

# Pitch Registration and Harmonic Fields in Works of Pierre Boulez, Marco Stroppa, and Yukiko Watanabe

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ABSTRACT: This paper discusses a method for harmonic field analysis of serial and post-serial music. The method is informed by perception-oriented considerations and was specifically designed for an analysis of Pierre Boulez's early serial music. It is therefore exemplified by his 1951 composition *Polyphonie X*. Harmonic field analysis can however be applied to any music where pitch registration plays an important role. Accordingly, I will provide a brief overview of harmonic relations in two more recent compositions by Marco Stroppa and Yukiko Watanabe, demonstrating that harmonic fields have been used by composers to mediate between the generative layers of pitch organization and the sounding surface.

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## 0. Introduction

[0.1] It is a dialectical situation: any separation between “structural” and “formal” qualities of a piece is artificial and provisional.<sup>(1)</sup> Music theorists know how closely the two domains are linked together and how problematic a distinction between them can be. But then again, assuming they are the same seems equally problematic. Serial and algorithmic music is sometimes criticized for its distinction between structure- and form-oriented compositional strategies. According to these critics, the organizational or generative procedures typical for this kind of music (which usually precede work on the actual score or soundscape) are meaningless in the sense that they cannot be perceived as part of the formal discourse.<sup>(2)</sup> For example, in an article on musical time, Gérard Grisey (1987) attacks a number of twentieth-century composers for applying organizational principles without closely considering the sounding outcome. Grisey (1987, 240) argues that such “speculations” end up “confusing the map with the lie of the land,” creating an artificial sphere that is separated from the composition itself. On a similar note, Fred Lerdahl (1992, 119) critically discusses Pierre Boulez's (1925–2016) serial composition *Le Marteau sans maître* and concludes with a normative claim: “The best music arises from an alliance of a compositional grammar with the

listening grammar.” The ideal behind these viewpoints seems to be identity: complete transparency of all generative and organizational principles to the listener as such, structure becoming form.

[0.2] In my opinion, such a perspective is reductionist on several levels. First, it arbitrarily reduces the complexity of an artistic practice to only one of many possible spaces: a composer subject who controls and shapes the listening experience via musical form. Second, it reduces the varied, mediated, and dynamic interconnections between different organizational layers to only those that are directly intelligible for the composer as well as the listener. And finally, it reduces the listening experience to a reconstruction of the compositional process. Alternatively, I would argue that each organizational principle applied to a piece of music to constitute “structure” is what one could call, following Bruno Latour (2005), an actant in a complex network that influences the sounding result with its potentials for perception as well as further compositional decisions.<sup>(3)</sup> In such a network, structure is neither identical with nor separated from the sounding result but dynamically entangled with it.

[0.3] These organizational principles act on different layers regarding the subjective agency of the composer: they can be closer to the surface and more controllable, or they can operate on a more mediated, less controllable layer. In serial music, the more hidden layers obviously play an important role. At the same time, the fact that protagonists often marginalized them as something that precedes the “actual composition”<sup>(4)</sup> shows that compositional agency toward the sounding result, in which an important task of the composer is arranging material in an audibly meaningful way, remains an essential concept.

[0.4] The distribution of pitches in register is an organizational structure that is relatively close to the surface layer. It has an immediate effect on the sounding result but can also deliberately reflect certain underlying organizational or generative structures.<sup>(5)</sup> For analysis of music that makes use of these structures, we require a method that systematically takes pitch registration into account. The method I will propose in this article can be described as a more perception-oriented take on Jean-Louis Leleu’s (2015) field analysis, shifting the focus from interval cycles to auditory streams and statistical interval accumulations. It was specifically designed for an analysis of Pierre Boulez’s (1925–2016) early serial composition *Polyphonie X* and will be presented using this composition as an example. But the method can be applied to any work of serial or post-serial<sup>(6)</sup> music where pitch registration plays an important role. In this spirit, I will provide a brief overview of harmonic relations in two more recent compositions by Marco Stroppa (1959–) and Yukiko Watanabe (1983–).

## 1. Methodology

[1.1] In his famous analysis of Boulez’s *Structure Ia*, György Ligeti (1958, 56–63) illuminates how the partial fixation of pitch registers, above a certain polyphonic density, leads to nodes in the form of repeated notes and intervals, and how, in this way, the space between decision (registration) and automatism (coincidence of serial forms) is made productive. But although Ligeti says that decision and automatism are not opposing principles, he treats them as such throughout the essay. Robert Piencikowski (1985) corrects this by illuminating the connections between register choice and serial structure. From an analysis of some of Boulez’s works, Piencikowski concludes that pitch registration is used by Boulez to bring certain characteristics of the serial structure to the sounding surface.<sup>(7)</sup>

[1.2] While Piencikowski’s merit is to tie Ligeti’s observations in pitch registration back to the serial structure of a piece, Christian Utz (2017; 2013; 2012) attempts an approach from the other side by delving into the interplay between auditory selection processes and register-related grouping mechanisms from a perceptual-psychological perspective. Taking into account the perceptual level, the interval nodes observed by Ligeti become, in Utz’s terms, *gestalt*-like, since the listener prefers to group them and connect tones with similar frequencies to each other even if they do not immediately follow one another.<sup>(8)</sup> According to Utz (2017, 4), these “*gestalt* nodes” can support hearing, even if they are not identified in an “analytical-rational sense” during listening.

[1.3] The idea of *gestalt* nodes—I prefer to call them *constellations*—brings Ligeti’s analysis together with Albert S. Bregman’s theory of auditory streaming. Bregman states that we group acoustic information according to the principle of similarity and perceive such groups as separate entities. Bregman’s observation is that the components of a group can be arranged discontinuously (1994, 47): “In this phenomenon the auditory system is grouping tones that are similar to one another in preference to grouping tones that follow one another immediately in time.” An important distinguishing feature or “cue” in Bregman’s theory is pitch. From experiments Bregman concludes that, in principle, those pitches are associated that are closest to each other in frequency (65). Later studies by several research groups have confirmed this assumption.<sup>(9)</sup>

[1.4] If a harmonic analysis of register movements can make use of these insights, then it can only do so within narrow limits. It can neither predict how exactly a particular passage is perceived—that would require a completely different, empirically oriented experimental set-up—nor do full justice to the complex interplay of disparate stimuli.<sup>(10)</sup> What it reveals are structures of pitch organization, not structures of the listener’s brain. Pitch structures characterize a piece and its poetics without necessarily being directly apparent to the listener. But at the same time, they also contain identifiable perceptual potentials. My aim is therefore to propose an analytical approach that takes the auditory level into account as a potential. This approach is oriented toward small intervals arising through pitch registration. With this orientation, it can record statistical fluctuations that might influence the perception of form.

[1.5] Jean-Louis Leleu’s field analysis is useful for this purpose. Leleu conceives more or less consistent and delimitable registral distributions (primarily of the twelve chromatic pitch classes) as harmonic fields that can extend over short passages to whole sections of a piece. Using Boulez’s *Livre pour quatuor* as an example, Leleu demonstrates the organic transitions between such fields: “It is interesting to see . . . how the different harmonic fields in this section string together smoothly, often unnoticeably, with a majority of the notes in each instance of the progression staying fixed . . .” (2015, 430–431).

[1.6] Leleu chooses a representation where the registered pitches of a given passage are placed in ascending order. In addition, each frequency has a fixed horizontal position so that identical pitches between several successive, vertically stacked field representations will share the same column. I will adopt this method of representation in examples to follow. Due to its proportionality, it allows a quick overview of the characteristics of the fields. Spread or compression, relative height or lowness in frequency, and homogeneity or heterogeneity within and between the fields can be read at a glance.

[1.7] I use the following systematic procedure to extract the harmonic fields from a given score:

1. Numbering every note with its corresponding pitch class number from 0 (C) to 11 (B);
2. Tracing each octave shift on the bottom of the page by noting the respective pitch class;
3. Identifying harmonic fields of relative consistency (ideally: no octave shifts within a field).

[1.8] Of course, the delimitation of the fields leaves room for interpretation. In Boulez, there are often clusters of register changes at the beginning of a field, which then remains constant for several bars and thus causes no problems with delimitation. Sometimes only one or two notes change quickly back and forth between the registers—in this case, I typically assume a single field (with some internal mobility) instead of many static, chromatically incomplete fields. In the Examples, I mark such octave shifts via horizontal dashes. If a note only appears within the transition between two fields (like the B $\flat$ 4 in Example 2), it is attributed to both fields. In each case, the definition of these fields must be adapted to the given piece and its particularities.

[1.9] To illustrate internal structures in his analytic reductions, Leleu connects groups of notes with beams. By doing so, he identifies and reveals interval cycles, continuing the work of George Perle.<sup>(11)</sup> Leleu (2015, 433) quite plausibly assumes that interval cycles such as stacks of fourths or thirds dispose the fields in a certain way and lead to “some remarkable configurations.” However, it also becomes clear that Boulez’s fields tend to be very heterogeneous with many small,

fragmentary, and interlocking interval cycles—or none at all. Informed by Bregman’s theory of auditory streaming, I propose an alternative interpretation of these fields. Instead of cyclic microstructures, my interpretation is more oriented toward small intervals and their statistical distributions. These distributions might influence the perception of form by giving certain sections a distinct harmonic coloring. At the same time, comparing them with the serial structure can reveal ramifications between generative background and sounding surface that other methods (such as Allen Forte’s set theory<sup>(12)</sup>) wouldn’t be able to capture.

## 2. Harmonic field analysis in the first movement of Pierre Boulez’ *Polyphonie X* (1951)

[2.1] Already as a young composer, Boulez was intuitively aware of the grouping and selection mechanisms outlined above. In a letter from March 1952, he replies to his colleague Henri Pousseur, who had been worrying about a latent C minor connection in the second piece of his *Trois chants sacrés* (see **Example 1**): “Votre impression d’accord d’ut mineur à la fin n’est que visuelle, car l’oreille entend plutôt le rapport [D3–G3–E♭4] suivi de [C2–A♭6] et pour ma part je n’en ai pas été choqué du tout.”<sup>(13)</sup> (“Your impression of a C minor chord in the end is only visual, because the ear only hears the relation D3–G3–E♭4, followed by C2–A♭6, and I, for my part, wasn’t shocked at all.”) Boulez’s grouping is consistent with Bregman’s theory: D3, G3, and E♭4 lie close together, and A♭6 and C2 are registrally isolated. The C minor chord in the last bar, spread over three octaves, would then elude the listener’s attention because its components belong to different auditory streams. Ten years later, in *Penser la musique aujourd’hui*, Boulez ([1963] 2011, 49–52) once again goes into detail about perceptual-psychological selection processes. He explains how one could make use of these, for example, to conceal octaves or diatonic chords (“accords classes,” 51). As one can see by these examples, the link between serial structures and their perceptual potential was a concern for Boulez early on.<sup>(14)</sup>

[2.2] For Boulez the choice of pitch registers is a privileged field in which the composer can play with such perceptual potentials.<sup>(15)</sup> In this function, pitch registration is far more than just a means of avoiding octaves. Instead, strategies like a constant interplay between fixed and mobile register positions become a central aesthetic idea. Boulez ([1952] 1991, 119–120) states:

There are many kinds of interference to be set up between the series itself and the register, on the basis that either of these two elements can be mobile or immobile in relation to the other. One has only to imagine the instability arising out of the relation between an unchanging series and a continuously changing register, or between changing series and a completely fixed register: the extreme points in the play of ambiguities of pitch, which may equally combine with ambiguities of rhythm or dynamics.

[2.3] Without making it explicit, this quotation describes the compositional method of Boulez’s unfinished *Première Polyphonie* (1950) with some precision. This work was planned to be the first of a series of compositions that explore the concept of polyphony—a project that due to its ambitious scale was quickly abandoned for the more manageable *Polyphonie X* (1951).<sup>(16)</sup> The beginning of this first version, *Première Polyphonie*, realizes the model of a relatively fixed pitch network for a multitude of rows running in parallel. In later sections in which only one row at a time is processed with different transpositions, movement between different registers accelerates.<sup>(17)</sup>

[2.4] In *Polyphonie X*, too, the registral distributions can be grouped into harmonic fields with varying stability. The following analysis will focus on the aspect of interval convergence (the accumulation of certain small intervals). It can be assumed that interval convergence within the fields influences the sounding result and its perception. For this reason, special attention is paid to recurring intervals and their strategic positioning (for example in the extreme positions). In a second step, I will examine how the harmonic fields relate to more hidden, row-specific background structures.

[2.5] The pitch registration of the first movement of *Polyphonie X* follows the dramatic principle of “[a]grégation et désagrégation” that Boulez already mentions in the early sketches.<sup>(18)</sup> In concrete terms, a gradual crystallization and dissolution of the tritone interval can be observed. Four stages are distinguishable and can be traced in various sections<sup>(19)</sup> of the movement:

1. interval heterogeneity or avoidance of intervals in close positions;
2. convergence of minor and major thirds;
3. superimposition of (minor) thirds and tritones;
4. convergence of tritones.

[2.6] The first fifteen bars up to the duet of the second violin and cello in m. 16 develop along these stages of interval heterogeneity to a predominance of third and finally tritone constellations. In the process, the gradual convergence of third and tritone intervals coincides with an increasing polyphonic density and, at the same time, with a shift to the lower registers. **Example 2** affords us a closer look at the three harmonic fields in mm. 10–15.

[2.7] As one can see, the register dispositions are relatively unstable, with only one pitch class (B) remaining in a single octave position over the whole six bars and two or three additional pitch classes that stay in their position between two fields (see vertical dashed lines). On top of that, B $\flat$  keeps changing its octave position even within each of the three fields (see the horizontal dashes). The first field represents stage 3 with superimposed minor thirds and tritones. Fields 2 and 3 move toward tritone convergence. The second field (mm. 12–14) places five of six possible tritone connections in close position, while the thirds no longer overlap the tritones but move between them, thus making the tritones more perceptible as entities.

[2.8] A look at the realization of this harmonic potential in the score (**Example 3**) shows an accumulation of melodic tritone successions in the individual voices, which result from two tritone segments in the underlying tone row. The tritone is particularly prominent in m. 15 with an E $\flat$ –B $\flat$ 5 succession in the trumpet in *ff* dynamics. Coincidences between the instruments create additional discontinuous tritone constellations. The perceptibility of these auditory streams is supported by the timbral homogeneity of the groups.<sup>(20)</sup>

[2.9] The four stages of interval convergence are then immediately repeated with the solo interlude (mm. 16–23) representing stages 1 and 2 and the second, more polyphonic part of this first section (mm. 24–49) returning to stages 3 and 4. The focal point of this second tritone convergence coincides with the entry of the first woodwind group in m. 32. As shown in **Example 4**, the harmonic field of mm. 30 and 31 prepares it. The first field already contains three tritone connections, two of them resulting from a cycle of thirds in the middle, one at the upper edge of the field. The cross-movement of E $\flat$ 5 into the low and E2 into the high register creates two new tritone connections in m. 32. Structurally, the tritone B3–F4 now becomes the mirror axis around which the two outer intervals emerge at the distance of a major ninth (Example 4).

[2.10] As if under a microscope, the slow *Assez lent* sections of the first movement seem to anatomize the harmonic processes that have been established at the beginning of the piece. For example, the first of these slow sections (mm. 75–96)<sup>(21)</sup> places the intervals E $\flat$ 4–A4 and G5–C $\sharp$ 5 melodically in one instrument per group. The tritone E $\flat$ 4–A4 is first heard *mp* in the trumpet (m. 75), and is then echoed in the flute, first violin, and oboe above a sustained A4 (**Example 5**). The reversed succession G5–C $\sharp$ 5 in the clarinet (m. 78) seems like a response and is also taken up by the other instruments (**Example 6**).

[2.11] Additionally, a striking instrumentation effect accompanies the tritone harmony in this section: the instruction “laisser rebondir l’archet” (“let the bow rebound”) in the third string section creates noisy, flickering impact curves (see the score in Example 10 below, mm. 75–80). Interestingly, the return of this effect toward the end of the section (m. 90) coincides with a reestablishment of the tritone after the polar thirds A2–C3 (**Example 7**, mm. 79–81, tuba, bass

clarinet, cello I) and C#6–E6 (**Example 8**, mm. 82–85, piccolo flute, piccolo trumpet, oboe) have dominated the field in the middle section.

[2.12] In **Example 9**, this harmonic process can be traced: the final field places all six possible tritones in close position. The structural principle in creating these fields seems to be a symmetrical interval distribution—as in the previous example, most notes are symmetrically arranged around a central interval.

[2.13] On the one hand, the tritone harmony in *Polyphonie X* result from artistic choices of the composer. Boulez shapes the material generated by a complex set of algorithms by means of harmonic fields that in turn influence the sounding outcome.<sup>(22)</sup> But it would be wrong to consider such efforts as completely decoupled from the other, less malleable layers of the composition. Quite the contrary: Boulez's creative decisions always show a tendency to be influenced by the characteristics of the material he works with.<sup>(23)</sup>

[2.14] As an example, let us return to the beginning of the piece (mm. 1–15, **Example 2** and **Example 3**), where we found a process of gradual minor third and then tritone convergence within the harmonic fields. Dodecaphonically, each instrumental group plays two consecutive forms of the twelve-tone row  $f\varphi$  while the individual pitches are distributed between the instruments of each group. The prime form of  $f\varphi$  is given in **Example 11**.

[2.15] The most frequent interval succession within the row is the minor third, followed by an even split of two major seconds, major thirds, fourths, and tritones; the minor second is missing. Taking a closer look, one can identify a symmetry concerning the tritone and minor third connections—the minor third B–G# is the mirror axis of the two tritone successions as well as the other two minor thirds immediately before/after these tritones. Additionally, the tritone complements of this mirror axis (D for G# and F for B) are also arranged symmetrically around this axis.

[2.16] Each row form in this section is a transposition of the inverted prime form. Consequently, when two row forms of  $f\varphi$  are played simultaneously, the interval between the row forms is likely to be prominent, as will be certain intervals within each individual row. Instead of tracing the complex and experimental procedure Boulez used to generate and distribute these row forms, let us just have a look at the outcome. **Example 12** shows which two transpositions appear in each group (numbered 1–7, group 6 being silent) and how they overlap.

[2.17] We can follow the interval vectors to see which intervals appear between the overlapping row forms in each phase: The first two overlapping forms of  $f\varphi$  (phase 1) are a minor third apart leading to a simple interval vector of <001000> (0 minor seconds, 0 major seconds, 1 minor third etc.), the next two are a major third apart (phase 2). The tritone interval between two forms appears in phases 3–5. In phase 4 it results from the double minor-third constellation between the transpositions on F#, A, and C. In the last phase, the tritone doesn't coincide with a stack of minor thirds anymore.

[2.18] The characteristics of the harmonic fields are thus mirrored in the underlying structure of pitch organization. Within the twelve-tone row, there is a symmetrical distribution of minor thirds and tritones, and minor thirds are statistically prominent. Between rows, there are tritones subdivided by minor thirds, followed by tritones without minor thirds.

[2.19] Similar observations can be made for the tritone harmony at the beginning of the slow section (mm. 75–79, **Example 9** and **Example 10**). This section uses only two forms of the twelve-tone row  $\beta$  consecutively per instrumental group. That means the same two row forms are played (more or less) simultaneously between all groups. Not only that: the content of both row forms is reduced to only one subset of five pitch classes, the other seven pitch classes being omitted.

[2.20] First, on a very abstract level, this reduction is caused by a tritone constellation within another "hidden" row: Boulez uses certain intervals within these hidden rows and their inversions to generate a selection of (still hidden) transpositions that then, using yet another algorithm, lead to the actual row forms.<sup>(24)</sup> In this system, a tritone (being identical with its inversion) results in two identical row forms being used. Boulez then decided to split those two row forms into two

segments, using only one segment in this section. These two partial row forms are once again characterized by tritone symmetry, similar to what we observed in  $f\phi$ ; see **Example 13**.

[2.21] Logically, the inversion of  $\beta_5$  has the same interval structure as the original form, which is characterized by a symmetrical distribution of two tritones around a central mirror axis. This leads to a duplication of not only the first but also the fifth pitch class in each of the two forms. The overall pitch content is thus reduced to eight different pitch classes instead of the usual twelve.

[2.22] Boulez now seems to react to the structural significance of the tritone in two ways. First, he distributes the contents of each row segment to the instruments in such a way that the tritone connections are played melodically within a single instrument (as shown in Examples 3 and 4 above). Second, as we have seen, he distributes the registers in such a way that these tritones appear in close position, with the two axis pitch classes without a tritone complement (E and C) being pushed to the low register in an open position (as a sixth).

[2.23] In sum, the examples above shed light on the importance of registral distribution in Boulez's harmonic thinking. Pitch registration is used as a mediating layer between the more hidden organizational structures and the sounding musical surface. A statistical accumulation of certain key intervals bears potentials for the listening experience without aiming at full transparency or even identity between the structural and formal characteristics of a piece. It is used as a means of compositional agency toward musical "form" and is at the same time influenced by its generative "structures." The following examples will pursue this idea further, applying harmonic field analysis to post-serial compositions by Marco Stroppa and Yukiko Watanabe.

### 3. Marco Stroppa: *Hommage à Gy. K. (1997–2003, rev. 2013)*

[3.1] Field structures with specific registral distributions have been an integral part of Marco Stroppa's compositional technique since the 1988 string quartet *Spirali*.<sup>(25)</sup> Stroppa combines two elements in his works: gestures with relative morphological conciseness, which Stroppa calls OIM (*organismi di informazione musicale*),<sup>(26)</sup> and harmonic fields, which Stroppa calls vertical pitch structures (VPS).<sup>(27)</sup> Both are typically subjected to a constant process of transformation and interfere with each other in different ways.

[3.2] The piece *Hommage à Gy. K.* for clarinet, viola, and piano was composed between 1997 and 2003. It is both a first- and second-order homage: the title refers directly to György Kurtág's *Hommage à R. Sch.* (1990), and both Stroppa and Kurtág incorporate elements from Robert Schumann's *Märchenerzählungen* op. 132 (1853), whose instrumentation they also adopt.

[3.3] Characteristic of the first movement of Stroppa's *Hommage* is an ascending sixteenth-note gesture in the piano that is repeated twenty-seven times and is constantly transformed; **Example 14** highlights its initial eight occurrences. It resembles the sixteenth-note figure from the first movement of Kurtág's *Hommage*, shown in **Example 15**. Whereas in Kurtág the chromatic band is constantly divided into three segments with a fixed registral distribution (3 + 2 + 3) so that each segment melodically reproduces a chromatic scale section, in Stroppa both the segmentation and the registration are subject to continuous change.

[3.4] The third column of **Example 16** shows the pitch-class sequences for all twenty-seven repetitions of the motive (0 = C; 1 = C♯ etc.). It becomes apparent that Stroppa works with these sequences in a post-serial manner by constantly shifting and permuting the contents of each chromatic segment. Initially, the sequence is split in only two segments. The notes of the second segment gradually change into the first until both segments are fused into a single chromatic band or "row" in m. 6. Then the segments separate again, this time into predominantly 3 + 2 + 4 notes, with the sequence in each segment being slightly changed.

[3.5] The vertical registral distribution now creates a second dramatic layer that interferes with these horizontal, row-like sequences.<sup>(28)</sup> Instead of realizing the chromatic relations in close registral position throughout, the harmonic fields tend to overwrite the chromatic sequences. In the

first seven measures, a gradual detachment of the harmonic fields from the pitch-class sequences can be observed (**Example 17**). After complete congruence in the first occurrence of the motive, additional minor-second constellations emerge solely through the pitch distribution across registers. This detachment process culminates in m. 7, where the minor second is completely erased and replaced by major-second constellations (Example 17, instance 7). One could say that the diatonic flair of the major second pushes itself in front of the chromaticism of the nominal pitch-class relationships and asserts its own priority.

[3.6] Measures 8–18 then abruptly restore the initial congruence between pitch-class sequences and harmonic fields, which, at least for me, makes it easier to follow the subtle shifts within the sequences. The lowest pitch gradually rises from B3 to C#4, and the highest sinks from G#5 to F#5 (see Example 16 and **Example 18**).

[3.7] The second half of the movement (mm. 19–38) takes the dissolution of the chromatic relationships to the extreme. In m. 29, minor and major thirds overwrite the minor seconds, similarly to what has happened in m. 7 (**Example 19**, instance 21); from m. 31, the fields gradually spread out over the entire ambitus, isolating each individual note in frequency. Only at the very end (m. 38) do the minor seconds reappear in a quasi-recapitulatory manner. But they belong to different segments within the pitch-class sequence and therefore do not appear melodically. Generally, from m. 29 onward, minor seconds in direct melodic succession are completely avoided; see Example 19.

[3.8] One can conclude that the juxtaposition of horizontal and vertical pitch organization (or, in other words, pitch-class sequence and pitch registration) in the first movement of Stroppa's *Hommage* enables a play with the structural and formal function of the minor second that is similar to the role of the tritone in *Polyphonie X*. In both cases, harmonic fields oscillate between convergence and dissolution, continuity and discontinuity, and perceptibility and virtuality.

#### 4. Yukiko Watanabe: *Living in the Box II* (2013)

[4.1] *Living in the Box II* is a collaboration between the Japanese composer Yukiko Watanabe and the video artist Kentaro Taki. During the ten-minute piano piece, a surreal video projection shows female-read body parts in differently sized white boxes (see **Example 20**).<sup>(29)</sup> Along with the live performance of the pianist, these body parts appear, disappear, stretch, and move within these boxes without any clear direction.

[4.2] This fractured imagery is paralleled by the music. The pianist first repeats an unwinding 24-note sequence several times (**Example 21**).<sup>(30)</sup> This figure—which Diego Ramos (2021, 113) notes is like a Möbius strip—is at the same time one of three main pitch structures that organize the piece (I will call them A, B, and C respectively).<sup>(31)</sup> In the first section after its full exposition (mm. 2–26), the sequence (identical with generative structure A) is radically de- and reconstructed: the pianist keeps moving their fingers over the keys as if they would continue repeating the sequence, but only some of the notes (those with open noteheads) are actually played, beginning with only a couple and then gradually increasing the density of actual sounds.

[4.3] Like Stroppa's piece, the pitch sequence is chromatically organized; as one can easily see, it traverses the full chromatic scale twice beginning with C, C# etc. But again, Watanabe challenges this linear chromaticism with the vertical pitch distribution across the registers. This interpolation of linear chromaticism and erratic pitch distribution is true for all three generative structures A, B and C. They provide not only the abstract pitch-class content like, for example, the twelve-tone rows in *Polyphonie X*, but are also linked to distinct registral distributions, each section of the piece applying different strategies of combination and transformation to these structures.<sup>(32)</sup> **Example 22** shows the three harmonic fields created by the registral distributions of structures A, B and C.

[4.4] Interestingly, the harmonic fields do not mirror the nominal chromaticism by emphasizing minor seconds (like, as shown above, many fields in Stroppa do) but rather complement it from the outset with diatonic constellations of major seconds and minor/major thirds. In structure A, for



example, these constellations can be grouped into four auditory streams of consistent diatonic scales, the lowest six pitches all belonging to the C# minor scale, the eight pitches in the middle belonging to D minor, the next four to D# minor (melodic), and the highest four pitches plus the overlapping F6 to A minor (melodic).

[4.5] Using only structure A, the first section of the piece (mm. 1–26) consists of a static, single harmonic field with the above-mentioned diatonic characteristics. While it is certainly possible to perceive the chromaticism of the sequence when it is repeated in the beginning, my own attention, in accordance with Bregman's theory, tends to shift toward these quasi-tonal streams and constellations. When most of the notes are muted during the rest of the section, the chromaticism is entirely virtual, uncovering the diatonicism of the harmonic fields and making it possible to follow these relations without distraction.

[4.6] In the second section (mm. 27–74), all three structures A, B, and C are combined. This leads to occasional minor-second constellations due to their complementary registral distributions (for example B2–A#2 in mm. 27, 29, and 37). During this second section, structure C gradually gains importance, culminating in a long, sustained chord that consists of the top eight pitches of its harmonic field (mm. 71–74, **Example 23**). The third section (mm. 75–114) then starts by exploring this harmonic field (structure C) by spelling out the top half of the field and step by step expanding it toward the low registers (**Example 24**). The harmonic fields of structures A and C are then played simultaneously, revealing their complementary registral distribution by a multiplicity of minor-second stacks and successions (**Example 25**). Finally, during the last section of the piece (mm. 115–166), structure A first appears isolated, like at the beginning. Toward the end, structures B and C are gradually reintroduced and combined with it so that the three harmonic fields overlap again.

[4.7] The overall arc of the piece can thus be described as an ABA' form, with registral distribution being the driving force and most prominent feature of this arc. However, it is noteworthy that the pitch organization in *Living in the Box II*, with its arc of harmonic de- and reconstruction, also contributes to a conceptual idea of the piece: it accentuates the bodily movements of the performer along the lines of the deconstructed body shown in the video.<sup>(33)</sup> Ramos (2021, 114) states: "The fact that there are three arpeggio layers for two hands creates a virtuosic choreography with continuous leaps and hand-crossing that is reminiscent of works by Franz Liszt." In some renditions of the piece, the video projection is even projected on the back of the pianist to accentuate this idea of musical embodiment. Harmonic fields are thus used to not only create musical form and drama but also with awareness of their consequences for the performance: while the piece explores the continuum between temporarily isolated and accumulated sounds on the one hand, as well as spatially close and distant sounds on the other, the mediated corporeal presence of the performer also becomes a part of the composition.

## 5. Conclusion

[5.1] The methodology of harmonic field analysis presented in this paper was designed to solve a specific problem: it is meant to uncover harmonic colorings with recurring interval constellations, relative pitch frequency, or register continuity that result from the choice of registers in serial music. In this sense, it is a continuation of the work of Jean-Louis Leleu that, instead of focusing on interval cycles, emphasizes the statistical accumulation of key intervals. This shift of perspective is informed by psycho-acoustical findings within the orbit of Bregman's auditory stream analysis.

[5.2] As shown in the discussions of composers from three different generations, harmonic field analysis is able to reveal a middle layer between the sounding surface and its underlying generative principles: harmonic fields are mediating structures with strong potentials for perception.<sup>(34)</sup> In the first movement of Boulez's *Polyphonie X*, they create a drama of tritone convergence (and deconstruction) that characterize the sections of the piece in different ways. Similarly, in the first movement of Marco Stroppa's *Hommage à Gy. K.*, minor-second constellations highlight the chromatic structure of the main motive until they become gradually detached and finally completely suspended. Lastly, Yukiko Watanabe's piece *Living in the Box II* also uses structural chromaticism while simultaneously confronting it with contradictory harmonic fields

consisting of quasi-tonal, diatonic auditory streams. Harmonic field analysis is a useful tool to uncover these structural-formal entanglements.

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#### Footnotes

1. For lack of better, less problematic alternatives, I use the term "structure" to denote the different layers of organization that contribute to the sounding outcome of a musical text, and "form" to denote the sounding outcome of a musical text and its perceptible features and/or processes.  
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2. See, for example, Thomson 2010.  
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3. In his critique of system-oriented analytic approaches, Joseph Dubiel (1997, 44) concedes the possibility of "hearing the *influence* of the series" but at the same time marginalizes the system's agency, concluding "how little the system specifies about the configurations that will occur, and how discontinuous and unpredictable the system's interpretative influence is likely to be, when it can be felt" (49). Against such viewpoints, Catherine Losada (2014, 118) stresses the "importance of a precise understanding of the interaction between precompositional schemes and the ultimate musical product at *all* stages of the work."  
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4. See Boulez [1954] 1991, 156.  
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5. The close curation of the whole registral space is typical for post-war serialism, where traditional voice leading in melodic lines is frequently suspended. However, register choice already plays an important role in the Second Viennese School—see for example Stephen Peles's (1983/84; 2004) analysis of symmetrical register dispositions in Schoenberg.  
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6. By "post-serial" I mean compositional approaches that either use generative background structures or apply algorithmic procedures to a given musical material.  
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7. In the mid-eighties, Piencikowski was concerned with placing innovations such as the mixture sounds in Boulez's *Eclat-multiples* in a broader context by revealing their roots in serial thinking. In this way, he turns against interpretations that see in it a radical shift of the composer from "structural" to perception-oriented composing. (I thank Pascal Decroupet for this

contextualization.)

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8. Utz cites studies by Diana Deutsch, Albert S. Bregman, Eleanor Rosch and Irène Deliège.

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9. For an overview, see Deutsch 2012, 196–200.

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10. Individual listening history is likely to have a decisive influence on the outcome of such a study. If perception is not simply passive registration of a stimulus but must be imagined as a dynamic-cyclical process between subject and object (see the remarks in Mosch 2004, 123–145), an analysis can only ever reveal potentials of the same.

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11. Compare Perle 1977, 18–19, 76–79.

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12. See Forte 1973.

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13. Boulez, autograph letter to Henri Pousseur, March 1952, 156, Paul Sacher Foundation, Bâle, collection Henri Pousseur.

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14. In light of these considerations, we have to reconsider statements that assume a sudden shift toward perception in the 1970s, such as Jonathan Goldman's (2011, 61–62): "Boulez's discourse in the Collège de France lectures provides evidence of a fairly dramatic about-face: he had clearly begun to include the listener in the realm of his preoccupations. . . . Indeed there is a conspicuous absence in *Penser* of any discussion of the way in which the series shaped the perception of serial music, that is, a link between the new serial language and the science of 'psycho-physiological acoustics'. It took twenty years for this 'psycho-physiological' threshold to be breached."

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15. During his formative years, Boulez was influenced by René Leibowitz, who familiarized him with the music of Schoenberg, Berg, and Webern. Despite their quarrel in 1946, Boulez had certainly read Leibowitz's 1947 treatise *Schoenberg et son école*, which repeatedly addresses Webern's use of fixed or mobile pitch registration. For example, regarding the second movement of Op. 28, Leibowitz reproduces a vertical pitch structure that strongly resembles the interlocking thirds and tritones that we will encounter in the first movement of *Polyphonie X* (1947, 251).

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16. See Tönies 2023, 30–35. Recent studies on *Polyphonie X* include Salem 2017; Strintz 2016; and Zenck 2015. After its premiere in Donaueschingen, Boulez decided to withdraw *Polyphonie X* from his work catalogue.

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17. See Tönies 2023, 80–95.

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18. The sketches are archived in the Paul Sacher Foundation, collection Pierre Boulez, folder C, 1a.

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19. Especially the three slow sections (mm. 75–96, 160–69, and 209–27).

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20. On the role of timbre in auditory streaming see McAdams 2012, 50–52.

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21. See Example 10 for a complete reproduction of mm. 75–80.

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22. A full overview of the underlying serial structure is not possible within the scope of this article. For a systematic reconstruction of the compositional process, see Tönies 2023. *Polyphonie X* is Boulez's first attempt to deduce a piece entirely from a single basic row that proliferates in various and complex ways. The other musical dimensions like rhythm, dynamics, articulation, timbre, etc. are autonomous systems, each following their own logic and being subsequently applied to the serial macrostructure. In contrast to his later works, where compositional control is reintroduced on the level of material disposition, this clash of distinct musical parameters is highly unpredictable and creates unforeseeable outcomes.

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23. This tendency is especially apparent in the many revisions and re-compositions in Boulez's output—see, for example Losada 2019 and Salem 2016, 232–245.

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24. See Tönies 2023, 64–67, 99–101.

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25. See Albert 2019, 41. On the importance of cognitive sciences and psychoacoustics for Stroppa's musical thinking, see Tiffon and Sprenger-Ohana 2012, 390–391.

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26. Stroppa explains the concept of OIM in his essay "Organismes d'information musicale: une approche de la composition" (1989).

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27. For an exemplary analysis of vertical pitch structures in Stroppa's piano cycle *Miniature estrose*, see Decroupet 2019.

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28. Only the piano motive as an entity is considered in the following analysis. A more in-depth view should also take into account the subtle resonance sounds created by the sustain pedal as well as eventual octave shifts in the accompaniment.

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29. The video reuses material from the (2012) installation *Living in the Box* by Kentaro Taki.

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30. Even though the score indicates that these eight initial repetitions should be played silently, Watanabe tends to contradict this indication for live renditions of the piece. A video documentation of a performance by Rei Nakamura can be found online: <https://vimeo.com/99947888> (accessed August 7, 2021).

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31. I thank Yukiko Watanabe for providing me drafts concerning the serial organization. In addition to the three main pitch structures, a fourth structure is used that governs the use of harmonics (plucked strings).

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32. See also Ramos 2021, 113–116. In the drafts, these structures contain additional information on rhythmic durations and dynamics that are developed in different ways during the piece.

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33. Watanabe (2021, 244–245) says: "Like the body parts in the video, I was seeking an expression that brings the beauty of the pianist's body to light even in the smallest muscular movements."

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34. Similarly, Losada (2019, 24) demonstrates how, in works like Eclat, “Boulez was concerned with creating a perceptible middleground organization” that iterates harmonic characteristics of the basic material.

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