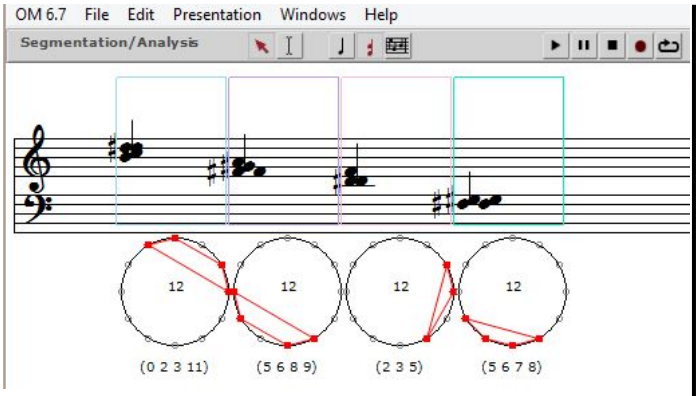
Analysis test with the Set Theory



An iconoclastic analysis or other tracks?

While I am well aware that the Set Theory is not appropriate for the analysis of tonal music atonal analysis , I did not resist the curiosity to examine the first steps in a very abstract wa L. Beethoven, Op. 18. No. 4. following the proposal of Mathieu A. as part of an open topic i And if this attempt can appear somewhat iconoclastic, it seems to me rich of lessons by tal way to discover a partition at the level of its intervallic structure, to understand its structural and vertically , to list the groups, to examine the operations undertaken as transpositions o symmetries, etc.
Precision, I am not an analyst and even less a musicologist warned and I am fully aware of analysis of classical music. On the other hand, if my interests are more focused on underst music and on which Set Theory has given me keys to understanding - both on paper and w Music - it seems to me that as soon as the classical material is fertile, the Set Theory toget representation via the twelve-tone circle can bring elements of understanding and who kno analyst towards other tracks?

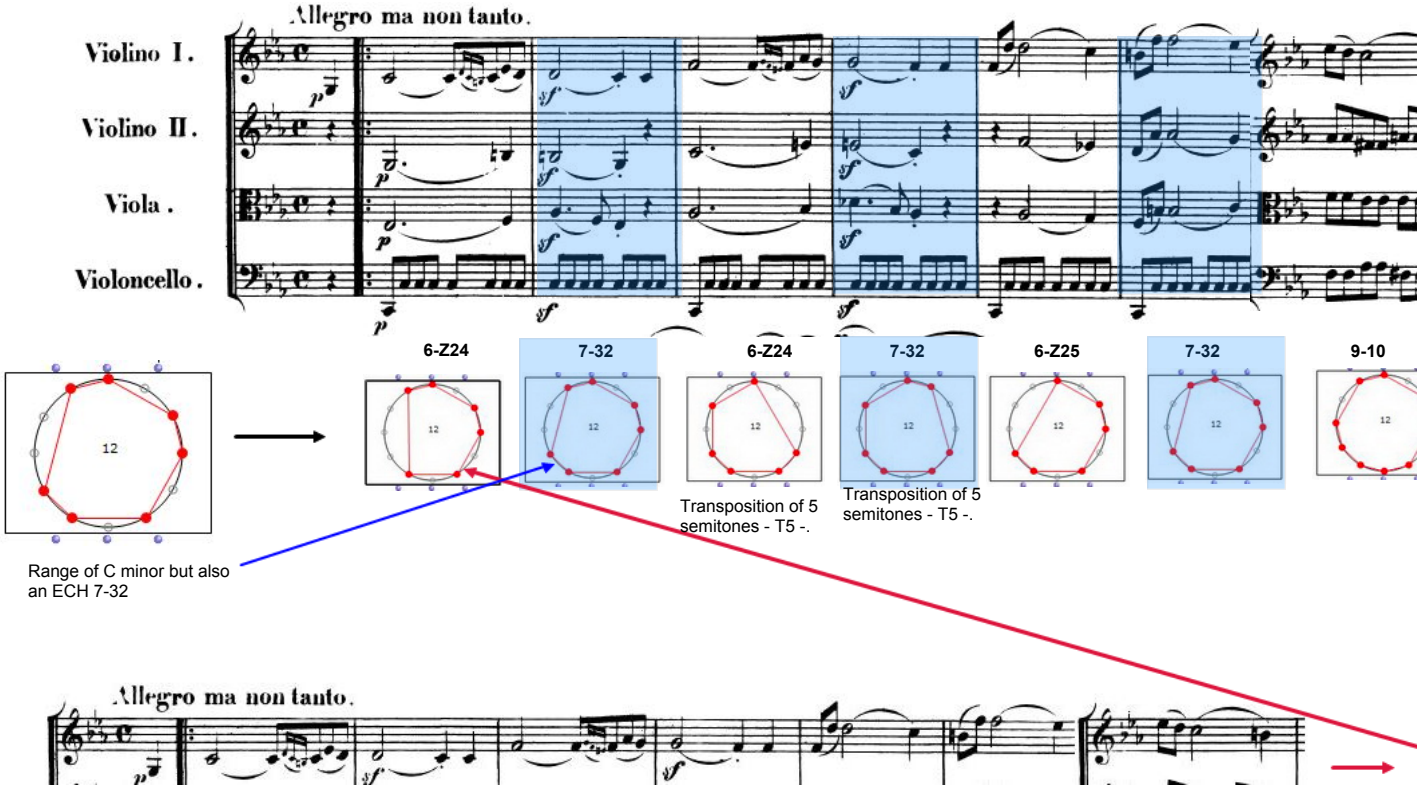


Fig 2. Observation: the set of height classes (ECH) of the measure 2, 6-Z24, is the same as that constituted by all the notes of the measure 1 to 8 of the violin 1 without the appendages. With these, the ECH is a 7-32.

Global look

Initially, I wanted to have a global vision on a defined number of measures and, for each of them, without hierarchy, the taking into account of all classes of heights to obtain a *set of Height classes* (ECH) defining for each of these measures what I will call a kind of genetic code, the basic DNA being perhaps fixed by the range of C minor? With the idea of updating what was possibly underlying in a measure.
Thus, a segmentation encompassing the four ranges makes it possible to follow the progression of the content of the melodic / harmonic material of the measurements 2 to 8 thanks to the circular representation as can be seen in FIG. 1. Two sets of classes of heights (ECH) emerge , **6-Z24** and **7-32** , the **6-Z24** becoming the 7th measure **6-Z25** . Measure 2 with the set of height classes (ECH) **6-Z24 {0, 2, 3, 5, 7,11}** / **{do, re, mib, fa, sol, si}** is transposed by 5 semitones (fourth) to measure 4 and it is almost in the state to measure 6 with ECH 6-Z25 to a close note, the si being substituted by the a flat. ECH 7-32 **{0, 2, 3, 5, 7, 8}** / **{do, re; mib, fa, sol, lab}** of measure 3 is transposed by 5 semitones to measure 5 and remains unchanged at measure 7.
An interesting observation concerns the material used by Beethoven in the ECH constituted by the notes without the appogiatures between the measure 2 and 8 (Fig 2). This is a **6-Z24** , 6-Z24 that becomes a **7-32** - declination of the C minor scale - if I add these. Note that the latter do not change the overall results of Figure 1, as their notes appear as such in the scope of the violin 1 and the viola. Below, as examples, three videos of the construction of the ECH 7-32 from measurements 3, 5 and 7. The twelve-tone circle used is Pierre Couprie's " Set Theory " utility (iAnalysis 3 and 4 , Iphone and Ipad) distributed freely.

Construction of the ECH 7-32 of Measure 3.

Construction of the ECH 7-32 of Measure 5.

Construction of the ECH 7-32 of Measure

Measure 8 with three notes near the chromatic total

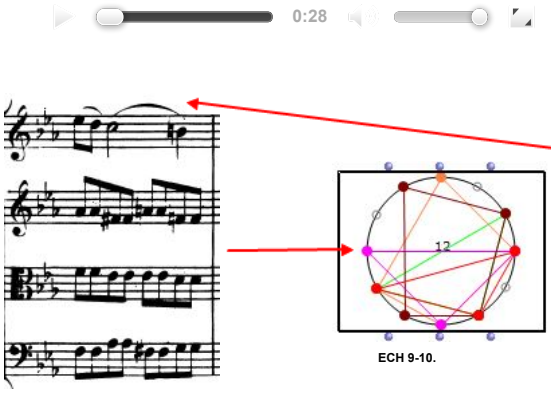


Figure 3. In measure 8, the chromatic total is declined to three notes.

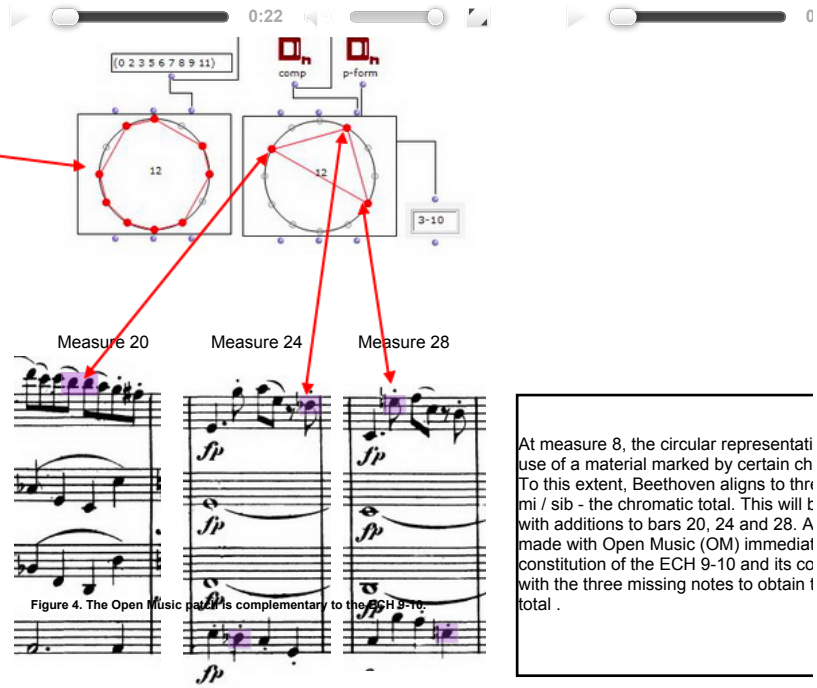


Figure 4. The Open Music patch is complementary to the ECH 9-10.

At measure 8, the circular representati
use of a material marked by certain ch
To this extent, Beethoven aligns to thr
mi / sib - the chromatic total. This will b
with additions to bars 20, 24 and 28. A
made with Open Music (OM) immediat
constitution of the ECH 9-10 and its co
with the three missing notes to obtain t
total .

Figure 4a. Steps 20, 24 and 28 will complete the chromatic total stated in part in Measure 8.

Recurrence of so-called " *Viennese* " agreements

Let's face it, I was rather surprised to find in the second chord of measure 2, just after the C minor, a very nice copy of a so-called " *Viennese* " accord , a nice **3-5** according to the classification of Allen Forte:
{do, fa, si} / {0, 5, 11} and which is characterized by the interval structure *quarter* , *fourth increased* and *second minor* or *octave decreased* or *increased* . This Viennese accord has been so much used in the context of dodecaphonic and serial music that it has become totally academic in the same way as a major agreement.

- 18th and 19th centuries

In fact, as Laurent Fichet pointed out at a conference given at the IUFM Lille on December 16, 1994: " *The " Viennese " agreement 1 " for example is in fact known since the eighteenth century, even if it 'appears at this time only by the game of passing notes and included in agreements that mitigate its harshness.But, from the nineteenth century, it is found, particularly at rates (still this place capital for the evolution of harmony) in an almost independent form* " .
In fact, as can be seen in Figure 5 thanks to the segmentations, in each of the measures from 2 to 7 are included ECH 3-5 with nestings due to common notes as in measure 6 {2, 8, 7 } / {re, lab, sol} and {8, 2, 3} / {lab, re, mib} and at measure 7 where Beethoven takes the same disposition as at measure 6 while adding a 3rd ECH 3- 5 {11, 5, 0} / {si, fa, do}.

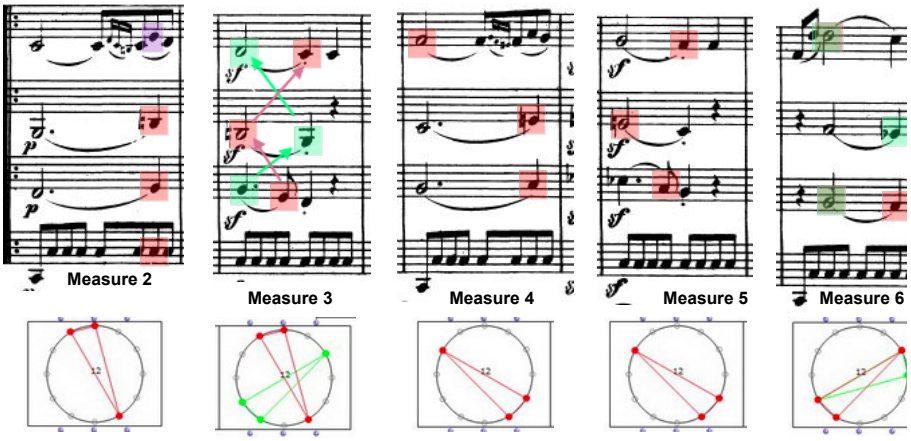
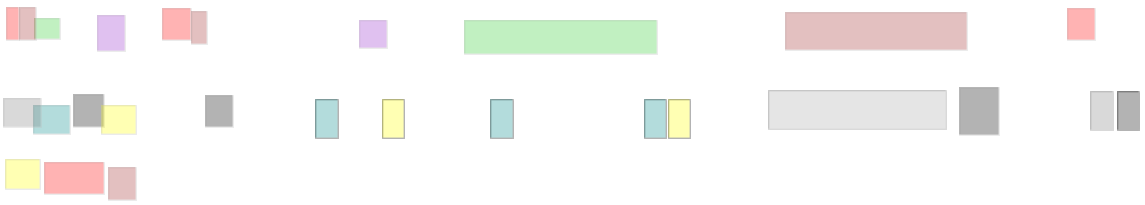


Figure 5. In each of the measures from 2 to 7 are included ECH 3-5 (Viennese accord which have as specific intervals a second minor, a fourth and a fifth) and which are often used in atonal music , dodecaphonic or serial).

Singularity of the measure 8

Measure 8 is quite surprising when we examine what it contains concretely but also by what it can present in an underlying way. Thus, as shown in Figure 7 below, with a segmentatio the notes of measure 8 (in screenshot on the left) but also using the native function of segmentation and circular representation of Open Music, we detect no less than eight ECH 3-5 visualized grouped in the twelve-dome circle of Figure 6. The circular representation shows two implicit ECH 4-9 {11, 0, 6, 5} / {if, do, fa #, fa} and {9, 8, 2, 3} / {la, lab, re, mib} symme or both symmetric ECHs 4-3: {3, 2, 0, 11} / { mib, re, do, si} is played by violin 1 and {8, 6, 9, 5} / {lab, fa #, la, fa} interpreted by violin 2 and has the characteristic of being transposed diminished fifth (6 semitones) or in the possible inverted transposition T8I (8 semitones), and whose T6 or T8I results were exchanged to obtain the sentence lab-fa # -la-fa.



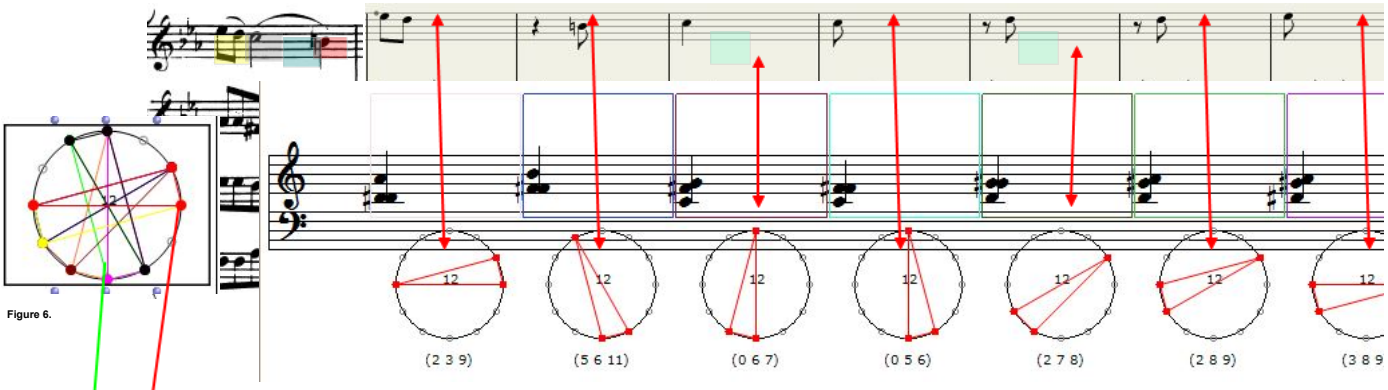


Figure 6.

Figure 7. The ci

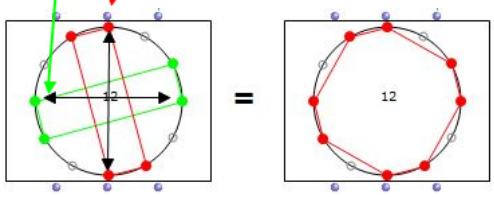


Figure 8 with both ECH 4-9 and the underlying 3-5.

Figure 9. The ECH 8-28.

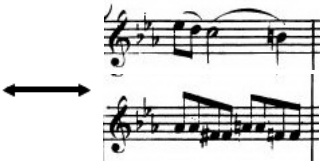


Figure 10. Violin range 1 and 2 of the measure 8. That of the violin 2 is transposed from T6 (6 semitones) or T8I (inverted and transposed by 8 semitones) then permuted with respect to that of the violin 1.

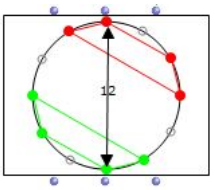
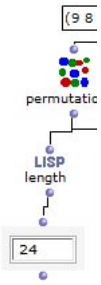
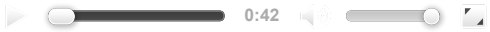


Fig 11. The ECH 4-3 {8, 6, 9, 5} is the transposed and then permuted from 4-3 {3, 2, 0, 11}.



By dividing the twelve-tone circle of Figure 8 with the triton do-fa # {0,6} and with the triton la-mib {9-3}, besides the fact that the symmetries appear, we detect the tracing of the chords " *Viennese* " 3-5 marked implicitly / implicitly in both ECH 4-9 of the staves of violins 1 and 2 of measure 8 (Figure 10). It is noted that the addition of the two ECHs 4-9 gives the octotonic set 8-28. Together 8-28, including Allen Forte in his analysis of *Op. 19 No. 4 Arnold Schoenberg* had noted " radiation " . But the actual declination of the two staves of violins 1 and 2 is given by the two sets 4-3. In its circular representation symmetry and mirror projection are well highlighted.
On the other hand, what does not appear, but which is blatant on the score, is the permutation that Beethoven performed on the part of the violin 2. Its transposition T6 is 6 semitones (diminished fifth) but can -be also obtained by performing an inversion of the set {3, 2, 0, 11) and then transposed by 8 semitones. But in both cases, the writing of the part of the violin 2 does not correspond to one or other of the two transpositions as can be noted by comparing the two parts. It appears that the violin 2 plays a symmetrical sentence while the violin 1 is in a descending movement. The " ordered " transposition of the violin 1 {3, 2, 0, 11} / {mib, d, do, si} is {9, 8, 6, 5} / {la, lab, fa #, fa}.
To obtain the sentence written by L. Beethoven {8, 6, 9, 5} / {lab, fa #, la, fa}, we must choose one of the 24 possible permutations as can be seen in FIG. 12, calculated permutations with Open Music.

Construction of octotonic ECH 8-28 with two ECH 4-9 in measurement 8 ..



Construction of octotonic ECH 8-28 with two ECH 4-3 of measurement 8.

Figure 12. The " inversion and tr violin 2 to meas Beethoven.

Agreements in measure 8

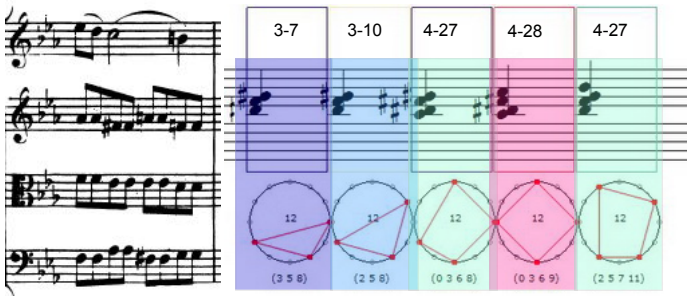


Figure 13. Vertical segmentation of measure 8 on the left in Open Music. Inserted in a native way in the " player " since the 6.6 version, this new function makes it possible to segment, in particular, the chords and to display them in their circular representation and with the notation of the Set Theory.

The "vertical" segmentation (violin 1 and 2, viola and cello) shows in Figure 13 a

Precision, the ECH and their circular representations are displayed in their first form, starting from C as 0 to allow on the ECH "neutral" comparisons. Similarly, the comparison was made with the ECH 8-28 for convenience, the width of th figure obtained and the fact that the chords were presen

progression with ECH 3-7, 3-10, 4-27 (including a T11 transposition), and 4-28. The set of notes gives an ECH 9-10 {0, 2, 3, 5, 6, 7, 8, 9, 11}. It was interesting to check with a patch of Open Music (Figure 14) to calculate and display at the click of a mouse - hence the interest of computational analysis - the agreements (subsets) in relation with a given ECH and compare the result with the chord segmentation performed (Figure 15). To these are added the ECH included in the staves of violin 1 and 2 (in yellow) is 3-5, 4-3 and 4-9. As can be verified these ECH are present in the list of subsets of 8-28 and 9-10.

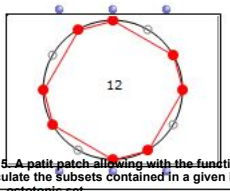


Figure 15. A patit patch allowing with the function " *sub-rel* " to calculate the subsets contained in a given ECH. Here, the 8-28, octotonic set.

in the 8-28. The figure of comparison from 9-10, with a greater number of possibilities, is here .

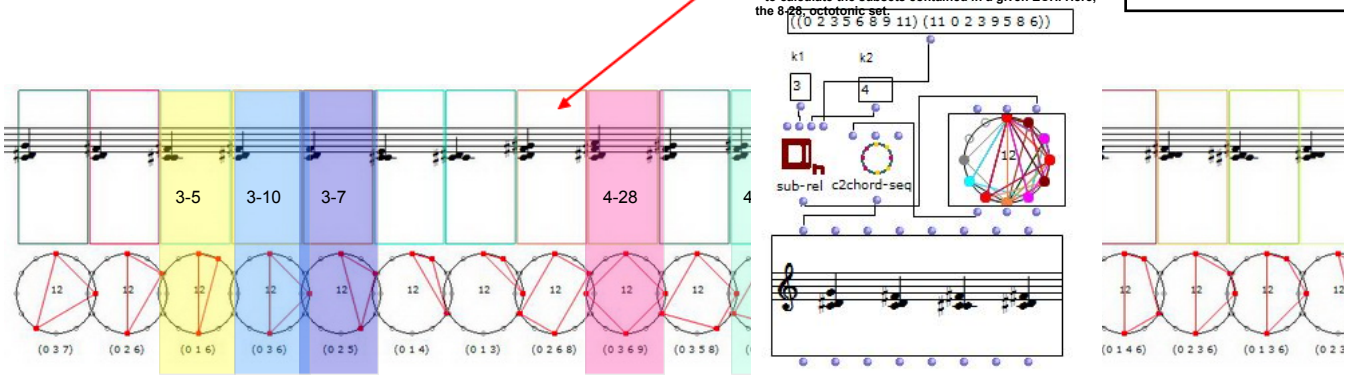


Figure 16. The result of the segmentation calculated in Open Music and displayed in the player with the different circular representations of the possible subsets of the ECH 828.