Overview of Pitch and Time Organization in Stockhausen's *Klavierstück* N.9

(Ending Section)

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Abstract

The *Klavierstücke N.9* by Karlheinz Stockhausen, with its "characteristic repeated chords, obsessive trills and peculiar ending, is a highly characteristic and unmistakably idiomatic piece. Composed between 1955-1961, the piece exemplifies the composers intensive researches specially in the field of musical time.

Those researches on musical time and our perceptions of it have been the subject of a very important and highly controversial article published on Vol.3 by *Die Reihe*[1]: *"How Time passes"*.

The actual compositions, directly connected with the article and all composed simultaneously are *Zeitmasze*, *Gruppen*, and *Klavierstück XI*. However in *Klavierstücke N.9* there are precursory signs on the same line of thinking.

This line of thinking will lead in the article and the musical compositions created around it to some interesting refreshing concepts: among them a scale of twelve tempos analogous to the twelve pitches of the chromatic scale; a technique for creating durations similar to the overtone series; the idea of relating the musical (large-scale) form to metric (duration) proportions[2]

The article was unique and probably the first in 1957 to investigate the *perception* of musical time and to suggest new techniques for handling the musical time. "The temporal organization of musical elements"[3] has never been studied, at least never so thoroughly. Musical rhythm was never processed in such a way.

The piece makes extensive use of the Fibonacci series in which each element is the sum of the two immediately preceding it. Those numbers are specially used in tempo and time (rhythm) relations. It also uses arbitrary sets in use a fundamental rhythmical concept probably best defined by Pierre Boulez: *temps strié - temps lisse*.

Temps strié: will be only incompletely translated as "pulsated time". The original meaning of the term is wider than that, it includes but is not limited to pulsation. More adequately it means any rhythmical construct which

[1]This important music journal (in German) has been edited by Herbert Eimert and Karlheinz Stockhausen, and published by Universal Edition (Vienna) between 1955 and 1962 (ISSN 0486-3267).

[2]There are other ideas presented in the article but they remained mostly obscure and sterile. The concept of "statistical" musical composition; the concept of "action duration" and the associated "variable form"; the notion of "directionless temporal field" and with it, the "polyvalent form" (Stockhausen Texte 1:99139).

[3]and this is not a fancy way of saying "rhythm". It rather encompasses concepts like "density of events" and how our perception of the time-flow of the music can be modeled.

can be measured, compared, referenced through a clearly defined basic unit or pulse. This is similar to a drawing on a quadrillated paper, while *Temps Lisse* is literally "smooth time", when there is no clear reference beat or pulse. These opposing concepts are clearly exposed in the beginning of the piece; the starting bars (1-3) with the equally spaced "pulsated" chords followed by the "smoothed" chromatic line motif at bar 4.

Regarding pitch organization, this piece clearly demarks with serial techniques especially by making abundant use of repeated identical chords, creating pitch reference axis by prolongation. This feature may even be called to be the "motto" of the piece.

This paper will however concentrate on the ending part, the *coda* of the piece. Specifically, starting from the third bar of the page 6 of the score.

The Pitch Space Organization of the Opening Measures

"The Chord

To get material, pitch-sets and "themes", for analyzing the *Coda*, one should have first some information on the main constituting elements of the piece. Those are clearly set in the opening bars.

Klavierstücke N.9 starts by a large diminuendo on a 140 times repeated chord, 139 eights and one dotted quarter, from ***ff*** followed by ***f*** to ***pppp*** at 160MM for a eight note.

Figure 1: The "chord" of the piece. This figure is creating both a central pitch axis by repetition and prolongation and a time pulse. Both elements will be of "kinetic" use throughout the piece.

As it will be seen soon, the time pulse of 160MM and therefore the accuracy in performance of that precise tempo indication is of a crucial importance for the structural integrity of the piece. The ratio 160BPM/120BPM (or 160BPM/60BPM), which is 2/3, will be used extensively throughout the piece.

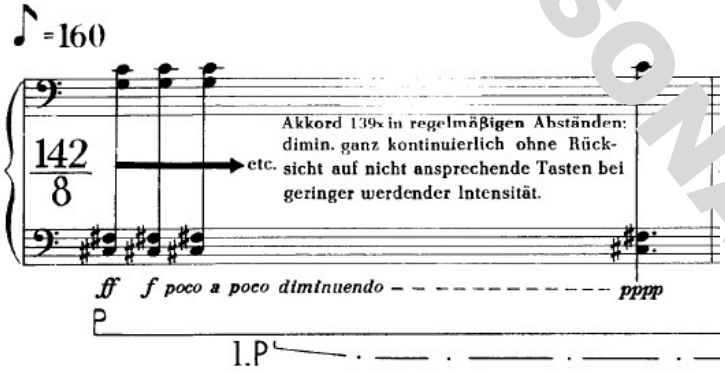


Figure 2: Pitch "axis" created by repetitive prolongation and time pulse set by regular attacks at 160MM.

To count the number of repeated chords in this analysis there was a decision to take in the first bar. Shall one count 140, which is the correct

number of chords: 139 time eight notes and one dotted quarter note or shall we take the number 142 from the time signature (142/8) as a "fake" (virtual) number of chords?

I think there is a subtle notational effect in here. The *diminuendo* is so long and goes so far ***pppp*** that I believe the last dotted-quarter chord is supposed to "sound" as if there were still three (more) eight-note chords yet imperceptible ones.

In live performance, if played well, the effect is (or should be) as if there are still three more repeated chords at the end of the bar, but so softly played that they are almost unheard...

Of course this may seem, and probably is, rather a subjective interpretation of the musical text; however the repeated chords all through the piece always appear as a succession of equal rhythm values and never with a "stop" as notated in the first bar.

The importance of this point is that if we assume there is actually 3 very-very soft (suggested but not actually played, "unheard") chords in the space of the last dotted-quarter, we get 142 for the number of attacks for the first bar and we shall base our numerical relationships analysis on that first number. That is the option I will take for the present paper.

However the stop with a dotted quarter note seems structural if we consider the connection to what may be called the "secondtheme" (bar 3).

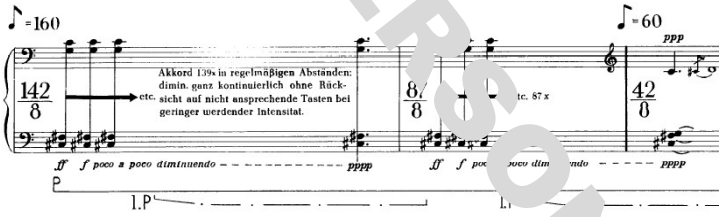


Figure 3: Releation of the last dotted-quarter chord at the end of the first bar with the same value (dotted-quarter) at the beginning of the third bar. However the tempo is not the same.

The "thematic chord" of the piece is a well-known and widely used aggregate. The PC-Set Prime Form: (0,1,6,7), Forte Code: 4-9 with Interval Vector: [200022].

One cannot miss the connection of this PC-Set with the beginning of Alban Berg's op.1 Piano Sonata.

In the second bar we have 87 chords with the same dynamic span. The time-length relationship between those two bars are 142/87 = 1.63218... A number very close to the golden ratio (1.618..)

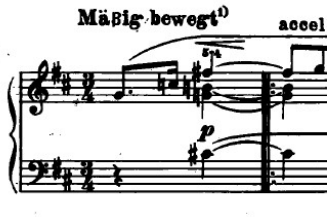


Figure 4: A. Berg's op.1 Piano Sonata (beginning).

The "Second Theme"

The third bar presents a very interesting setting of a straight chromatic scale.

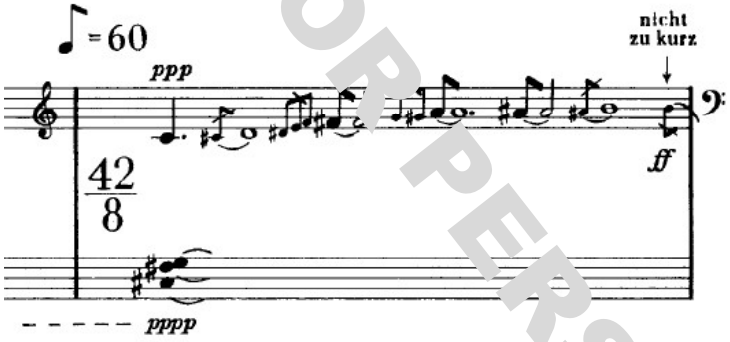


Figure 5: This may be called a sort of second theme in a sense that it presents a totally contrasting idea

From the point of view of pitch-space organization, there are here many points to note.

The line is a straight chromatic one with "stops" at pitches D, E♭, A, A♯ and B. Those are PC-Classes: 2,6,9,10,11. The gaps between them are filled with grace notes.

Those lasting "main" notes form the PC-Set (0,2,3,4,5,8), Forte Code 6-Z39, interval vector: [333321].

This set, (023458), has no common tone with the set of the previous chord (0167), and their interval vectors [200022] and [333321], even though they have common values[1], present very different characteristics.

[1] IC-1: 2 and 3; IC-5: 2 and 2; IC-6: 2 and 1

Specially on IC's 2-3-4[1] "the chord theme"s interval set has all 0's and while the "second chromatic theme"s set has all 3's.

In this beginning the composer presents us with two completely contrasting ideas. From the point of view of pitch organization, the first idea of a repeated chord affirms a strong reference sonority and prolongation with PC-Set (0,1,6,7) while the second "theme" (or idea) creates a "smooth", unmeasured-like sound-space[2] by delicately underlining PC-Set (0,2,3,4,5,8) from within a chromatic scale.

Time Organization in the Opening Measures

In the presentation of the two main musical ideas, at the beginning of the piece, the contrast in time organization is even more accentuated than the pitch differences.

With 1 for an eight-note, the durations of the second theme notes form a series: [3-8-5-13-5-8] if we consider the first "3" we have a perfectly symmetrical Fibonacci series: 8 (+) 5 (=) 13 (-) 5 (=) 8.

On one hand the omission of the dotted-quarter note in the beginning of the third bar as shown above, may suggest that this note (chord), which is identical to the opening one, is a part of the preceding bar, thus it makes a connection with the last chord of the first bar, on the other hand the duration (3) of that chord also fits in the Fibonacci series above.

Duration and tempo relations for the first 3 bars of the composition can be summarized as follows:

In the "Duration in 8th." column the symmetries: 139 - 3 / 87 - 3 and 8 - 5 - 13 - 5 - 8 are clearly visible. Furthermore if as explained in section : **??** we count 142 attacks for the first bar and compare this to the length of the second bar; 142 by 87 we get the ratio : 1.6321839080459770117 an irrational number interestingly close to the Golden Ratio...

This first part of the composition is now continued by an interesting series of the same chord and silences:

The row created by the repetitions of the chord and the silences in between is worth noting: [13-2-21-8-1-3-8-1-5-13-2-5-3]. This is actually a shuffled Fibonacci series: [1-2-3-5-8-13-21].

With these constituting elements we can now get to the point of this paper which is the *Coda* of the piece.

[1] Maj.2d, Min.3rd., Maj.3rd.

[2] *Temps Lisse*

Pitch	Rhythm	Dur. in 8th.	Dur. in msec.
Chord	Eight	139	375 * 139 = 52,125
Cl[illegible]	Dotted-quarter	3	375 * 3 = 1,125
C[illegible]hord	Eight	87	375 * 87 = 32,625
Chord (N[illegible])	Dotted-quarter	3	3,000
Note [illegible]	Whole	8	8,000
Note F♯	Eight+half	5	5,000
Note A	D[illegible]tted-whole+eight	13	13,000
Note A♯	Eight+half	5	5,000
Note B	Whole	8	8,000

Figure 6: Comparing the notated durations and actual sounding durations of [illegible] elements in the first 3 bars

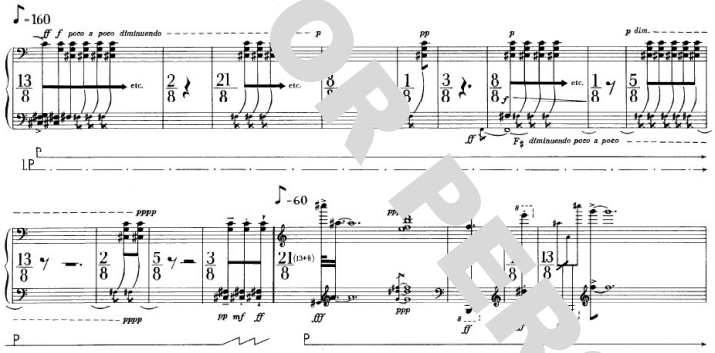


Figure 7: The continuation part of the chords theme [illegible] interestingly sectioned way. Note the prolongation of [illegible] F♯

Overview of the Ending

From the notation we see three kind of notes in this section:

Normal Notes As in the music, regularly fitting in the bar, note-[illegible]A;

Normal-size notes within grace-note groups Note-type B;

Grace-notes groups Note-type C;

Beside that there is an aggregate (chord), gradually created in the low range of the instrument. This can be thought like a pedal chord [E-B-A♯] which is to be sustained until the end of the piece. This aggregate, the PC-Set Prime Form: (0,1,6), Forte Code: 3-5 with interval vector: [100011] is a subset of the first chord (see fig. 2

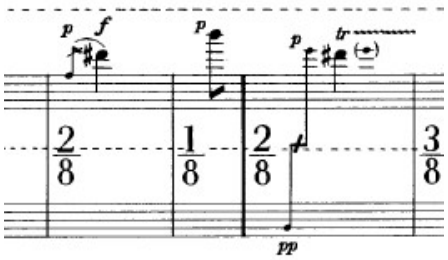


Figure 8: Coda note-type A: Normal-size notes with "normal" time-span. Any dynamic can be applied to them but they are mostly in the ***mf-ff*** range.

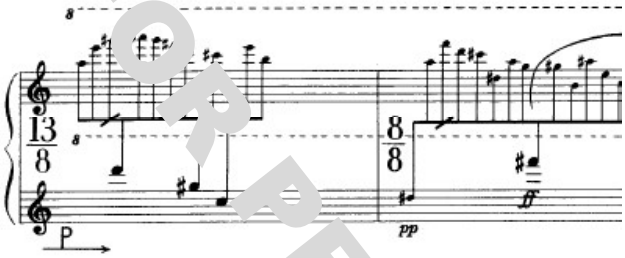


Figure 9: Coda note-type B: Normal-size notes within grace-note groups. These are clearly notated to be played ***mf-f-ff*** by the composer's explicit note: Dicke Noten ***mf,f,ff***.

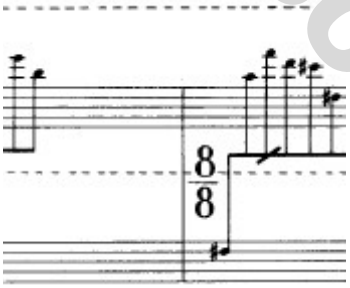


Figure 10: Coda note-type C: regular grace-notes. These are also explicitly noted to be played in the range ***ppp-pp-p*** (kleine Noten ***ppp-pp-p)***

The perceptibility of this last "chord" is created by the dynamics ***mf ff*** and ***f*** the range contrast (low to extreme low compared with the other notes

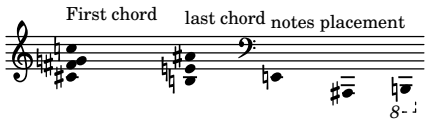


Figure 11: Comparison of the "chords" at the beinning and the end of the piece.

in the section) and the resounding effect of the sustain pedal in that range.

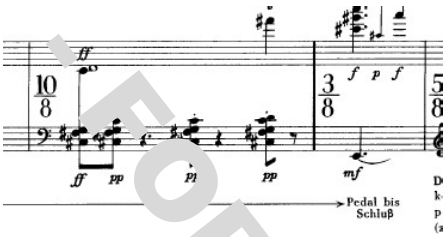


Figure 12: First pitch of the pedal-aggregate 0,1,6 note: E with the piano's sustain pedal noted to be kept depressed until the end

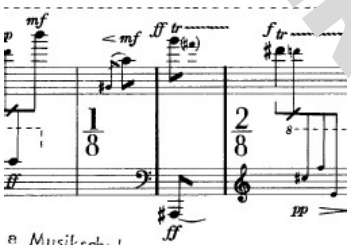
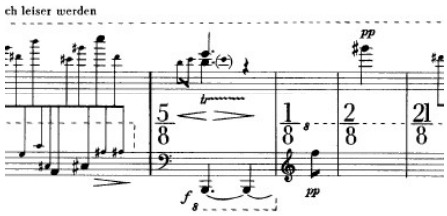


Figure 13: Second constituent of the pedal-aggregate 0,1,6 note: A♯

Pitches as Groups of Grace-Notes

In this section the ending of the piece is examined bar by bar. The division in bars in this section of the piece is structurally significative because it presents groups of grace-notes with varying time-intervals between them. The speed of the groups of notes and the evolution of the "waiting" times between each group is the subject of the next section.



Figur Third constituent of the pedal-aggregate 0,1,6 note: B

Bar 1 of the *Coda* (measure 3, page 6

The first group of notes-bar starting the *Coda* section shows a clear analogy to the second "ther of the piece (see Fig. 5): The analogy is obvious

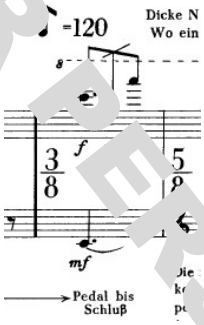


Figure 15: First group of notes i th *Coda*

when comparing the PC-Set of this bar (all notes take s equal in weight) which is: (0-1-2-4-5-8), Forte-Code 6-15, interval vecto 421] with the "long" lasting "main" notes of the "second theme": the PC et 0,2,3,4,5,8, Forte Code: 6-Z39, Interval Vector: [333321]. See fig.5, page

Bar 2 of the *Coda* (measure 4, page 6

The second group, set in a bar of 5/8 duration[1] forms the PC-Se 1-2-4-8), Forte-Code 5-13, interval vector: [221311], this is a subset of the previous bar.

[1]note the duration is a step in the Fibonacci series: 1-2-3-5...

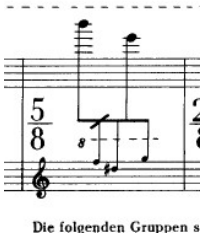


Figure 16: Second bar of the ending section, a subset of the previous bar

Bar 3 of the *Coda* (measure 5, page 6

This third bar is one of the longest of the section: 21/8[1], note that the notes are to played as fast as possible but gradually slowing down, and one must wait for the remaining time of the bar throughout the section.

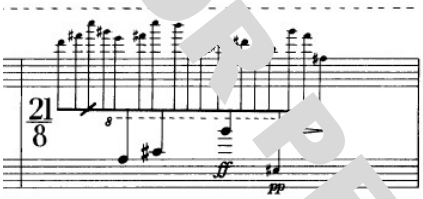


Figure 17: One of the longest bars in Bar:3

The pitches are presented here transposed down one octave with duplicates removed, in three groups. Group one is the grace-notes:

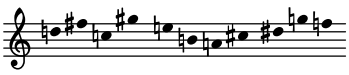


Figure 18: Pitches series:1. Grace notes (all played **pp**)

The second group of notes is the full-size notes, to be played ***mf,f*** of ***ff***:

A table presenting the notes used and their relative weights displays interesting results. In the first row are the twelve pitches. Each pitch-class has a $*$ for each time it is played as a grace-note and a $\bullet$ when played as a regular-note.

[1]The last step in the Fibonacci series used in the composition: 1-2-3-5-8-13-21

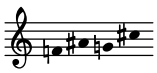


Figure 19: Pitches series:2. Full size notes (all played **mf** to **ff**)

C	C♯	D	D♯	E	F	F♯	G	G♯	A	A♯	B
**	**	**	*	*	●*	***	●*	*	*	●	**

Figure 20: Relative weights of all the notes of the 21/8 bar.

There are interesting points to note in this table. Considering the grace-notes only, pitch-classes **C** and **F♯** are most repeated ones, three times each. There are closely followed by **C♯**, **D** and **B**. Those PC-Classes form the set: Prime Form (0,1,2,3,7) Forte Code 5-5, Interval Vector: [321121].

This set is related to the one of the first repeated chord: (0,1,6,7) and have related ones in many structurally characteristic places throughout the piece. Here are some examples:

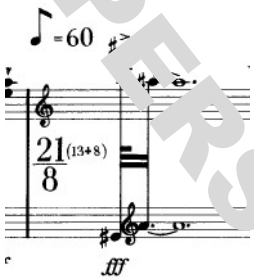


Figure 21: Set (0,1,2,5) at bar: 17

However, the "weighted" pitch-classes stated above, **C-F♯-C♯-D-B** are most clearly heard just before this *Coda* section in two different ways.

First it is stated as a chord:

Then slightly modified, as PC-Set (0,1,2,6,7) Forte Code 5-7, Interval Vector: [310132]:

Bar 4 of the *Coda* (measure 6, page 6)

This bar is one of 13/8 length which is the previous step from the last in the Fibonacci series used: 1-2-3-5-8-13-21.

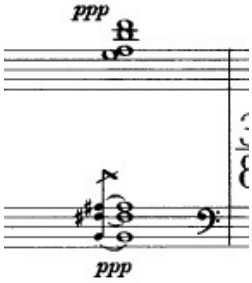


Figure 22: Same bar (7) a super set of the previous one, (0,1,2,3,4,5,8), played **ppp** as a modified "echo" of the previous **fff** notes. See fig.21

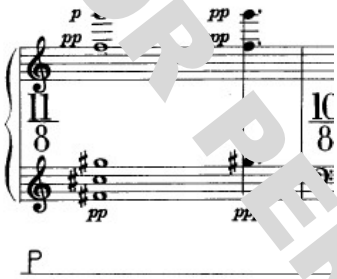


Figure 23: Set (0,1,2,3,7) played as a chord

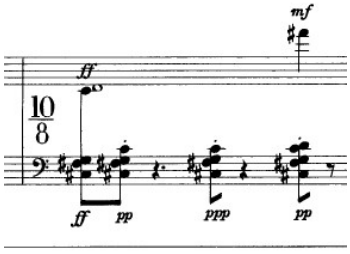


Figure 24: Chord, set: (0,1,2,6) related to the opening chord (0,1,6,7) and very close to the preceding one (0,1,2,6,7). Note the emphasis on **F♯**

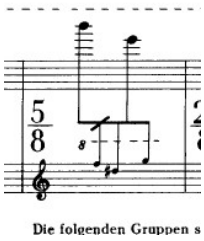


Figure 25 Second bar of the ending section, a subset of the previous bar

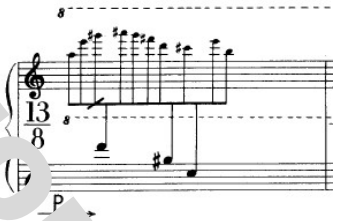


Figure 26: Bar:4 of the *Coda*

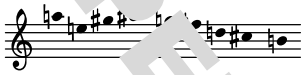


Figure 27: Bar 4 of the *Coda*. Pitches s.ri.. Grace notes (all played **pp**)

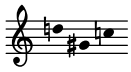


Figure 28: Bar: 4. Full size notes (all played ..o **ff**)

C	C♯	D	D♯	E	F	F♯	G	G♯	A	.♯	B
•	*	•*	(none)	**	(none)	*	*	•*	*	*	*

Figure 29: Relative weights of the notes of the 13/8 bar.

In analyzing first the most weighted notes **C,D,G♯**, notated as ..n-size note-heads one can not miss the analogy with the initial chord of t.. piece**C♯,F♯,G,C**. The sets for the first chord of the piece and this passage being respectively (0,1,6,7) and (0,2,6) present analogy even though their

interval vectors are somehow different: [200022] [010101]. This analogy is seen best when the two chords are displayed next to each other in their most compact form:

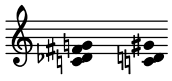


Figure 30: The first chord of the piece compared to the one notated in full-size note-heads at bar 4 of the *Coda*

In another display, when the chords are "expanded" into their form as used in the piece the second chord is seen like an "expansion" of the first:

Figure 31: The first chord of the piece compared to the one notated in full-size note-heads at bar 4 of the *Coda*

The pitches notated as grace-notes display interesting analogies with previously heard elements too.

All pitches (see fig.27, page: 12) form the PC-Set (0, 2,3,4,5,7,8,10) with Forte Code: 9-7 and the interval Vector: [677673]. But the way those pitches are segmented is very interesting from the point of view of the structural integrity of the piece.

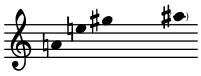


Figure 32: First segment, bar:4, PC-Set: (0,1,5) without the **A**♯ in parenthesis and PC-Set: (0,1,2,6) with the **A**♯

In fig.32 we have the same interval content as the first chord of the piece. All the notes of this bar can be segmented in several ways with or without the full-size notes of the left hand and the resulting sets can be examined and compared to the first chord of the piece.

Pitches in the Remaining Bars of the *Coda*

The remaining bars of the *Coda*, from the point of view of pitch organization can be similarly analyzed. One crucial point in here should be the separation of the grace-notes sized notes with the full-sized ones.

These "parts"(grace-notes and full-size notes) can (and probably should) be examined both as different "voices" for the PC-Sets emerging by connecting even distant full-size note-heads but also as a kind of "PC-Set Polyphony" to display how two different sets are sounding simultaneously because they are clearly set apart by dynamics and texture.

For example connecting notes notated at the same or close dynamic levels (i.e. ***f*** and ***ff*** reveals structural points worth noting.

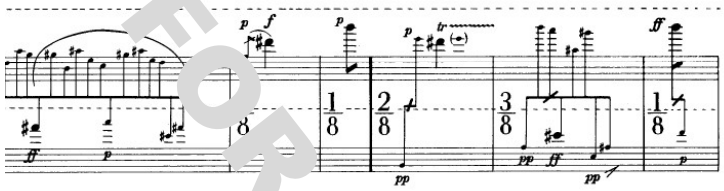


Figure 33: Connecting the notes played **f** or **ff** reveals interesting structures.

The sets are all centered around PC 6 thus emphasizing the tritone and building around with minor-major seconds. This creates a continuity by referring to the sound of the first chord which has been set through repetition and prolongation and a central reference sonority in the piece.

Time Organization in the *Coda*

The instructions for performing this *Coda* are very peculiar: the "small" notes are to be played as fast as possible but one must wait for the remaining time of the bar before proceeding to the next but at the same time towards the end the speed of those "small" notes must decrease, they must go slower and slower yet the tempo of the beat duration which affects the elapsing time of each bar should not change.

The schematic view of the bar-lengths are as follows:

$3-5-21-13-8-2-1-2-3-1-5-8-3-2-1-1-2-$
$1-3-2-5-1-2-5-3-8-13-5-1-2-21-3-13-8-$
(ending bar until the sound dies)

All values are from the Fibonacci series:

$$1 - 2 - 3 - 5 - 8 - 13 - 21 - 34$$

This schematic view can be sectioned as sub-groups in several ways. There are some centers of symmetries around some values.

A graph view of the bar-lengths displays a beautiful, semi-symmetrical shape and helps to spot symmetry axis, there are several.

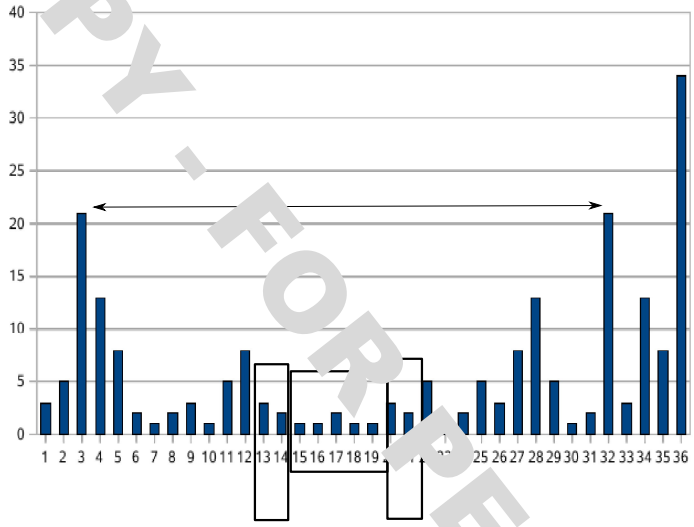


Figure 34: Graph view of the length of each bar and some symmetry points outlined of the *poco*

In the time organization domain, one particularly striking effect is created, from the 13/8 bar (measure: 28) marked "nach und nach leiser werden" : *poco a poco rall.*.

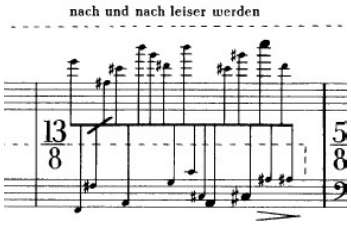


Figure 35: The bar where the *rallentando* starts

But this slowing down is for notes only, the main beat of 120BPM for an

eight note remains unchanged. One other "dimension" is changing as well, the number of notes in a bar.

The number of notes, their speed (from "as fast as possible" and gradually slo ing down), the length of each bar, they are all varying in a complex anner. The following table offers a schematic view:

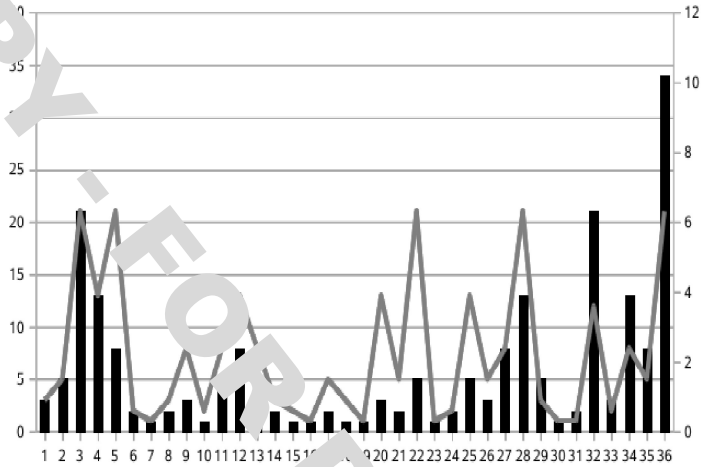


Figure 36: Number of notes compa d to the bar length in each measure. Li eas

In analyzing the number of notes versus l ar length, must take into account the gradual slowing down of the no and the trills. The graph fig.36 can only be regarded as a rough guide.

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