats fell onto unevenly onset 5 and 7, but it remains geometrically symmetry. Whether significant alignment of symmetry and asymmetry quality of the pattern has taken in consideration in Ligeti's compositional process, is a question worthy to examine.



Example 1.Ligeti, Études pour piano, premier livre No.4/ m. 1. Copyright (c) 1986 Schott Music GmbH & Co. KG, Mainz, Germany. All Rights Reserved. Used by permission of European American Music Distributors Company, sole U.S. and Canadian agent for Schott Music GmbH & Co. KG, Mainz, Germany.

Figure 1. the 3+2+3 timeline (pseudo-aksak)



The 3+2+3 pattern suits in the term Euclidean rhythm, which contains binary metrical structures, regular beat divisions and irregular groupings. Talking about Euclidean rhythm, Brad Osborn addresses the Euclidean algorithm, which identifies the relation between elements *n* and total number of onsets *k* as E(*k*,*n*).[2]

[2] Brad Osborn, "Kid Algebra: Radiohead's Euclidean and Maximally Even Rhythm," *Perspective of New Music*, 52/1(Winter 2014), 93-94.

The pattern can interpret itself as E(3,8). Osborn claims that, under two categories $k > .5n$ and $k < .5n$, we perceive the latter one as more of some metrical component than the previous one, therefore we perceive the 3+2+3 pattern as some sort of metrical reference rather than as a rhythmic entity. Also, the pattern shows the quality of maximally evenness. It means that *k* onsets divide themselves close-to-even, and the spaces between the events *n* and their order are maximally even. We can perceive the kind of phenomena as slightly varied even rhythm; such illusions can be keys of interpretation of the flows in performance practice context. The pattern has also a palindromic structure, that can relate to the compositional concepts from Messiaen.

We cannot avoid African concept of meter while talking about metrical perception. The lack of meter or metrical hierarchy results in highly variable rhythmic organization that obtains features others than the framework in western common practice music. Arom lists five salient features that help defining the rhythmical figures, they are mark, duration, morphology, metricity and structure.[3] The metricity here means the relationship between rhythmic figures and the pulsation level, there are two types of metricity: commetricity and contrametricity. Both types can be regular or irregular, and these two types can also fuse together. To know is also that the contrametrcity is a predominant feature in Cerntal Africa. In the case of *Fanfares*, the 3+2+3 pattern shows a regular commetricity with accents always happening on the beats. If we perceive the pattern more on the pulsational level, the interweaving polyrhythmical part alongside creates often a contrametric level toward the pulsational level. The kind of mixture give rise to not only conflict between two rhythmic levels, but also conflicts between rhythmic and metrical levels. Though Ligeti still use barlines in most of the etudes in the cycle, they serve rather as optical aids than as a framework of metrical hierarchy. The lack of meter happens not solely in the African music tradition. In the Renaissance period, though there is music features mensurstriche sometimes, bar-lines in modern sense were still rarely in use. The metric structure of the pieces often can *be heard but not seen*.[4] Ligeti's great admiration on renaissance master like Ockeghem may also have influence on his choice of metric concept.

1.2 Metrical function of 3+2+3 pattern and its perceptional issues

Ligeti expresses saliently how are the moto perpetuo ostinatos supposed to be played. His instructions toward the 3+2+3 figure focus on the accents, which need to be clear heard and evenly accentuated. The statement is essential to metrical structure, because the metrical hierarchy disappears when the accents on the first beat are dynamically equal to those on the subdivisions. Ligeti also mentions that the ostinato figure should remain in the background, and the accents on the motif lines are always stronger than those on the ostinato. It is noticeable that different surfaces of the musical texture apply here different metrical rules. Ligeti allows the motif lines to orientate the common metrical hierarchy at the beginning. The prerequisite only lasts until measure 91, where he intentionally omits the metrical function of the bar-lines written onward. The bar-lines serve from then on only as a synchronization tool for the hands. At this point, Ligeti emphasizes again the consistency of independency of the ostinato figure, which functions as meter framework evidently. Within the part in which the metrical hierarchy rules motif lines, we see dynamic contours that challenge the rule. Ligeti utilizes crescendo and decrescendo marks to create spotlight on the weak notes in the bars. The kind of metrical confusion fuses into phrases with accents on the first beat, so that the perception of the metrical hierarchy is questionable, while the bar-lines are still metrical tools. Such metrical confusions base fundamentally on the contrast to the ostinato surface. Therefore, I contend that the 3+2+3 pattern is a surface functioned metrically throughout the piece.

There is issue how the moto perpetuo pattern changes register. It sounds almost throughout the whole piece from the beginning till m. 209, the pitch classes (PCs) of the ostinato pattern remain identical and connect withs each other seamlessly. There are two exceptions that contains two PCs-identical ostinatos pattern playing simultaneously on variable registers (mm. 137–138, Example 2.1; mm. 198–200, Example 2.2). To note is that the motif lines are not connect with the second ostinato pattern. They form together a temporary three-part structure. There are differences in effect on these 2 exceptions. The first exception (Example 2.1) has dynamic mark *PPPP sempre*, the coming-closer effect of both ostinato lines is very subtle in terms of perception while the motif line has more dynamical proportions. The second exception (Example 2.2) has a similar structure as exception 1, but it is a process of dynamical accumulation in contrast. With the pauses on the last eighth note of the lower ostinato line pattern and on the first eighth note of the upper ostinato line, the perception of large fracture is perceptible.

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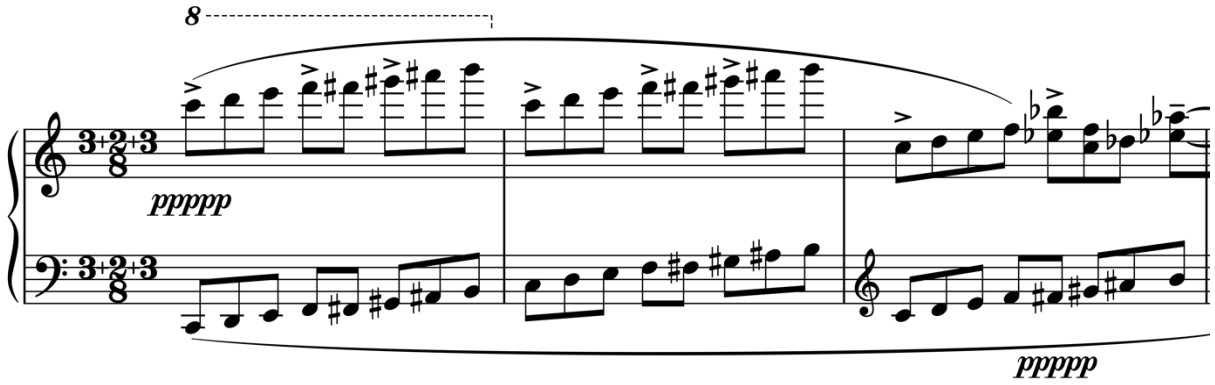
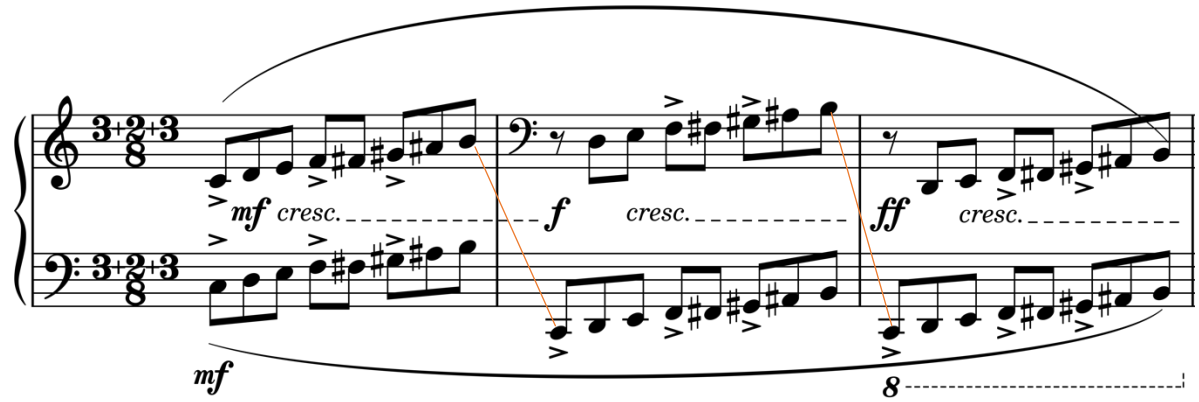
[3] Simha Arom,"Time Structure in the Music of Central Africa: Periodicity, Meter, Rhythm and Polyrhythmics," *Leonardo, Art and the New Biology: biological Forms and Patterns* XXII/1 (1989), 93.

[4] Simha Arom, *African Polyphony and Polyrhythm: music Structure and Methodology* (New York: Cambridge University Press, 1991),196.

The accents on the first beat only exist in lower ostinato line in mm. 199–200, but it regains its dynamical power easily from the lower register to build the crescendos. It shows evident here how Ligeti adapts his compositional intention into proper performance practice study.



Example 2.1. Ligeti, Études pour piano, premier livre No.4/ mm. 137–139. Copyright (c) 1986 Schott Music GmbH & Co. KG, Mainz, Germany. All Rights Reserved. Used by permission of European American Music Distributors Company, sole U.S. and Canadian agent for Schott Music GmbH & Co. KG, Mainz, Germany.



Example 2.2. Ligeti, Études pour piano, premier livre No.4/ mm. 198–200. Copyright (c) 1986 Schott Music GmbH & Co. KG, Mainz, Germany. All Rights Reserved. Used by permission of European American Music Distributors Company, sole U.S. and Canadian agent for Schott Music GmbH & Co. KG, Mainz, Germany.

1.3 Metrical dissonance and its pattern

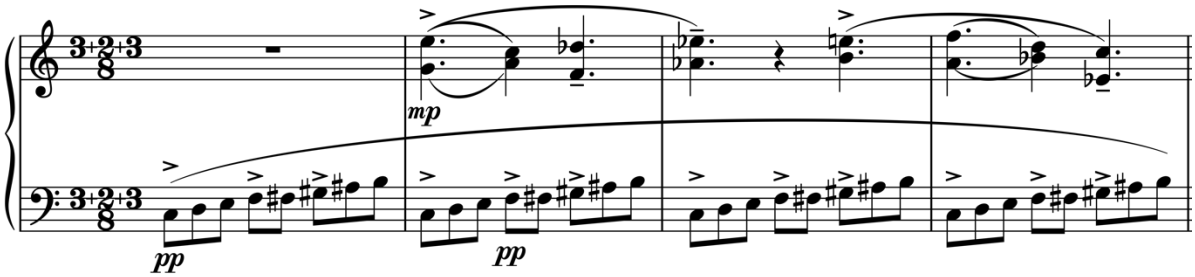
Before we dive into the phenomena of metrical dissonance in the etude, there are several basic terms involving in the field. According to Herald Krebs's theory, it is essential to first determine the layer of motion. Krebs points out that the musical meter functions as a set of multiple layers of motion, and the pulse level is the basic level in each layer.[5] Basing on the pulse level, interpretive levels involve with each other, and they move slower than the pulse level. Krebs claims also that the definition of metrical consonance and dissonance bases on the degree of alignment among different levels, and they should consist of at least one pulse level and two interpretive levels. Krebs categorize metrical dissonance into two types: grouping dissonance and displacement dissonance. The typology of the metrical dissonance bases on the cardinality, which represent the relation of the pulse's number from one level to another.

[5] Krebs, Herald. (1987). "Some Extensions of the Concepts of Metrical Consonance and Dissonance." *Journal of Music Theory*, 31, 100.

In the situation of grouping dissonance, the association of interpretive layer are not congruent in a way that their cardinality numbers are different from each other, while the displacement dissonance is just the disposition of the congruent levels. There are also direct and indirect types of metrical consonance and dissonance, we will mainly focus on the direct consonance and dissonance. As Krebs indicates that "indirect dissonance exists because of our tendency as listeners to maintain an established pulse for a short time after it is discontinued in actuality."[6] We will not encounter the situation of indirect dissonance because of the continuality of the 3+2+3 pattern that consists of isochronous pulses.

Speaking of metrical dissonance, we could not possibly avoid the classification of accents because of its significancy of define types of metrical dissonance. There are three types of accents, also known as stimulus, according to the theory of Fred Lerdahl and Ray Jackendoff[7]: Phenomenal accents, which represents the changes on the textual surface on parameters such as density or loudness, structural accents that relates to the grouping boundaries, and metrical accents that bases primarily on the metrical hierarchy. Phenomenal accents occur often with the situation of displacement dissonance, while structural accents are coherent with the grouping dissonance. It is noticeable that the kind of relation are not universal, because the definition of phenomenal accents and structural accents can blur with each other in some cases.

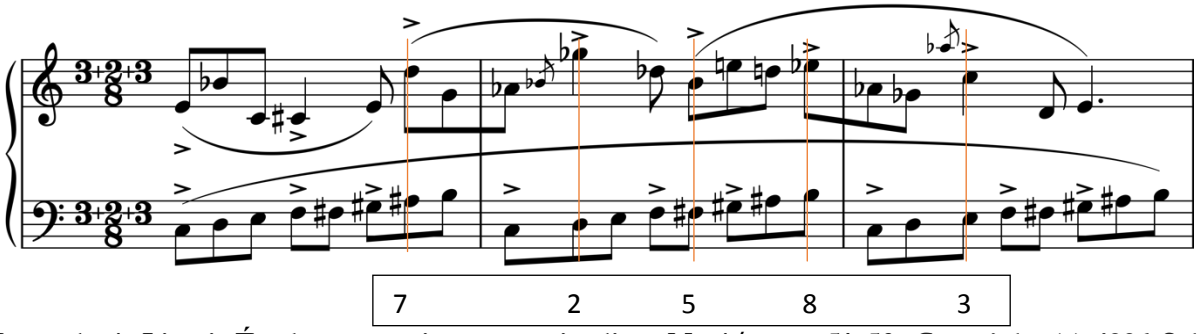
The opening of the piece (Example 3) shows a high degree of metrical consonance. The grouping of the motif line is coherent to the 3+2+3 pattern. Ligeti indicates clearly in the instruction, that the performer should accentuate initial tone of the two-part motif till the end of the piece. The reason is to make the listeners to perceive these accentuations as the beginning of the bars. The information is essential regarding metrical dissonance, because it is to say that metrical quality can also apply to the motif lines as the ostinato lines. It is the prerequisite of the metrical dissonance: two interpretive levels. In most of the case, the first beat of the motif lines has accents. The accent feature gains also a salient function on metrical confusion, where the motif lines lost its two-part quality and become more



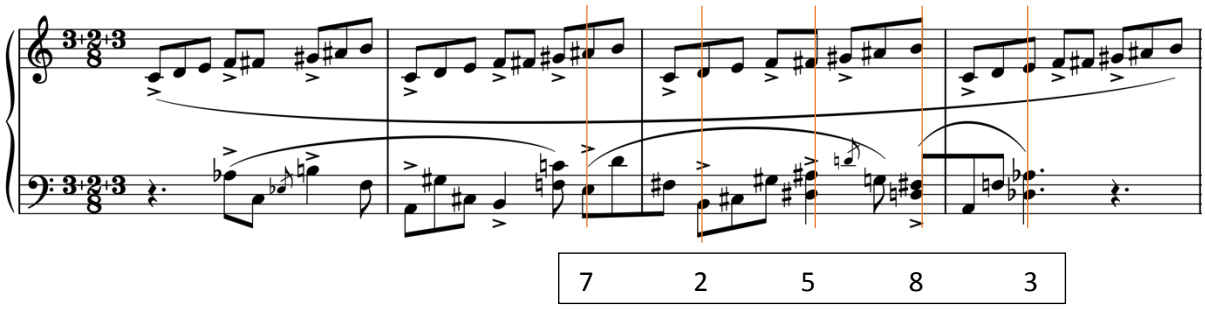
synchronous with the pulse level in measure 46.

Example 3. Ligeti, Études pour piano, premier livre No.4/ mm. 1–4. Copyright (c) 1986 Schott Music GmbH & Co. KG, Mainz, Germany. All Rights Reserved. Used by permission of European American Music Distributors Company, sole U.S. and Canadian agent for Schott Music GmbH & Co. KG, Mainz, Germany.

[6] London, J. (2012). *Hearing in Time: Psychological Aspects of Musical Meter.* (2nd ed.). New York: Oxford University Press, chapter 5.
[7] Lerdahl, F., Jackendoff, R. (1983). *A generative theory of tonal music.* Cambridge. MA: The MIT Press, chapter 2.



Example 4. Ligeti, Études pour piano, premier livre No.4/ mm. 51–53. Copyright (c) 1986 Schott Music GmbH & Co. KG, Mainz, Germany. All Rights Reserved. Used by permission of European American Music Distributors Company, sole U.S. and Canadian agent for Schott Music GmbH & Co. KG, Mainz, Germany.



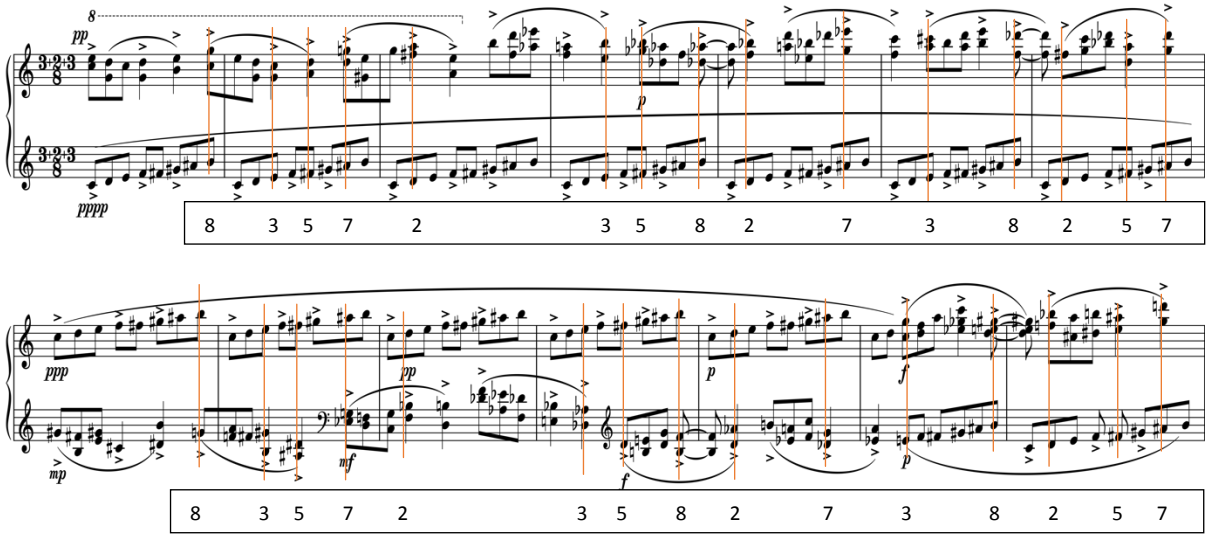
Example 5. Ligeti, Études pour piano, premier livre No.4/ mm. 59–62. Copyright (c) 1986 Schott Music GmbH & Co. KG, Mainz, Germany. All Rights Reserved. Used by permission of European American Music Distributors Company, sole U.S. and Canadian agent for Schott Music GmbH & Co. KG, Mainz, Germany.

From measure 46 onwards, the motif lines become more vivid. There is an interesting feature, the first group of the motif phrase, that starts with an accent on the first beat, most of the case are ternary. The ostinato pattern always starts on a group of three pulse, and it is perceptible throughout the piece. Based on the psychological tendency to metrical expectation, we may assume that the motif lines imitate the construct of the ostinato pattern to cause an illusion of new metrical organizations. The imitation of the metrical structure contrasts with the non-alignment latter in phrase to increase the feeling of metrical confusion.

In measure 48, we encounter the first instance of grouping dissonance, the motif line draws different phrase boundary as the 3+2+3 pattern, the non-alignment occurs later throughout the piece, and it blends constantly together with realignment to the ostinato pattern. Upon that, it builds up a tension-release structure of metrical dissonance and resolution. There are also instances of displacement dissonance. For example, in mm. 51–52 (Example 4), the accents on the motif lines doesn't align with those on the ostinato patter, and it contains structural accents on the beginning each phrase and phenomenal accents in the phrases. According to the onset theory, the accents that are dissonance to the 3+2+3 timeline can be marked with onset numbers. For example, these is the dissonance pattern of [7,2,5,8,3] in mm. 51–52 (Example 4). After understanding the method, we can discover potential coherence of certain dissonance pattern that forms certain narratives or hypermetrical structure. For example, there is also an identical displacement dissonance pattern in mm. 60–61 (see example 5), though the structure of grouping dissonance between the [7,2,5,8,3] patterns is not the same, we can still identify the undermining coherence between them.

There is another pair of metrical dissonance pattern followed by each other (Example 6). In mm. 116–122, a long dissonance pattern [8,3,5,7,2,3,5,8,2,7,3,8,2,5,7] embraces 7 bars. Right after in mm.123–129, this pattern repeat itself after the switching side of the ostinato and motif lines. Ligeti demands a progressing interpretation of these identical dissonance patterns. He writes for the first pattern "*da lontano*" and "*poco meno lontano*," which means from far away and a bit less far away, and "*näher*" for the second one, which means closer. In the very next part in measure 130, Ligeti writes "*entferner*" to enlarge the distance again, which means further away. In this process, the identical patterns create an objective media to present the physical distance. This fantastic compositional intention represents the objectiveness and computational logics in Ligeti's aesthetics. One detail about performance practice appears during

this process: as the dynamics become more contrasting from measure 126, there is a sudden twist of the surfaces in measure 128. With a better understanding on the metrical dissonance, one is more likely to keep on track with dissonance flow instead of losing the overview in affection of the twist.



Example 6. Ligeti, Études pour piano, premier livre No.4/ mm. 116–129. Copyright (c) 1986 Schott Music GmbH & Co. KG, Mainz, Germany. All Rights Reserved. Used by permission of European American Music Distributors Company, sole U.S. and Canadian agent for Schott Music GmbH & Co. KG, Mainz, Germany.

The relations and ambiguities between these metrical elements are essential to understand the musical narratives, and the degree of performative difficulty is in direct proportion to the metrical complexity in this piece. We can see that metrical components don't function solely for certain perceptible irritation on noted meter as in eighteenth and nineteenth century. It can be a center subject to the core of a compositional concept. In search of the narratives behind the use of metrical dissonance, an informed performance practice requires abilities like classification of the metrical phenomena. Careful examination and interpretation of these phenomena will help bringing out maximal effects in performance.

2. Perception and interpretation of polyrhythmic features

2.1 Isochronous pulsation in *Fanfares* and its African origin

Can we interpret a work both mechanically and musically? The question may seem contradictory at the first glance, but it is what we need to deal with in the 3+2+3 pattern. Besides its function of metrical reference, it can also represent the property of pulsation level in polyrhythmic structure. While talking about basic rhythmic features in African music, one could not avoid the term pulsation. On western notation, it often relates to a constant series of sixteenth notes. Simha Arom defines the term in his research on pulsation as the basic rhythmic unit in the music of central Africa. The term "pulsation" means the smallest unit of the beat level that cannot divide any further, and it must be "the isochronous, neutral, constant, intrinsic reference unit which determine tempo.[8] When we look into the isochronous pattern in *Fanfares* (see Example 1), it repeats constantly almost throughout the piece with exception of the last six bars, and repeats itself in the ascending pitch class C-D-E-F-F#-G#-A#-B. The contour of the pattern is not a random arrangement. It shows Ligeti's experiment with equidistant divisions of the octave.[9] He divides the octave into two equal part, and each part consists of the structure of three whole-tone steps plus one half-tone steps. From the perspective of tonal material, it illustrates Ligeti's mathematical thoughts and his adaption of the non-western mode system. The pattern shows also an intrinsic quality by establishing a reference of time and determining the tempo.

[8] Simha Arom, (1991). *African Polyphony and Polyrhythm: Music Structure and Methodology*, New York: Cambridge University Press, 202.

[9] Stephen Andrew Taylor, (2003). "Ligeti, Africa and Polyrhythm," *The World of Music,*45, 91.

We can almost assume that the steady repeating pattern repeating functions at the pulsation level in the piece. However, it contradicts one of Simha Arom's definition, which is the neutrality. With its accentuation on the onsets (0, 3, 5), the pattern separates itself from the equal-weight pulsation by consisting of a combination of 3+2+3.

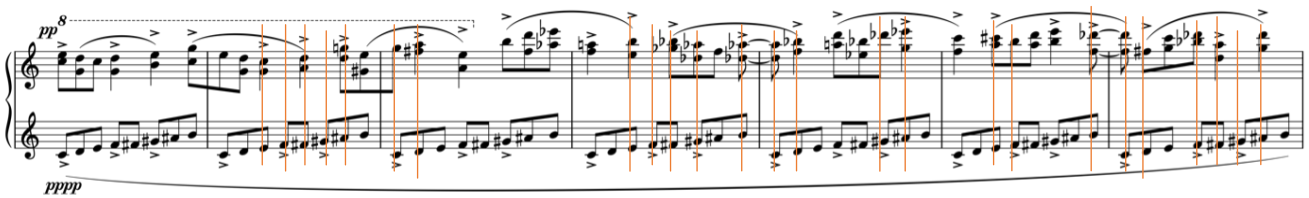
It still works quite well as pulsation in perceptional context, because it attains most of the qualities of an underlying pulsation level. The idea of pulsation is not completely new in Ligeti's music. In fact, he has already developed a steady pulsation web in his early work *Continuum* (1966). The difference is that he multiplicate the common denominator and applies various contours on it to create the complex, overlapping sound landscape, which Ligeti classified as interlocking technique. It is why Ligeti shows great interest on the pulsation phenomena and has no difficulty adapting it: he has come up with the similar rhythmic conception unconsciously in his early style. The derivation of the additive rhythms in *Continuum* can be the Balkan folk music tradition from his youth. The Function of the pulsation is salient in Central African music, because there is no temporal reference such as mete in use. The plain and strict pulsation is the foundation of the rhythmic periodicity that offers a framework to the rhythmic events.[10]

2.2 Polyrhythm in Fanfares and the related performance practice

Simha Arom's research on polyrhythmic feature in central Africa has a profound influence on Ligeti's late style. He has even written a foreword to the English translation of Arom's book *African Polyphony and Polyrhythm* to describe his encounter of the rhythmical phenomena other than European music culture. Ever since then, polyrhythm becomes one of the "Ligeti signals" referring by composer himself. *Fanfares* is a great example for Ligeti's experiment on polyrhythmical issues.

In this part of the article, I would like to examine three instances of polyrhythmic conflict by using the five salient features from Simha Arom. To note is that all three examples share the same properties regarding morphology: the figures are all in uniform; it means that the figures based primarily on repetition of a cell or configuration.

Example 6 shows the conflict between the repeating 3+2+2 rhythm upon 3+2+3 pattern. Noticeable is that two groups of the 3+2+2 pattern (m. 116 and mm. 117–118) demonstrate contrametric properties while other groups are commetric. From the duration perspective, the 3+2+2 rhythm has 7 pulses, and appears eight times while the 8-pulse 3+2+3 pattern rises 7 times. Both rhythms are regular but asymmetric on the aspect of structure. Given the fact that 3+2+3 functions also as metrical components, we may assume that the 3+2+2 rhythms challenge our perception by providing denser accentuations than the underlying part, thus produces the illusion of forwarding effect. It is also interesting to see that all accents laying next the others require switching hands. The phenomenon suggests a practice of switching accents between the left and the right will benefit the interpretation of the polyrhythmic conflicts. Proper understanding the polyrhythmic structure can also help keeping the accent-web flow. This 7-bar periodicity appear later again but with the left and the right hand switching their roles, thus creating a symmetry but reverse polyrhythmic structure. After that, both hand reunion gradually on 3+2+3 pattern from m. 134. We can identify this kind of process as a rhythmical modulation, because it releases the tension created by the rhythmic conflicts. Similar use of such rhythmic reading also appears in Thelonious Monk's song *Hackensack*, from whom Ligeti may take influences of the unconventional use of polyrhythmic conflicts on piano[11].



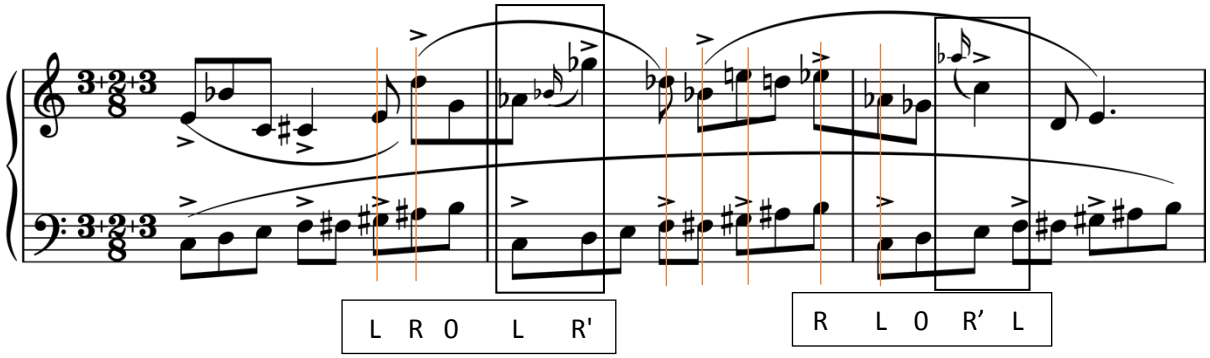
Example 7. Ligeti, Études pour piano, premier livre No.4/ mm. 116–122.Copyright (c) 1986 Schott Music GmbH & Co. KG, Mainz, Germany. All Rights Reserved. Used by permission of European American Music Distributors Company, sole U.S. and Canadian agent for Schott Music GmbH & Co. KG, Mainz, Germany.

[10] Simha Arom,(1989). "Time Structure in the Music of Central Africa: Periodicity, Meter, Rhythm and Polyrhythmics," *Leonardo, Art and the New Biology: biological Forms and Patterns,*22, 91

[11] Mark S. Haywood, (1995). "Rhythmic Readings of Thelonious Monk," *Annual Review of Jazz Studie,* 7, 28.

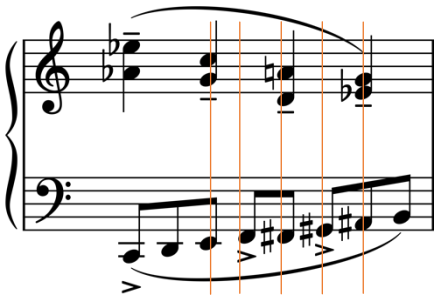
Example 7 shows how the regular symmetric ternary rhythm groupings conflict with the 3+2+3 irregular, asymmetric pattern. The duration of the ternary pattern is all in three, but it groups itself in a 6+6+12 periodicity. To note is that the next-to-other accents here require also alternating hands. The regular ternary grouping, which represents the feeling of flow, conflicts here with the maximally even 3+2+3 pattern.

It creates an effect that the 3+2+3 chase after the ternary pattern, because the regular ternary pattern sounds more fluent than the other one. Ligeti uses also ornaments at this part. It shows here one of the basic rhythmic features in Central Africa, the strict formulae are not always identical, and it applies "a certain degree of variation." Such feature requires performers to prepare in advance. We should therefore determine the finger positions while creating the accents. The coordination of the accents on the left hand (L), right hand (R), no accents (0) and ornamented (R') creates together a pattern that also has some sorts of regularity in-between.



Example 8. Ligeti, Études pour piano, premier livre No.4/ mm. 51–53. Copyright (c) 1986 Schott Music GmbH & Co. KG, Mainz, Germany. All Rights Reserved. Used by permission of European American Music Distributors Company, sole U.S. and Canadian agent for Schott Music GmbH & Co. KG, Mainz, Germany.

Example 8 differentiate itself from last two example: the binary pattern is not isochronous comparing with the 3+2+3 pattern. It forms even a trace back of the western metrical hierarchy by divide 8 pulses regularly into 4 onsets. We can also see dynamic and articulation contrasts between the conflicting polyrhythmic levels. There is sostenuto on the right hand instead of accents mark. We should take dynamical and articulation issues into consideration while practicing, because they complement the rhythmic feature by widen its dimension. Therefore, I contend that the precise execution of the musical elements can enhance the performance of rhythmic figure and add more dimension on the sounds of the polyrhythm conflicts. There is one common feature comparing to the former example, which is the dense switching accents.



Example 9. Ligeti, Études pour piano, premier livre No.4/ m. 105. Copyright (c) 1986 Schott Music GmbH & Co. KG, Mainz, Germany. All Rights Reserved. Used by permission of European American Music Distributors Company, sole U.S. and Canadian agent for Schott Music GmbH & Co. KG, Mainz, Germany.

According to empirical experiment from Ève Poudrier and Bruno H. Repp, [12] tracking different beats simultaneously is difficult even for well-trained musicians, but rhythmic related practice and training can enhance the

[12] Ève Poudrier and Bruno H. Repp, (2013). "Can Musicians Track Two Different Beats Simultaneously?" *Music Perception: An Interdisciplinary Journal,* 30, 388.

accuracy of the perception of two beats levels. Because of the interwoven accent web in the music scores, a clear visualization of the polyrhythmic conflicts in *Fanfares* is in need to fulfill the practice purpose.

3. Visualization of the polyrhythmic patterns

3.1 principles of rhythmic graph

To clarify the African footprint in his music, Ligeti had once emphasized the use of elementary pulsation: "In Africa, cycles or periods of constantly equal length are supported by a regular beat (which is usually danced, not played). The individual beat can be divided into two, three, or sometimes even four or five 'elementary units or fast pulses. I employ neither the cyclic form nor the beats, but rather use the elementary pulse as an underlying gridwork."[13] Therefore, since the ongoing pulsation is a significant feature in the *Études*, the rhythmic graph will be based on the elementary pulse as the common denominator, even though the elementary pulses in each étude do not share the same actual note values. The rhythmic graphs serve as optical tools for an analysis on the elementary pulsations and the polyrhythmic structure. Simha Arom has elaborated on the pulsation in Central African culture in his book *African Polyphony and Polyrhythm*:

"By pulsation we mean the isochronous, neutral, constant, intrinsic reference unit which determines tempo. To take this definition piece by piece:

- *Isochronous*, that is, repeated at regular intervals.
- *Neutral* insofar as there is no difference between one pulsation and another: the idea of an arrangement of beats at a higher level [i.e., meter] is excluded.
- *Constant* in being the only *invariable* element in the course of the piece.
- *Intrinsic*, that is, inherent in the music itself and specific to each piece: this makes it always a relevant factor.
- A *reference unit*, that is, establishing a unit of time.
- *Determining tempo* by setting the internal flow of the music it underlies."[14]

In the rhythmic graphs, the pulsations will be marked with hyphens, while the accents will be marked with X. "The intervals between the onsets of successive notes (IOIs) are the main component of a rhythm. Hence, two rhythms sound similar even if one is a sequence of staccato notes, each followed by a rest, and the other is a series of legato notes that each last until the onset of the next note."[15] To simplify the score information into the rhythmic graph, some information from the accent level are to be reduced by following rules:

1. Accents or sounding notes, depending on the practical context in each étude, will be marked as attacks with X. Sustained notes are treated the same as the short note and marked as an accent without indication of its length, since the intervals between the attacks of accent impact the perception of a rhythm more than the length of the accents.
2. Tenuto count toward accents because of their contextual function of emphasizing the notes to make them sound louder.
3. The pause will be presented with a empty grid.
4. Phrase marking will be eliminated in the rhythmic graph, while some recurring rhythmic pattern will be framed together as an optical aid.
5. Fermatas will be left out in the rhythmic graph as the length of them are to be determined by an individual performer to achieve the desired effects.
6. Dynamics will not be taken in consideration in the rhythmic graph in order to focus on the interrelationship of the layers in a purely rhythmical context.

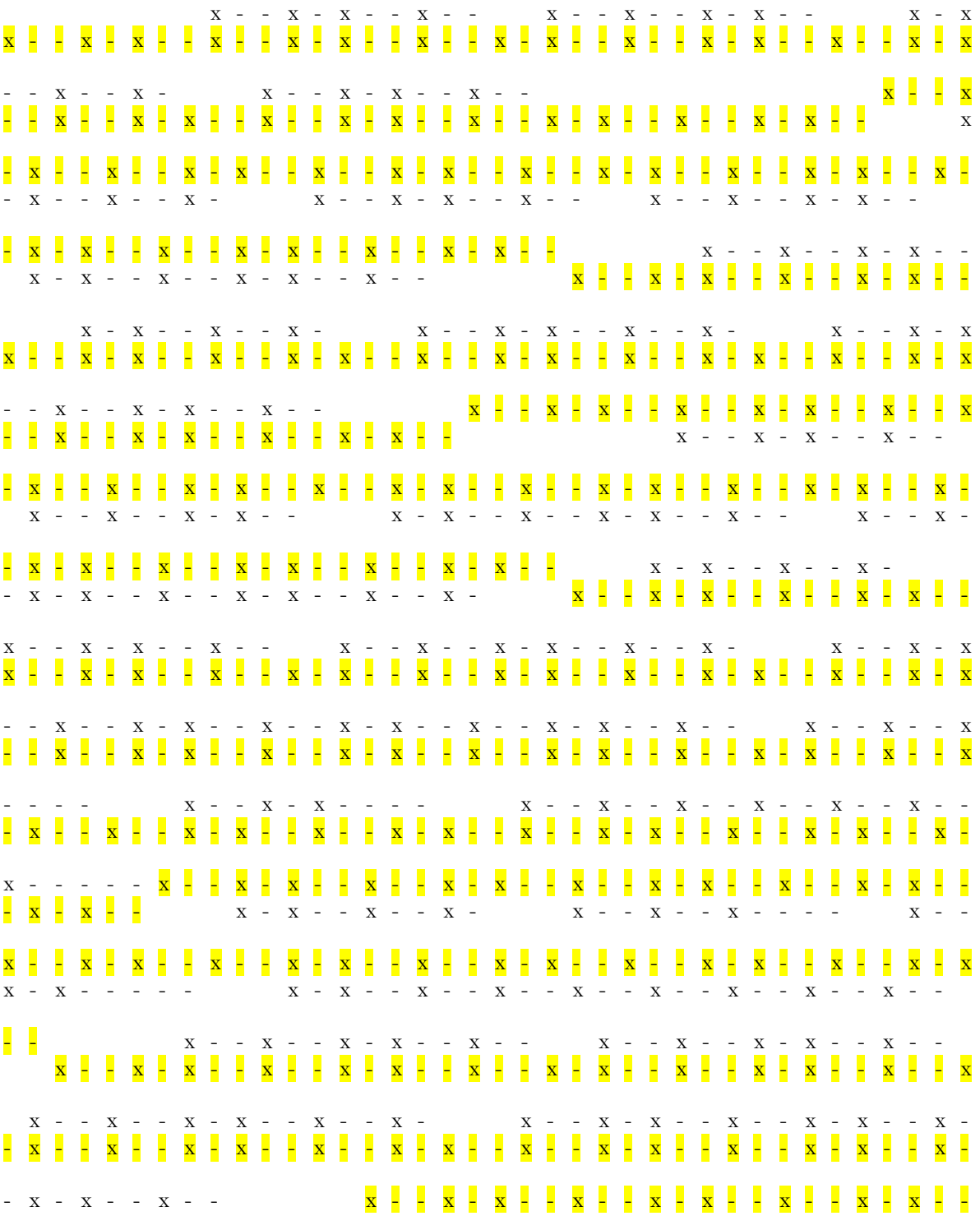
3.2 Rhythmic graph of *Fanfares*

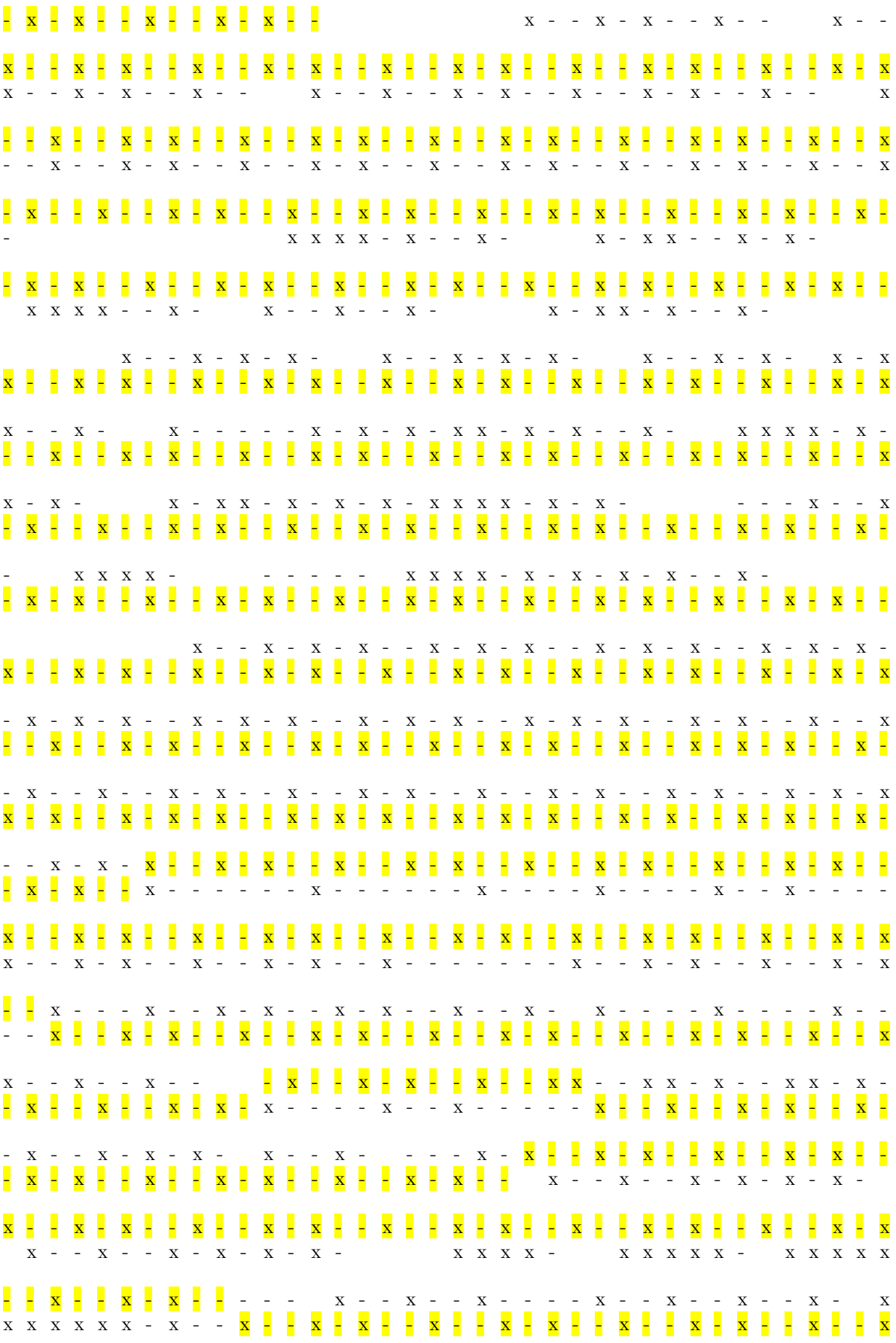
Based on the principles of rhythmic graph described above, the visualization of the polyrhythmic structure in *Fanfares* is shown in Figure 2. The 3+2+3 ostinato, which is to perceive as potential metricity in the étude, is indicated in yellow. The ostinato cycles ongoingly in most of the part in *Fanfares*, and it appears on both hands in turn. Through

[13]György Ligeti, notes on Erato ECD 75555, (1990).
[14]Simha Arom, (1991). *African Polyphony and Polyrhythm: Music Structure and Methodology*. New York: Cambridge University Press, 202.
[15]Erica Cao, Max Lotstein and Philip Johnson-Laird, (2014)."Similarity and Families of Musical Rhythms," *Music Perception: An Interdisciplinary Journal,* 31, 446.

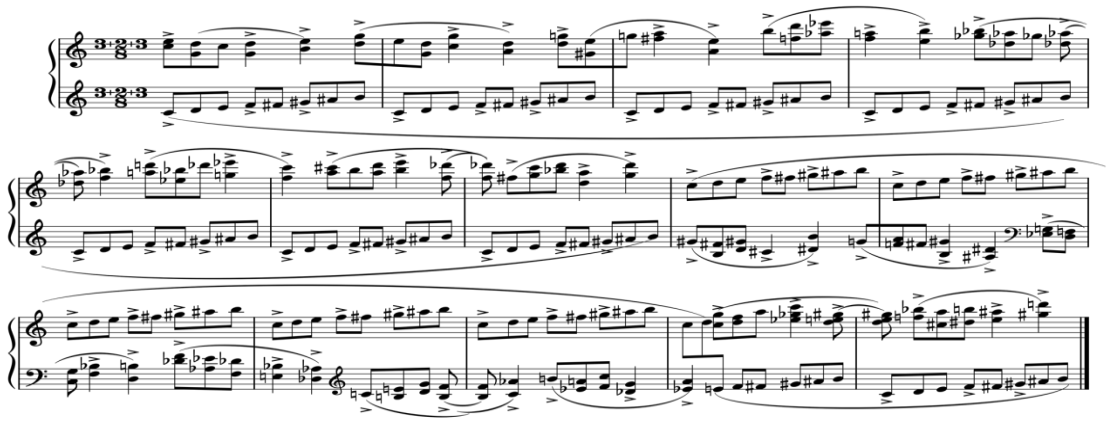
the rhythmic graph, the performers can have a better view on how the opposed rhythmic layer interacts with the ostinato layer, and it allows early physical approaches to difficulties in bimanual coordination, such as the switching accents on both hands.

Figure 2.Rhythmic graph of Ligeti, Études pour piano, premier livre No.4. Copyright (c) 1986 Schott Music GmbH & Co. KG, Mainz, Germany. All Rights Reserved. Used by permission of European American Music Distributors Company, sole U.S. and Canadian agent for Schott Music GmbH & Co. KG, Mainz, Germany.



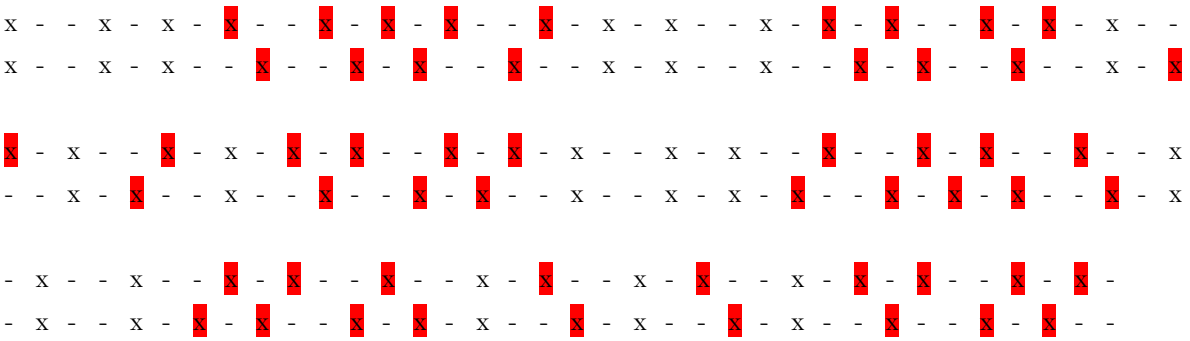


Taking mm. 116–129 as example (Example 9), the interaction between the recurring 3+2+2 and the regular 3+2+3 ostinato creates symmetric but reverse polyrhythmic structure. Such polyrhythmic relationship is clear visualized by the shape of the polyrhythmic patterns; the two symmetrical phrases show the same patterns of rhythmic conflicts in reversion, which are marked in red in Figure 3. Allocating and mastering such polyrhythmic patternscan benefit the bimanual coordination while dealing with the interacted accents. From the perceptual perspective, the 3+2+2 pattern is also characterized with regular repetition of binary cells, and it results in a shortening effect as opposed to the 3+2+3 layer.



Example 10. Ligeti, Études pour piano, premier livre No.4/ mm. 116–129. Copyright (c) 1986 Schott Music GmbH & Co. KG, Mainz, Germany. All Rights Reserved. Used by permission of European American Music Distributors Company, sole U.S. and Canadian agent for Schott Music GmbH & Co. KG, Mainz, Germany.

Figure 3. Rhythmic graph of Ligeti, Études pour piano, premier livre No.4/ mm. 116–129. Copyright (c) 1986 Schott Music GmbH & Co. KG, Mainz, Germany. All Rights Reserved. Used by permission of European American Music Distributors Company, sole U.S. and Canadian agent for Schott Music GmbH & Co. KG, Mainz, Germany.



Conclusion

After examination of the rhythmic properties and polyrhythmic structure in *Fanfares*, the 3+2+3 rhythmic ostinato is a pseudo-aksak timeline that functions potentially as metric framework from the perceptual perspective, while the opposed rhythmic layer creates polyrhythmic conflicts that are characterized by switching accents between both hands. To enhance the perception of the potential metricity and polyrhythmic conflicts, rhythmic graph based on the elementary pulsations provides a visualization of polyrhythmic patterns, thus benefiting the practice of bimanual coordination. Tackling bimanual coordination issue is essential in the learning of the étude, because the precise interpretation of the polyrhythmic pattern affects how well we can perceive the polyrhythmic structure in *Fanfares*. Therefore, the rhythmic graph should serve as first-hand material for the practice purpose as well; it helps the performers to identify the polyrhythmic patterns, and makes physical approaches to the patterns possible even in the early learning phase. Because of the distinct polyrhythmic characteristics in *Fanfares*, we can assume that the understanding of the metricity and polyrhythmic figures is the key to an informed interpretation. To interpret the rhythmic complexity in his work properly, a thorough understanding on the rhythmic properties and interaction of the rhythmic layers on both perceptual and physical perspective is essential for successful tackling of the synchronization difficulties. Conceptually, Ligeti's attempts toward cultural "otherness" are not merely imitations of particularly concrete musical material, but more of adaption of its concepts and expressivity. Moreover, how to interpret the polyrhythmic features stably and flexibly will be a topic that requires further studies in performance practice field.

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