Temporal Proportions as a Unifying Process in Anton Webern's *Variations for Piano* Op. 27

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Abstract

Austrian composer Anton Webern (1883-1945) often emphasized the importance of creating comprehensive formal unity between all musical elements within in his serial composition. Previous studies have focused primarily on properties of symmetry and invariance as unifying elements in pitch and rhythm domains. This study concerns Webern's Variations for Piano Op. 27 (1937), specifically examining how organization of time and duration in Op. 27 contributes to formal unity through both large-scale temporal organization and connections between temporal structure and the organization of other musical parameters. The analysis provides evidence that Webern consistently organized musical time in each of the three movements of Op. 27 as series of temporal proportions determined by the Golden Ratio, and further demonstrates the significance of temporal structure to comprehensive formal unity by identifying patterned correspondences between Golden Mean points within series of Golden Sections and structural points within the organization of other parameters.

Keywords: Webern, variations, Op. 27, Golden Mean, Golden Section

Introduction

In his public lectures and private correspondence, Anton Webern often emphasized the importance of establishing a comprehensive formal unity between musical elements within his twelve-note compositions. As he stated in one lecture, "Unity is surely the indispensable thing if meaning is to exist. Unity, to be very general, is the utmost relatedness between all component parts." (1963, p. 42) Previous Webern studies have focused extensively on formal processes within pitch and rhythm domains, where unifying properties of symmetry and invariance are evident in Webern's palindrome canons, mirror-inversion canons, chains of elided tone rows, and arrays of fixed-register pitches. Onecompositional parameter that has not yet been adequately addressed is Webern's organization of time and duration in his twelve-note music—specifically, how formal unity is achieved through both large-scale temporal organization and connections between this temporal structure and the organization of other musical parameters. This study includes a temporal analysis of Webern's *Variations for Piano* Op. 27 (1937), arguably his most well-known and often-studied twelve-note composition. My analysis will provide evidence that Webern consistently organized musical time in each of the three movements of Op. 27 as series of temporal proportions determined by the Golden Ratio. Most importantly, the analysis will show the fundamental role of temporal structure in establishingcomprehensive formal unity through patterned correspondences between Golden Mean points within series of Golden Sections and time point locations of a movement's most significant musical events.

Background to Analysis

Terminology

Figure 1a) illustrates that a line of fixed length can be divided into two segments at a mean point, whereby the ratio of the smaller segment (CB) to the larger (AC) is the same ratio as that of the larger segment to the whole length (AB). The ratio between each pair of segments AC:CB and AB:AC is the Golden Ratio, a unique, irrational value that can only be approximated numerically as 1: .618034…. Point C in Figure 1a) is the Golden Mean (GM), the point of division by which the three proportionally-related lengths AB, AC and CB together comprise a Golden Section ACB.

As applied to the organization of time in the *Variations for Piano*Op. 27, large-scale temporal structure arises from divisions of the duration of a movement or its formal subsections into Golden Sections of proportionally-related durations. GMpoints within GoldenSections frequently correspond with time point locations of particularly significant musical events. The types corresponding events include the beginning or end point of a formal section or subsection, the appearance of a primary pitch or rhythm motive, the location of a referential chordal sonority, the axial point bisecting a canon or palindrome, and a focal point emphasized by dynamic, articulation or register extremes.

Figure 1b) illustrates how series of "nested" Golden Sections result from recursive Golden Mean divisions of line AB. As shown, Golden Section ACB is further subdivided, with point D being the Golden Mean for Golden Section ADC and point E being the GM point for section AED. Webern's temporal organization in each of the three movements of Op. 27 takes the form of nested series of proportionally-equivalent Golden Sections. It appears that Webern created these nested series of Golden Sections through proportional replication of an initial segment of duration—what I will refer to in this study as the "temporal cell". This fundamental, generative duration corresponds to the length of a movement's opening musical event, such as a primary pitch or rhythm motive, a tone row segment, row canon or palindrome. As shown in Figure 1b, where segment AB represents the duration of movement, segment AErepresents the temporal cell from which Golden Sections AED, ADC and ACBthen unfold proportionally as a nested series.

It is instructive to note the relationship between the process of proportional replication resulting in a sequential series of Golden Sections and the principle of accretion evident in a Fibonacci sequence of integers, such as 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89 …, whereby successive integers beginning with 1 are the sum of the preceding pair of integers. As the series progresses, the ratio between each consecutive pair of integers more closely approximates the Golden Ratio: 5:8 = 1.6; 8:13 = 1.625; 13:21 = 1.6154; 21:34 = 1.619; 34:55 = 1.6176; 55:89 = 1.61818. Webern appears to have made significant connections in Op. 27 between Golden Sections and the Fibonacci series, where GM points within a series of nested Golden Sections correspond with Fibonacci numbers that represent measure number locations or the number of beats within a section.

Methodology

I determined the absolute time duration of a movement or subsection by counting the number of beats within that segment of duration, multiplying the total number of beats by 60 seconds, and dividing that product by the number of beats per minute as indicated by Webern's metronome marking:

$$\frac{\text{number of beats}}{\text{beats per minute}} = \frac{\text{duration (in seconds)}}{\text{60 seconds}}$$

Durations and GM point locations were recorded to within one one-hundredth of a second (.01"). This tolerance proved significant for determining precisely the correlation between GM points and the time point location of musical events in the score, particularly in faster passages that including several notes per second. The first and third movements of Op. 27 include changes in tempo. Each tempo area appears in the tables with inclusive measure numbers and Webern's metronome marking. I intentionally determined durations without accounting for irrational tempo fluctuations or suspensions of the metrical pulse, such as those that would result from indications for *ritard*, *accelerando* or fermata. Beside the inherent subjectivity in attempting to quantify these irrational tempo fluctuations, my analysis indicates that Webern invariably structured temporal proportions within each movement according to the absolute value of notes and rests. I have listed durations and time points in the tables uniformly as units of seconds. Aduration of one and one-half minutes, for example, will appear as 90.00" rather than as 1'30.00". For tables listing GM points within the duration of an entire movement, the GM points are ordered GM1, GM2, GM3…etc., representing the recursive order of GM points within a nested series of Golden Sections.

In order to demonstrate that Webern consciously employed Golden Sections as a means toward formal unity in Op. 27, it is necessary to establish a pattern of consistency, complexity and relevance between the structure of temporal proportions and structures of other parameters within a movement. The listing of musical events in the tables serves two purposes: 1) to provide reference points and descriptive terms for the discussion of significant correspondences between GM points and certain musical events; 2) to provide an overview of the golden structure within a movement or formal section, so that patterns of correspondences and multi-level connections between temporal proportions and other parameters can be viewed together in their entirety.

Each GM point listed in the tables includes its measure number location and a brief description of the musical event located at that time point. Musical events include those that are evident in the score notation—chords and intervals, pitch and rhythm motives, dynamic markings, timbres—as well as subsurface elements pertaining to tone row operations, row distribution and properties of symmetry and invariance.

The Op. 27 Tone Row

Webern constructed the row for Op. 27 from two complementary hexachords belonging to set class 6-1 (012345) (Bailey, 1996b, p. 203).Figure 2 shows the Op. 27 prime row (P0) followed by its constituent hexachords (H1 and H2) in normal order, the second hexachord complementing at T_6. Webern also used this particular hexachord as the basis for rows in his Symphony Op. 21 and Variations for Orchestra Op. 30 (Bailey, 1996a, p. 336; 1996b, pp. 186, 212). Although the row for Op. 27 is not symmetrically-structured, instances of pitch symmetry and invariance are significant formal aspects within Op. 27, where Webern combines rows to form palindrome and mirror-inversion canons.

Two aspects of row structure with particular significance to the golden proportions in Op. 27are the tritone interval axis between hexachords in each row and a property of pitch-class invariance between certain pairs of rows. In his row tables for Op. 27 Webern appears to have made special note of this tritone axis, drawing a red pencil line between hexachords in each of the forty-eight rows. (Bailey 1996b, p.200). The following analysis will demonstrate the significance of the tritone to the golden structure of each movement, as more than half of the GM points in Op. 27 correspond with the location of tritone axes between row hexachords. The Op. 27 row contains an invariance property by which two rows related such as P-R or P-I with an index number of 12 (or 0) will hold pitch classes Eb and A order-invariant between rows and limit the remaining intervals between rows to only five dyads—B-G, Bb-G#, D-E, C#-F, and C-F# (Straus, p. 152). This particular invariance is the basis for pitch structure in the second movement. The following analysis will illustrate how Webern organizes these dyads in the second movement as a series of intervals with sizes determined by the Fibonacci series.

First Movement*Sehr Mässig*

The opening movement of Op. 27 is an ABA ternary form. Meter and tempo remain constant throughout the movement. The ternary form is perfectly balanced, with each section precisely 27.00” in duration. Each section contains a series of two-voice palindrome canons. Within each canon the *dux* and *comes* consist of a P or I row paired with its retrograde row form. The framing A sections include four canons each, with six shorter canons in the B section.

Table 1 includes the recursive series of GM points for the duration of the first movement. Figure 3 includes locations of these GM point in the score. It is interesting to note that the measure number locations for this series of GM points are themselves a proportional series, comprising a Fibonacci sequence 2 through 34. The tritone axis bisecting the palindrome rows proves to be a focal point in the structure of each canon and in the pattern of corresponding GM points. Five of the eight GM points in the series are located at palindrome axes in sections A and B. GM1 is the exception, occurring at the focal point of section B, where the apex of the line in canon 5 (Db6) sounds *fortissimo*.GM8 represents the shortest duration of structural significance, this being the sixteenth-note trichord figure initiating the movement(mm.1-2). The duration of this opening trichord (1.72”) serves as the temporal cell from which the movement’s entire duration unfolds as a series of nested Golden Sections.

Second Movement*Sehr schnell*

The middle movement of the *Variations for Piano* is a two-reprise binary form. Meter and tempo are constant throughout the movement. As with the first movement, rows are paired in a series of two-voice canons. Whereas in the first movementWebernfeatured horizontal symmetry through palindrome canons, here he turns his attention to vertical symmetries in the form of mirror-inversion canons. The Op. 27 row yields a property of invariance under inversion such that rows related as P-I or R-RI with an inversional index of 12 (or 0)will hold two pitch-classes order invariant and limit the remaining intervals to five dyads. The canons include only R-RI pairs with index 12: where its four mirror-inversion canons consist of row pairs RI0-R0; RI5-R7; R2-RI10. As a result, the pitch classes Aand Eb are order-invariant between each row pair, with the remaining pitch-classes paired as dyads G-B, G#–Bb, E-D, F-C#, and C–F#.

Webern creates a proportional relationship between dyads through his organization of pitch space. As illustrated in Figure 4, when these five dyads are arranged in ascending order as intervals equidistant around the axis pitch A4, the number of half steps above and below the axis in each consecutive interval follows a Fibonacci series 2, 3, 5, 8, 13: 2 (G4-B4), 3 (F#4–C5), 5 (E4-D5), 8 (C#4-F5), 13(G#3–Bb5).

Table 2 lists the series of recursive GM points for the entire duration of the second movement. As in the previous movement, this movement also contains patterned correspondence between GM points and Fibonacci numbers. Given that the total number of beats is 89, a Fibonacci correspondence appears where the number of elapsed beats corresponding with the series of GM points follows a Fibonacci series 1 through 55. Another Fibonacci correspondence occurs in the series of time points at GM point locations. The total duration of the movement in seconds is precisely 33.37", closely approximating the Fibonacci number 34. The subsequent series of time points for GM points 1 – 9 then also closely approximates a Fibonacci series 1 through 21.

Figure 5shows GM points in the score. As seen in Table 2 and in these score examples, the F#4-C5 tritone is a significant musical event corresponding with multiple Golden Mean points in the series. In Figure 5a), the F#4-C5 tritone in measure16 aligns with the GM point for the duration of the entire movement(GM1). The GM point for part B of the binary form also corresponds with another F#4-C5tritone in measure 18. As illustrated by Figure 5b), other instances of theF#4-C5 tritone in measures 11 and 4 align with GM3 and GM5 and additionally intersects with key structural points within the binary form, concluding part A and intersecting the GM point of canon 1 in part A.The structural significance of the F#4-C5 tritone, demonstrated here in the series of GM points, has been viewed another way in an earlier study of this movement. In a pc-set analysis of the second movement, Catherine Nolan determines that the initial 3-5 (016) trichords in measures 3 and 4—which include theF#4-C5 tritone interval aligned with GM5—are the basis for the unfolding of the movement's pitch structure, with the tritone providing coherence between trichord and tetrachord sets at multiple structural levels (1995, pp. 60-63).
Other GM points in the series that do not include the F#4-C5 do correspond with significant musical events and structural points. GM2 and GM4 align precisely with the conclusion of Canon 1 and beginning of Canon 2 in part A. The time point for GM9 (.43") corresponds to the shortest musical event of structural significance; this being the anacrusis quarter-note beat (G#3-Bb5) in m.0.As such, this initial segment of duration represents the temporal cell from which the duration of entire movement expands in golden proportions.

Third Movement*Ruhig Fliessend*

The third movement of the *Variations for Piano* was actually first in the order of composition; an aspect that will be discussed in summary regarding its bearing on the types of musical events that correspond with GM points in all three movements (Moldenhauer, p. 485). The concluding movement is a set of six variations, each being eleven measures in length. As the variations are not based upon a recurring theme or melodic motive, the uniform length of the variations is considered to be a fundamental aspect of the form (Bailey, 1995a, p.56). Large-scale symmetrical structure has been noted by Arvin Klammer who suggests that the movement unfolds in an arch form delineated by the textural contrasts within the six variations (1959, p. 83).Textural contrasts in terms of pitch organization are a principal method for variation and also serve as a means toward establishing large-scale formal unity. Webern groups pitches as either isolated single notes, linear dyads, vertical dyads, vertical trichords belonging to set 3-5 (016) or patterned combinations of these groups.

Table 3 lists the recursive series of GM points for the duration of the entire movement. As in the first and second movements, GM points here also frequently correspond with the location of tritone intervals. Five of the eight GM points in the movement's series of nested Golden Sections correspond with the location of tritone axes between row hexachords. Five of these axial tritones are C-F#, the interval which corresponds most often with GM points in the previous two movements. Figure 6 shows GM4 through GM8 in the score, all of which are all located within Variation 1. The C-F#tritones in measures 3 and 10 have dual significance as they not only correspond with GM points 4 and 7, but align with the GM points for the duration of rows P0 and R0. GM points 5 and 8 correspond with rhythmic palindromes within Variation 1. Klammer's analysis demonstrated that Variation 1 includes a series of rhythmic palindromes patterned in quarter-note values as 4-1-1-4 and 3-1-1-3 (1959, p.83). GM points 5 and 8 are located at the end points for the two 4-1-1-4 palindromes initiating rows P0 and I0. GM 5 additionally bisects the variation's palindrome dynamics: *p – f – p - f / f – p – f – p*. These palindrome correspondences are illustrated in Figure 6. GM8 corresponds with the end of the opening rhythm palindrome (mm. 1-2), and represents the duration of the temporal cell from which the movement unfolds as a series of nested Golden Sections.

Table 4 lists GM points within the variations. Figure 7 shows the location of these GM points in score with their corresponding musical events. In five of the six variations, GM points correspond with the location of tritone intervals. Four of these tritones are row axes. The tritone at the GM for Variation 2 occurs differently through the close proximity of disjunct row members 4 (C) and 8 (F#) within the row RI1. Three of these five GM point tritones involve C-F#. The importance of this interval within the golden structure of the movement is evident in the fact that seven of the fourteen GM points listed in Tables 3 and 4 correspond with the location of C-F# tritones. As with GM 4 and GM7 in Table 3, the C-F#tritone in m.7 has structural significance at multiplelevels as the GM point for Variation 1 and the GM point for the duration of the row I0. The Db/C#-G tritone—while not as prominent in the golden structure as the C-F# interval—has significance as the interval at GM points for Variations 3 and 6, and the interval located at the GM point for the entire movement (GM1). The GM point for Variation 4 is the only one which does not correspond with a tritone interval. Variation 4 consists of three palindromes—two are exact in both pitch and rhythm, the third is exact in rhythm only. The particular significance of the GM point for Variation 4 is its location precisely at the axis of the central I8/RI8 palindrome.

Summary

Soon after completing the third movement variations of Op. 27Webern wrote, "During the last few weeks I was uninterruptedly at my work and now see that the *variations go on further*, even if they turn into movements of the most diverse types."(Moldenhauer, p.482).Webern's observation offers insight into those aspects of form which provide large-scale unity between movements. Here the order of the movements as composed—third, first, second—becomes an important consideration. As Webern suggests, the organization of pitch, rhythm and other parameters that serve to differentiate the formal characteristics of the six variations are further developed within the following ternary- and binary-form movements. The pitch and rhythm palindromes featured most notably in Variation 4 can be seen as the basis for the ten palindrome canons comprising the first movement. The grouping of pitches as primarily dyads and trichords is central to the rhythmic organization of both the first and second movements. The 3-5 (016) trichord—a vertical sonority present within Variations 3, 4 and 6—appears as the only vertical sonority within the second movement and, as viewed from Nolan's pc-set perspective, is seen as the trichord from which the movement's hierarchical pitch structure unfolds. The palindromic ordering of dynamics seen in Variation1 is also found within the first movement, where dynamic palindromes appear within five of the six canons in section B of the ternary form.

Significant inter-movement connections are present as well in relationships between the golden structures of each movement. Variation 1 consists of three presentations of prime rows, P0-I0-R0. The C-F#axes between row hexachords in these rows correspond with GM points at multiple structural levels. The C-F#tritone is the musical event that corresponds most often with GM points in the variations; one half of the GM points within the third movement correspond with this interval. It has been demonstrated that C-F#tritone correspondence with GM points is also a significant aspect in the golden structures of the first and second movements. Of the 36 GM points discussed in these three movements, 21 (58%) correspond with the location of tritone intervals. Of these, 29 tritone correspondences, 14 (66%)are C-F#tritones. The frequent patterned correspondences between the C-F#tritones and GM points not only articulates temporal organization in golden proportions, but also demonstrates Webern's means of integrating temporal structure with the structures of other parameters through associating GM points with the interval that lies as the axis of the prime row and proves most significant to the horizontal and vertical symmetries derived from that row. Other types of correspondences include GM points aligned with the beginning or ending of row canons, intersecting rhythm or dynamics palindromes, appearing at locations of significant dyads, rhythmic figures, and intersections between two GM points at different structural levels.

Conclusion

The analysis shows that durations within each movement of Op. 27 are structured as nested series of Golden Sections with GM points aligned with the location of significant musical events. As a result, large-scale temporal organization within movements is unified as a hierarchical network of interconnected Golden Sections. Furthermore, correspondences between GM points and other musical events contribute to achieving large-scale, comprehensive unity through connections between temporal organization and that of other musical parameters.

It appears that Webern did not directly reference golden proportions as a compositional method in any of his public or private writings.

The complexity of golden structures in Op. 27 and the consistency with which GM points correspond with significant musical events and patterns of events does provide compelling evidence that Webern consciously and systematically organized series of durations according to golden proportions. Webern's reticence on the subject should not discourage ongoing study of temporal organization in his music. The substantial body of literature on Webern and his music attests to the fact that much has been and continues to be mined from his music that was not addressed directly by his words or is not readily-apparent in his scores. In his comments at the close of his series of lectures on *The Path to Twelve-Note Composition* Webern acknowledges as much as points to the need for further study of his music:

Here there's certainly some underlying rule of law, and it's our faith that a true work of art can come about in this way. It's for a later period to discover the closer unifying laws that are already present in the works themselves. (1963, p.56)

Considering the complexity of the networks of golden proportions evident in the *Variations for Piano*Op. 27, it is likely that Webern's method of temporal organization by golden proportions developed throughout his twelve-tone period and may extend to include a larger number of his serial works. An expanded study could potentially reveal an evolutionary process in which his larger body of work shows increasing sophistication in techniques for integrating Golden Sections within his music.

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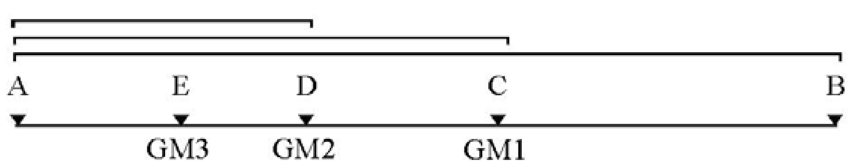
a) Golden Section AB with Golden Mean (GM) Point C



AB:AC = AC:CB = AC:AD = AD:DC = AD:AE = AE:ED = 1: .618034

b) Series of Nested Golden Sections AB, AC, AD

Figure 1: a) Golden Section; b) Series of Nested Golden Sections

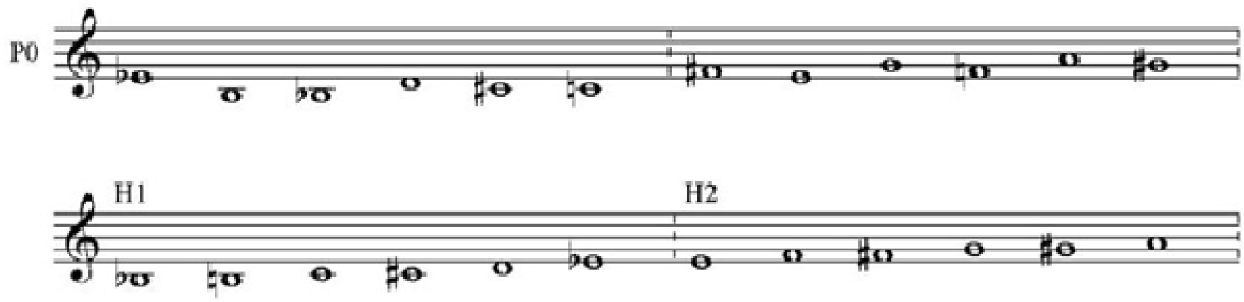


Figure 2: P0 Row and Hexachords (H1 H2) as T6 -related Sets 6-1 [012345]

Table 1: FirstMovement: GoldenMean Points for the Duration of the Movement

Total Duration: 81.00”

Golden Mean Points		Locations	Events
GM1	50.06”	m.34	focal point, *ff*
GM2	30.93”	m.21	palindrome axis RI1/I1
GM3	19.12”	m.13	palindrome axis R8/P8
GM4	11.81”	m.8	palindrome axis RI8/I8
GM5	7.30”	m.5	palindrome axis R8/P8
GM6	4.51”	m.3	palindrome axis R8/P8
GM7	2.78”	m.2	end openingtrichord (dux)
GM8	1.72”	m.2	end openingtrichord (comes)

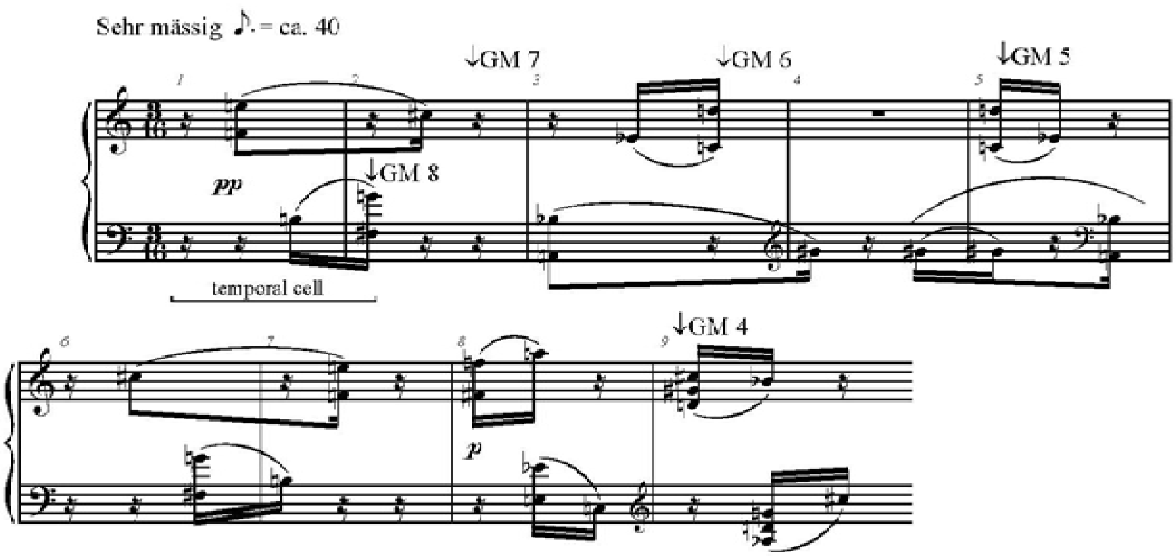


Figure 3: First Movement: Golden Mean Points 1 – 8 in Score

Table 2: Second Movement:Golden Mean Points for theDuration of the Movement

Total Duration: 33.37” Total Number of Beats: 89

Golden Mean Points		Beats	Locations	Events
GM1	20.62”	55	m.16 (B1)	F#4-C5 dyad, R2-RI10
GM2	12.74”	34	m. 6a (A2)	B2-G6 dyad, RI0-R0; ends Canon 1
GM3	7.87”	21	m.11a (A1)	C5-F#4 dyad RI5-R7; ends section A, Canon 2
GM4	4.86”	13	m.6b	D3-E6 dyad, RI5-R7; begins Canon 2
GM5	3.00”	8	m.4a	F#4-C5 axis, R0; intersects GM for Canon 1
GM6	1.85”	5	m.2b	B2-G6 dyad, RI0-R0; focal point in Canon 1
GM7	1.14”	3	m.1b	axial pitch A4, comes (R0)
GM8	.70”	2	m.1a	axial pitch A4, dux (RI0)
GM9	.43”	1	m.0	G#3-Bb5 dyad;duration of anacrusis

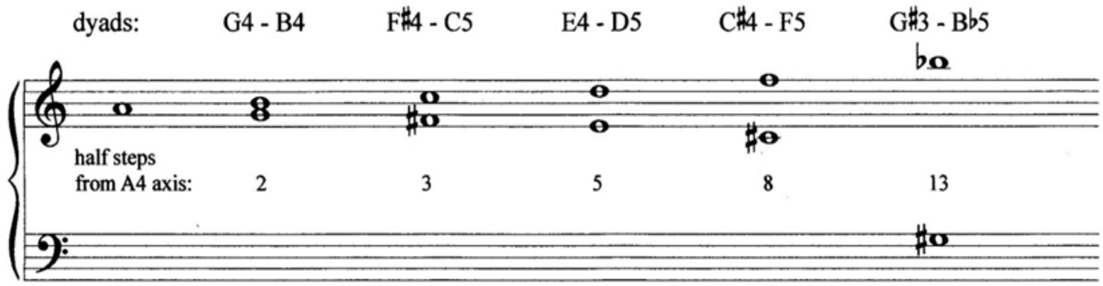
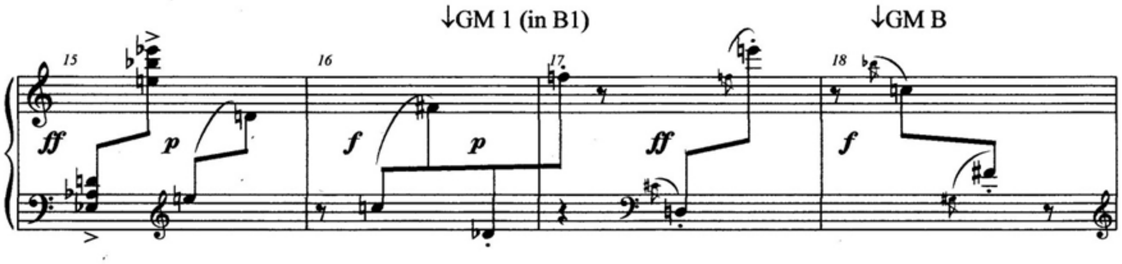
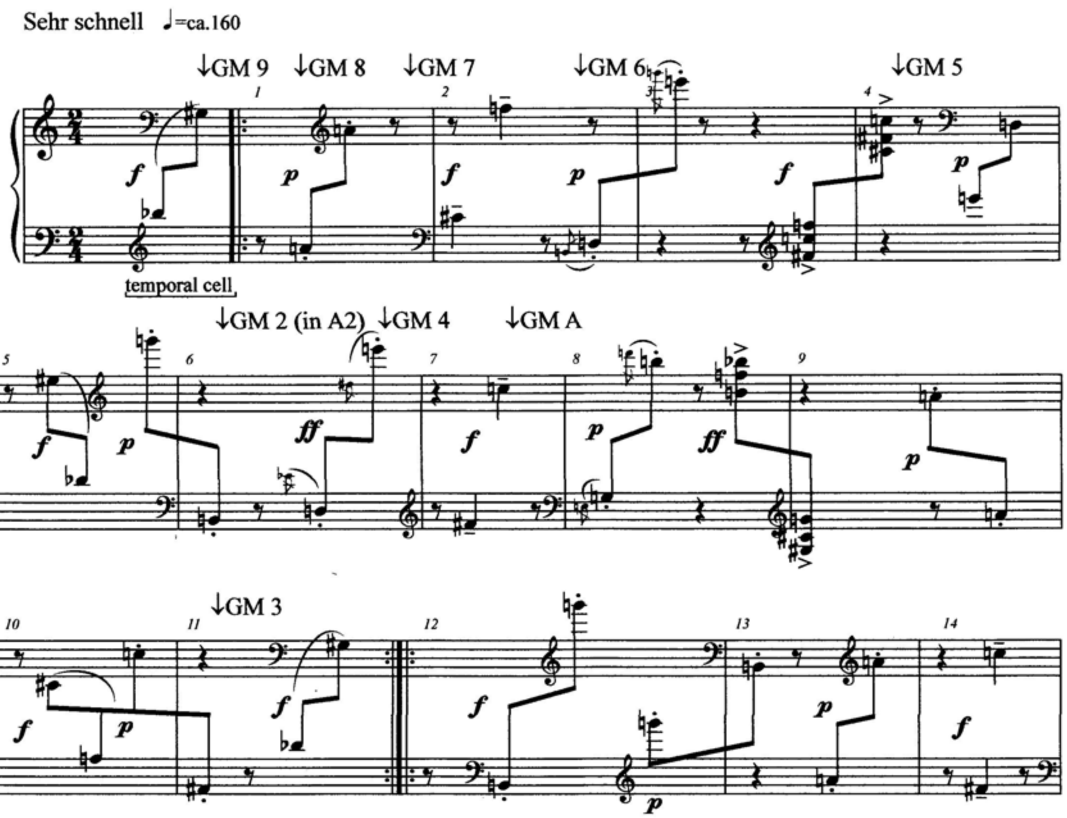


Figure 4: Second Movement: Dyad Intervals in Fibonacci Series



a) Second Movement: Golden Mean Point 1; Golden Mean Point for Part B



b)Second Movement: Golden Mean Points 2 – 9; Golden Mean Point Part A

Figure 5: Second Movement: Golden Mean Points in Score

Table 3: Third Movement: Golden Mean Points for the Duration of the Movement

Total Duration: 148.50”

Golden Mean Points		Locations	Events
GM1	91.77”	m.41 (Var.4)	G#-D axis RI8
GM2	56.72”	m.26 (Var.3)	C-F# axis R6
GM3	35.05”	m.16 (Var.2)	C-F# axis P0
GM4	21.66”	m.10 (Var.1)	C-F# axis R0; GM for row R0
GM5	13.39”	m.7	ends rhythmic palindrome in I0; bisects dynamics palindrome in I0; GM for row I0; intersects GM1
GM6	8.27”	m.4	F6, focal point of Variation 1
GM7	5.11”	m.3	C-F# axis P0;
GM8	3.16”	m.2	GM for row P0; end rhythmic palindrome

III

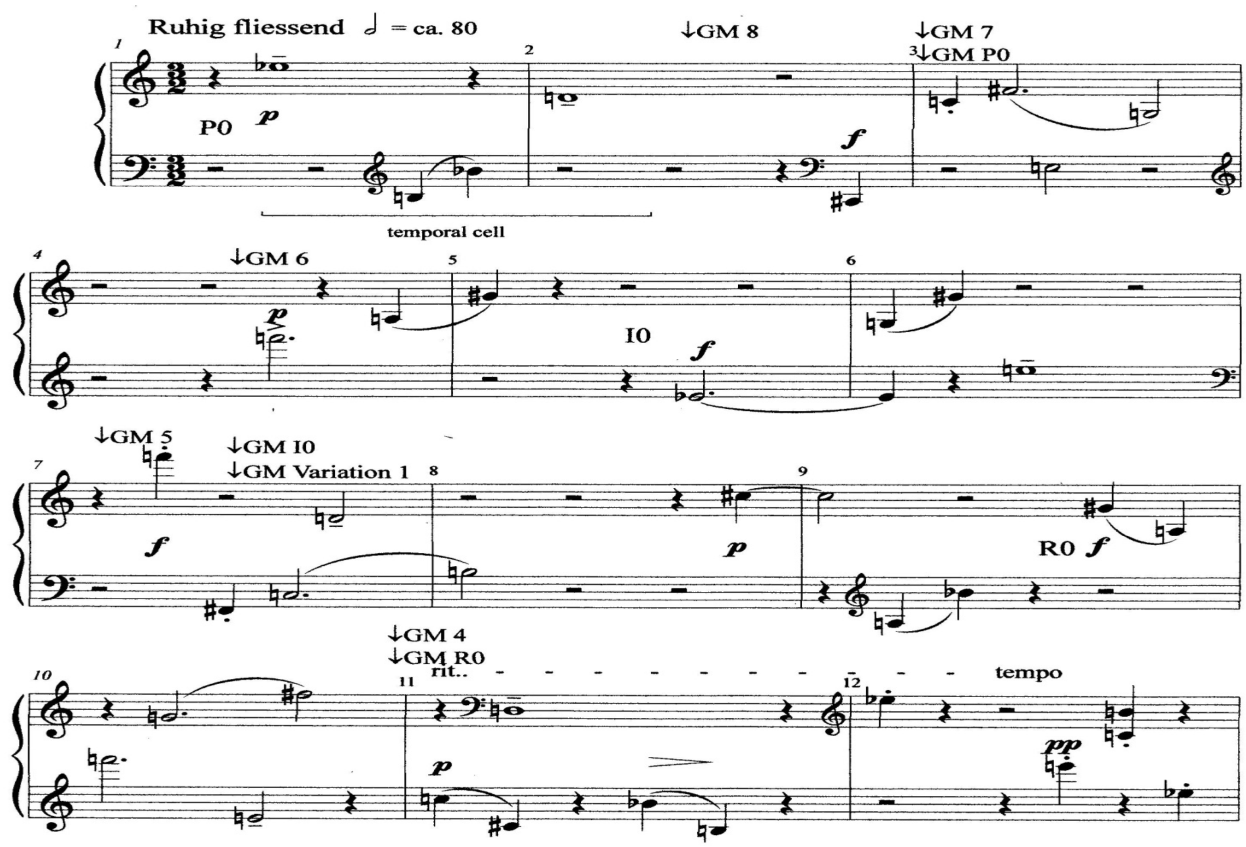


Figure 6: Third Movement: Golden Mean Points 4 – 8 in Score

Table 4: Third Movement: Golden Mean Points in Variations

Golden Mean Points Variation		Locations	Events
1 (24.75")	15.29"	m.7	C-F# axis I0;intersects GM for row I0
2 (24.75")	15.29"	m.18	C-F# interval in RI1, (pcs 4,8)
3 (24.75")	15.29"	m.29	G-Db axis R1
4 (24.75")	15.29"	m.40	F#4 palindrome axis I8/RI8
5 (24.75")	15.29"	m.51	C-F#axis P6
6 (24.75")	15.29"	m.62	C#-G axis RI1

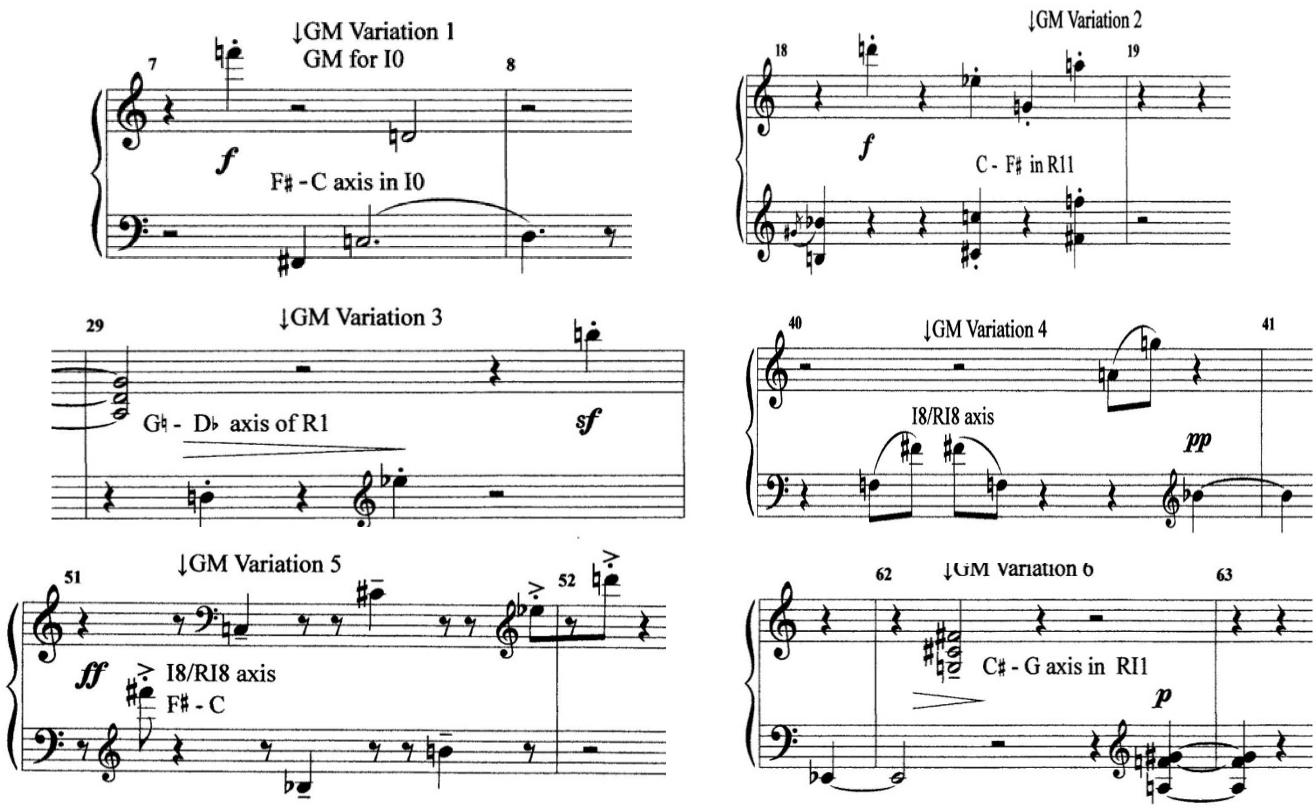


Figure 7: Third Movement: Golden Mean Points in Variations 1 - 6