

# Journey to the Heart of Music

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## *Example S2* *Prelude by J.S. Bach*

### MUTABLE NUMBER ANALYSIS

This document (Example S2) is a companion to Example S. Example S presents my original 'hand-made' modulating-oscillatory-system / mutable-base-number analysis of Prelude No.1 in C-major, from the *Well-tempered Clavier* by J.S. Bach, constructed several years ago. (The harmonic basis of this analysis is founded upon that given by R.F. Goldman, 1965, pages 168 – 172.) Since then I have developed a suite of computer programs (Perl scripts: *mid2txt*, *txt2mos*, *mos2col*, etc.) to aid the production of MOS/mutable number analyses. A detail guide to the use of these scripts is given in Appendix F – CHPT21.PDF.

In this document, Example S2, presented side by side as left-right page pairs, are the original 'hand-made' analysis (left pages) and an autonomously generated analysis made using the above mentioned perl scripts (right pages). Although the original 'hand-made' analysis presented on the left pages is different in some minor respects and more complete in other ways, to that given in Example S – because the facilities of the perl scripts have also been used in its generation – the essential substance of the harmonic analysis is the same. The differences between Example S and Example S2-left/right are:

- 1) Example S2 is worked through as a continuous computation from start to finish with the pitch gradually drifting away from middle C 256Hz, in contrast, in Example S the pitch is periodically restored.
- 2) No account of combination tones is given in Example S2, in Example S many difference and summation tones are shown.
- 3) The use of computer generated material in Example S2 has facilitated the inclusion of full harmonic series, whereas in Example S there are many abbreviated columns of ratios.
- 4) In Example S2 all three (equivalent) modes of analysis: subscript format, factor format and the full MOS analysis are presented, while in Example S only the full MOS analysis is given.
- 5) Written notes in Example S2 (i.e. the music as represented in the score) are underlined, rather than circled as in Example S.

- 6) In Example S2 hyphens are introduced to denote the ‘degree’ (i.e. primary, secondary, tertiary, etc.) of the middle level nested series exchanges, this feature is absent from Example S and earlier analyses.
- 7) And finally, Example S2 omits the detail of a separate line of addition or subtraction in the MOS analysis between the incoming and outgoing conjunctions, which is present in Example S.

The reason for using the computer programs to produce a version of the original analysis is, hopefully, that an identical format and left-right page layout will facilitate the comparison between the human produced analysis (left-hand pages) and the entirely computer generated right-hand pages. Another secondary reason for reproducing Example S in the new apparel of Example S2-left is that the Prelude occupies a special position both in the history of western harmony, and, as a central test piece for the application of the MOS model to the analysis and understanding of traditional western tonal music; therefore, it is desirable that the prelude’s analysis should be available in the new style format produced with the aid of a computer. Indeed, the intention is that the format illustrated in this document should form a standard representation for a modulating oscillatory system (MOS) analysis.

In this revamped style of computer aided MOS analysis, a few new conventions have been adopted so as to better represent and convey the integrated workings of a complex nested system, and, also to accommodate the increased detail produced by the *txt2mos* perl script. In contrast to this and subsequently produced analyses, the earlier Examples G–S henceforth shall be referred to as *old style* MOS analyses, though of course there is no substantive difference between the two styles of analysis – merely changes in presentational detail.

It has already been noted that the *new style* MOS analyses are worked through as continuous computations (i.e. without recalibration to the initial pitch level) and as a consequence of this, the pitch of the full MOS analysis is likely to differ progressively from the fixed pitch values of the factor format digit sequences attached below the staff. Even more conventional in form, the mutable base numbers above the staff are presented with a fixed unit value ( $0_1$ ) which subsumes the flexing of the fundamental tone shown of occasion in the factor format numbers. In recognition of this occasional imprecision in number processing (i.e. measure 2–3, MBN:  $8_5 0_{28} 0_1 \rightarrow 6_4 0_{48} 0_1$ ) an arrow rather than an equals sign is employed. The rationale behind this choice is that such imprecision is suitably reflective of the tolerance of ear. Overall, both the subscript and factor format mutable numbers are giving a ‘shorthand’ version, they are approximations to the full mathematical account described in the MOS analysis set out below.

The metrical aspects of the prelude are accounted for by separate modulating oscillatory systems presented at the beginning of the two analyses. In essence a metrical MOS is no different from the more familiar and extensive MOS analyses that cover the harmonic structure of a composition. Generally a metrical MOS is less complex than its harmonic counterpart, and given the uniform 4/4 meter and static sixteenthnote figuration of the prelude this is indeed the case here. A single unchanging nested arrangement fully encapsulates the meter, pulse and figuration of the prelude. (This is rather like the simplest of tonal compositions consisting of one single chord being captured harmonically by a similar static arrangement.) There is however a small difference of nuance between the hand-made and computer generated analyses, in that the computer-made analysis has chosen a fundamental tone set an octave lower. This impacts upon both the metrical and harmonic analyses, producing a slightly more complex nested arrangement for the meter – as well as a rough doubling of the values in the harmonic MOS.

Further comments and comparisons concerning the two analyses are scattered through the pages below.

## Symbol Guide

|                                                                                       |                        |
|---------------------------------------------------------------------------------------|------------------------|
| Objective frequency in hertz<br>(E.g. middle C = 252.8Hz)                             | Logical frequency (hn) |
| Conjunction from preceding chord/series                                               |                        |
| Objective harmonics/<br>Combination tones                                             |                        |
| Objective Notes<br>(the music, underlined)                                            |                        |
| Aggregated groupings<br>(top level of nesting carrying<br>the harmonic gist of chord) |                        |
| Degrees of incoming<br>Nested series exchange<br>(hyphen)                             |                        |
| Fundamental tone of<br>middle level Nested series                                     |                        |
| Measure:005.000                                                                       |                        |
| A-minor (b)                                                                           |                        |
| Chord, root/inversion                                                                 |                        |
| Harmonics of the<br>middle level Nested series                                        |                        |
| Conjunction with<br>succeeding chord/series                                           |                        |
| Outgoing Aggregated series<br>(asterisks)                                             |                        |
| Degrees of outgoing<br>Nested Series exchange<br>(hyphens)                            |                        |
| Root of chord 'R'<br>(i.e. fundamental group<br>in aggregated series)                 |                        |
| Fundamental series harmonic 'Hn'                                                      |                        |

## Mutable Number Analyses

Subscript format mutable base numbers are placed above the staff, ascending Factor format mutable base numbers immediately beneath the staff and a full Modulating Oscillatory System analysis is spread out lower down the page. Two analyses are given side by side, left-hand pages contain the original 'hand-made' analysis (Example S) while the analysis generated automatically by the perl scripts is presented on the right-

Mutable Base Number:  $10_4 0_{32} 0_1$  ----->  $9_5 0_{28} 0_1$  MBN:  $8_5 0_{28} 0_1$  --->

$\text{♩} = 60 \text{ MM}$

|                           |                  |                |        |        |
|---------------------------|------------------|----------------|--------|--------|
|                           | Value (decimal): | 1280-E         | 1280-E | 1152-D |
|                           | Mutable          | 10             | 9      | 8      |
|                           | Digit            | 4              | 5      | 5      |
|                           |                  | 32             | 28     | 28     |
| (Pitch: middle C = 256Hz) | Sequences:       | 1 (C-H1 = 1Hz) | 1.016  | 1.029  |

### meter

MBN:  $4_4 0_1$

**240MM: (h4)...**Figuration

180MM: (h3)

120MM: (h2)

**60MM: (h1/H4)**Pulse 60MM

45MM: (H3)

30MM: (H2)

**15MM: (H1)**Meter 4/4 Time

Measures 1 through 35

Normally the metrical aspect of a composition is accounted for in a separate and independent MOS system, as above. However, given an easy tempo of 60MM and a pitch level of mid-C = 256 Hz, the general conceptual link between the harmonic and metrical realms of tonal music can, in a somewhat mechanistic way, be made real in this case by using an appropriate tempo and pitch.

(Metronome 60 = 1Hz, i.e. C-H1)

|                       |                        |
|-----------------------|------------------------|
| 1280.0:E-(h40)*-----> | -*1280.0:E-(h45)       |
| 1248.0:--(h39)        | 1251.6:E-(h44)         |
| 1216.0:D#(h38)        | 1223.1:--(h43)         |
| 1184.0:--(h37)        | 1194.7:D#(h42)         |
| 1152.0:D-(h36)*       | 1166.2:--(h41)         |
| 1120.0:D-(h35)        | *1137.8:D-(h40)*-----> |
| 1088.0:C#(h34)        | 1109.3:--(h39)         |
| 1056.0:--(h33)        | 1080.9:C#(h38)         |
| 1024.0:C-(h32)*-      | 1052.4:--(h37)         |
| 992.0:--(h31)         | - 1024.0:C-(h36)       |
| 960.0:B-(h30)         | * 995.6:C-(h35)*-      |
| 928.0:--(h29)         | 967.1:B-(h34)          |
| 896.0:A#(h28)*        | 938.7:--(h33)          |
| 864.0:A-(h27)         | 910.2:A#(h32)          |
| 832.0:A-(h26)         | 881.8:--(h31)          |
| 800.0:G#(h25)         | * 853.3:A-(h30)*-      |
| 768.0:G-(h24)*-       | 824.9:--(h29)          |
| 736.0:--(h23)         | 796.4:G#(h28)          |
| 704.0:F#(h22)         | - 768.0:G-(h27)        |
| 672.0:F-(h21)         | 739.6:G-(h26)          |
| 640.0:E-(h20)*        | * 711.1:F#(h25)*-      |
| 608.0:D#(h19)         | 682.7:F-(h24)          |
| 576.0:D-(h18)         | 654.2:--(h23)          |
| 544.0:C#(h17)         | 625.8:E-(h22)          |
| 512.0:C-(h16)*-       | 597.3:D#(h21)          |
| 480.0:B-(h15)         | * 568.9:D-(h20)*-      |
| 448.0:A#(h14)         | 540.4:C#(h19)          |
| 416.0:A-(h13)         | - 512.0:C-(h18)        |
| 384.0:G-(h12)*        | 483.6:B-(h17)          |
| 352.0:F#(h11)         | 455.1:A#(h16)          |
| 320.0:E-(h10)         | * 426.7:A-(h15)*-      |
| 288.0:D-(h09)         | 398.2:G#(h14)          |
| 256.0:C-(h08)*-       | 369.8:G-(h13)          |
| 224.0:A#(h07)         | 341.3:F-(h12)          |
| 192.0:G-(h06)         | 312.9:E-(h11)          |
| 160.0:E-(h05)         | * 284.4:D-(h10)*-      |
| 128.0:C-(h04)R        | - 256.0:C-(h09)        |
| 96.0:G-(h03)          | 227.6:A#(h08)          |
| 64.0:C-(h02)          | 199.1:G#(h07)          |
| 32.0:C-(h01/H32)      | 170.7:F-(h06)          |
|                       | R 142.2:D-(h05)R-      |
|                       | 113.8:A#(h04)          |
|                       | 85.3:F-(h03)           |
|                       | 56.9:A#(h02)           |
|                       | 28.4:A#(h01/H28)       |

Measure:001.000  
C-major (a)

Measure:002.000 D-minor (d)

See notes at the end of document for a discussion of the opposite placement of the 9:8 and 9:10 proportions in the two analyses.

(10 grps of 4)-9:10-----> -9:10->(9 grps of 5) // (8 grps of 5)-3:4----->

(5 x eight)-9:8-----> -9:8->(5 x nine) // (8 x five)-3:5----->

hand pages. In preparation for the autonomous computer analysis each measure was converted into two halfnote chords and the suspensions in measures 8 and 23 were removed before the export of file P1.MID. From this point onward the production of the analysis was entirely automatic. The commands used were:

```
perl mid2txt P1.MID > P1txt
perl txt2mos -k -s -w96 P1txt > P1mos
perl mos2col P1mos > P1col
```

Mutable Base Number:  $9_4 0_{64} 0_1$  ----->  $8_5 0_{56} 0_1$  MBN:  $6_5 0_{56} 0_1$  --->

$\text{♩} = 60 \text{ MM}$

| Value (decimal): | 2304-D           | 2304-D | 1664-A |
|------------------|------------------|--------|--------|
| Mutable          | 9                | 8      | 6      |
| Digit            | 4                | 5      | 5      |
| Sequences:       | 64               | 56     | 56     |
|                  | 1 (C-H1 = 0.5Hz) | 1.029  | 0.990  |

(Pitch: middle C = 256Hz)

### meter

MBN:  $4_4 0_2 0_1$

**240MM: (h16)\*...Figuration**

225.0:(h15)

210.0:(h14)

195.0:(h13)

180.0:(h12)\*

165.0:(h11)

150.0:(h10)

135.0:(h09)

120.0:(h08)\*

105.0:(h07)

90.0:(h06)

75.0:(h05)

**60MM: (h04)Pulse 60MM**

45.0:(h03)

30.0:(h02)

**15MM: (h01/H2)Meter 4/4 Time**

7.5: (H1)

Measures 1 through 35

Normally the metrical aspect of a composition is accounted for in a separate and independent MOS system, as above. However, given an easy tempo of 60MM and a pitch level of mid-C = 256 Hz, the general conceptual link between the harmonic and metrical realms of tonal music can, in a somewhat mechanistic way, be made real in this case by using an appropriate tempo and pitch.

(Metronome 60 = 1Hz, i.e. C-H2)

```
1152.0:D-(h36)*----->-*1152.0:D-(h40)
1120.0:D-(h35)          1123.2:--(h39)
1088.0:C#(h34)          1094.4:C#(h38)
1056.0:--(h33)          1065.6:--(h37)
1024.0:C-(h32)*         1036.8:C-(h36)
992.0:--(h31)          *1008.0:C-(h35)
960.0:B-(h30)          979.2:B-(h34)
928.0:--(h29)          950.4:--(h33)
896.0:A#(h28)*         921.6:A#(h32)
864.0:A-(h27) -        892.8:--(h31)
832.0:A-(h26)          - * 864.0:A-(h30)*----->
800.0:G#(h25)          835.2:--(h29)
768.0:G-(h24)*         806.4:G#(h28)
736.0:--(h23)          777.6:G-(h27)
704.0:F#(h22)          748.8:G-(h26)
672.0:F-(h21)          * 720.0:F#(h25)*-
640.0:E-(h20)*         691.2:F-(h24)
608.0:D#(h19)          662.4:--(h23)
576.0:D-(h18) -        633.6:E-(h22)
544.0:C#(h17)          604.8:D#(h21)
512.0:C-(h16)*         - * 576.0:D-(h20)*-
480.0:B-(h15)          547.2:C#(h19)
448.0:A#(h14)          518.4:C-(h18)
416.0:A-(h13)          489.6:B-(h17)
384.0:G-(h12)*         460.8:A#(h16)
352.0:F#(h11)          * 432.0:A-(h15)*-
320.0:E-(h10)          403.2:G#(h14)
288.0:D-(h09) -        374.4:G-(h13)
256.0:C-(h08)*         345.6:F-(h12)
224.0:A#(h07)          316.8:E-(h11)
192.0:G-(h06)          - * 288.0:D-(h10)*-
160.0:E-(h05)          259.2:C-(h09)
128.0:C-(h04)R         230.4:A#(h08)
96.0:G-(h03)           201.6:G#(h07)
64.0:C-(h02)           172.8:F-(h06)
32.0:C-(h01/H64)      R 144.0:D-(h05)R-
                        115.2:A#(h04)
                        86.4:F-(h03)
                        57.6:A#(h02)
                        28.8:A#(h01/H56)

Measure:001.000 C-major (a)
Measure:002.000 D-minor (d)
```

(9 grps of 4)-8:9-----> -8:9->(8 grps of 5) // (6 grps of 5)-3:2----->

(4 x nine)-10:9-----> -10:9->(4 x ten) // (6 x five)-3:5----->

--> 6<sub>4</sub>0<sub>48</sub>0<sub>1</sub>MBN: 4<sub>4</sub>0<sub>48</sub>0<sub>1</sub> -----> 6<sub>4</sub>0<sub>32</sub>0<sub>1</sub>MBN: 10<sub>4</sub>0<sub>32</sub>0<sub>1</sub> -->

1152-D

6  
4  
48  
1

768-G

4  
4  
48  
1

768-G

6  
4  
32  
1

1280-E

10  
4  
32  
1

- \*1137.8:D- (h24)  
1090.4:-- (h23)  
1043.0:C# (h22)  
- 995.6:C- (h21)  
\* 948.1:B- (h20)  
900.7:A# (h19)  
- 853.3:A- (h18)  
805.9:G# (h17)  
\* 758.5:G- (h16) \*----->  
- 711.1:F# (h15)  
663.7:F- (h14)  
616.3:E- (h13)  
- \* 568.9:D- (h12) \*  
521.5:C# (h11)  
474.1:B- (h10)  
- 426.7:A- (h09)  
\* 379.3:G- (h08) R-  
331.9:F- (h07)  
- 284.4:D- (h06)  
237.0:B- (h05)  
R 189.6:G- (h04) R-  
- 142.2:D- (h03)  
94.8:G- (h02)  
47.4:G- (h01/H48)

Measure:003.000  
G-major seventh (b)

1264.2:E- (h40) \*----->  
1232.6:-- (h39)  
1201.0:D# (h38) -  
1169.4:-- (h37)  
1137.8:D- (h36) \* -  
1106.2:D- (h35)  
1074.6:C# (h34) -  
1043.0:-- (h33)  
1011.4:C- (h32) \* -  
979.8:-- (h31)  
948.1:B- (h30) -  
916.5:-- (h29)  
884.9:A# (h28) \* -  
853.3:A- (h27)  
821.7:A- (h26) -  
790.1:G# (h25)  
- \* 758.5:G- (h24) \* -  
726.9:-- (h23)  
695.3:F# (h22) -  
- 663.7:F- (h21)  
\* 632.1:E- (h20) \* -  
600.5:D# (h19)  
- 568.9:D- (h18) -  
537.3:C# (h17)  
\* 505.7:C- (h16) \* -  
- 474.1:B- (h15)  
442.5:A# (h14) -  
410.9:A- (h13)  
- \* 379.3:G- (h12) \* -  
347.7:F# (h11)  
316.0:E- (h10) -  
- 284.4:D- (h09)  
\* 252.8:C- (h08) \* -  
221.2:A# (h07)  
- 189.6:G- (h06) -  
158.0:E- (h05)  
R 126.4:C- (h04) R-  
- 94.8:G- (h03)  
63.2:C- (h02) -  
31.6:C- (h01/H32)

Measure:004.000  
C-major (a)

-3:4->(6 grps of 4) // (4 grps of 4)-3:2-----> -3:2->(6 grps of 4) // (10 grps of 4)-6:5----->

-3:5->(8 x three) // (8 x two)-3:2-----> -3:2->(8 x three) // (20 x two)-3:2----->

On first viewing the two MOS analyses of Bach's prelude it may be useful to take a little time over this first phrase covering measures 1 to 4, as it provides a microcosm of the MOS/mutable number approach. In both analyses the phrase begins with a burst of energy created by the complex and extended arrangements of nested series needed to encompass the narrow harmonic exchange of one tone, while also accommodating the transition from major to minor chord. After this initial 'splash' there follows a gradual relaxation as the phrase, living off the momentum of the opening exchange, coasts down to the dominant and thence to the tonic. The two analyses, hand-made and computer-made, describe this same trajectory in essentially the same terms. The differences between the analyses are differences of detail arising out of issues of human taste or choice set against the rule driven inflexibility of a computer program. Both analyses discover the same

-->  $9_2 0_{96} 0_1$  MBN:  $8_2 0_{96} 0_1$  ----->  $6_4 0_{64} 0_1$  MBN:  $10_4 0_{64} 0_1$  -->

| 1664-A | 1536-G | 1536-G | 2560-E |
|--------|--------|--------|--------|
| 9      | 8      | 6      | 10     |
| 2      | 2      | 4      | 4      |
| 96     | 96     | 64     | 64     |
| 0.963  | 1      | 1      | 1      |

```

1280.0:E-(h40)*----->
1248.0:--(h39)
1216.0:D#(h38) -
1184.0:--(h37)
1152.0:D-(h36)*-
1120.0:D-(h35)
1088.0:C#(h34) -
1056.0:--(h33)
1024.0:C-(h32)*-
992.0:--(h31)
960.0:B-(h30) -
928.0:--(h29)
896.0:A#(h28)*-
864.0:A-(h27)
832.0:A-(h26) -
800.0:G#(h25)
768.0:G-(h24)*-
736.0:--(h23)
704.0:F#(h22) -
672.0:F-(h21)
640.0:E-(h20)*-
608.0:D#(h19)
576.0:D-(h18) -
544.0:C#(h17)
512.0:C-(h16)*-
480.0:B-(h15)
448.0:A#(h14) -
416.0:A-(h13)
384.0:G-(h12)*-
352.0:F#(h11)
320.0:E-(h10) -
288.0:D-(h09)
256.0:C-(h08)*-
224.0:A#(h07)
192.0:G-(h06) -
160.0:E-(h05)
R 128.0:C-(h04)R-
96.0:G-(h03)
64.0:C-(h02) -
32.0:C-(h01/H64)

Measure:004.000 C-major (a)

-3:2->(9 grps of 2) // (8 grps of 2)-3:4-----> -3:4->(6 grps of 4) // (10 grps of 4)-6:5----->
-3:5->(6 x three) // (8 x two)-3:2-----> -3:2->(8 x three) // (20 x two)-3:2----->

```

chords, indeed, throughout the prelude there is only one difference in harmonic interpretation – measure 16. And equally in this phrase both analyses construct the same underlying nested structure to carry these chords, even though the computer-made analysis has set the overall fundamental tone one octave lower than the hand-made analysis. The principal difference between the two analyses regards the choice of conjunctions and here the computer always chooses the lowest viable conjunction between the systems whereas in the hand-made analysis human taste and judgement has intervened to choose higher conjunctions matching chord root notes, thirds or fifths. Overall, the autonomous computer analysis has produced substantially the same MOS analysis, and reason for this concurrence is, barring matters of detail, that there is only one MOS analysis that will fit the music. This pattern continues, more or less throughout the prelude.

--> 12<sub>5</sub>0<sub>21</sub>0<sub>1</sub>MBN: 8<sub>5</sub>0<sub>21</sub>0<sub>1</sub> -----> 6<sub>4</sub>0<sub>36</sub>0<sub>1</sub>MBN: 8<sub>4</sub>0<sub>36</sub>0<sub>1</sub> -->

1280-E

832-A

832-A

1152-D

-----  
 12  
 5  
 21  
 1.016

-----  
 8  
 5  
 21  
 0.990

-----  
 6  
 4  
 36  
 0.963

-----  
 8  
 4  
 36  
 1

- \*1264.2:E- (h60)  
 1243.1:-- (h59)  
 1222.1:-- (h58)  
 - 1201.0:D# (h57)  
 1179.9:D# (h56)  
 \*1158.8:-- (h55)  
 - 1137.8:D- (h54)  
 1116.7:-- (h53)  
 1095.6:D- (h52)  
 - 1074.6:-- (h51)  
 \*1053.5:C# (h50)  
 1032.4:-- (h49)  
 - 1011.4:C- (h48)  
 990.3:-- (h47)  
 969.2:-- (h46)  
 - \* 948.1:B- (h45)  
 927.1:B- (h44)  
 906.0:-- (h43)  
 - 884.9:A# (h42)  
 863.9:-- (h41)  
 \* 842.8:A- (h40) \*----->  
 - 821.7:-- (h39)  
 800.7:G# (h38)  
 779.6:-- (h37)  
 - 758.5:G- (h36)  
 \* 737.4:G- (h35) \* -  
 716.4:F# (h34)  
 - 695.3:-- (h33)  
 674.2:F- (h32)  
 653.2:-- (h31)  
 - \* 632.1:E- (h30) \* -  
 611.0:-- (h29)  
 590.0:D# (h28)  
 - 568.9:D- (h27)  
 547.8:D- (h26)  
 \* 526.7:C# (h25) \* -  
 - 505.7:C- (h24)  
 484.6:-- (h23)  
 463.5:B- (h22)  
 - 442.5:A# (h21)  
 \* 421.4:A- (h20) \* -  
 400.3:G# (h19)  
 - 379.3:G- (h18)  
 358.2:F# (h17)  
 337.1:F- (h16)  
 - \* 316.0:E- (h15) \* -  
 295.0:D# (h14)  
 273.9:D- (h13)  
 - 252.8:C- (h12)  
 231.8:B- (h11)  
 \* 210.7:A- (h10) \* -  
 - 189.6:G- (h09)  
 168.6:F- (h08)  
 147.5:D# (h07)  
 - 126.4:C- (h06)  
 R 105.3:A- (h05) R-  
 84.3:F- (h04)  
 - 63.2:C- (h03)  
 42.1:F- (h02)  
 21.1:F- (h01/H21)

1123.7:D- (h32) \*----->  
 1088.6:-- (h31)  
 1053.5:C# (h30)  
 1018.4:-- (h29)  
 983.3:C- (h28) \* -  
 948.1:B- (h27)  
 913.0:B- (h26)  
 877.9:A# (h25)  
 - \* 842.8:A- (h24) \* -  
 807.7:-- (h23)  
 772.6:G# (h22)  
 - 737.4:G- (h21)  
 \* 702.3:F# (h20) \* -  
 667.2:F- (h19)  
 - 632.1:E- (h18)  
 597.0:D# (h17)  
 \* 561.9:D- (h16) \* -  
 - 526.7:C# (h15)  
 491.6:C- (h14)  
 456.5:B- (h13)  
 - \* 421.4:A- (h12) \* -  
 386.3:G# (h11)  
 351.2:F# (h10)  
 - 316.0:E- (h09)  
 \* 280.9:D- (h08) \* -  
 245.8:C- (h07)  
 - 210.7:A- (h06)  
 175.6:F# (h05)  
 R 140.5:D- (h04) R-  
 - 105.3:A- (h03)  
 70.2:D- (h02)  
 35.1:D- (h01/H36)

Measure:006.000  
 D-dominant seventh (d)

Measure:005.000 A-minor (b)

-6:5->(12 grps of 5) // (8 grps of 5)-3:4-----> -3:4->(6 grps of 4) // (8 grps of 4)-3:4----->

-3:2->(20 x three) // (8 x five)-3:5-----> -3:5->(8 x three) // (8 x four)-3:4----->



-->  $12_5 0_{42} 0_1$  MBN:  $8_5 0_{42} 0_1$  ----->  $6_4 0_{72} 0_1$  MBN:  $8_4 0_{72} 0_1$  -->

|        |        |        |        |
|--------|--------|--------|--------|
| 2560-E | 1664-A | 1664-A | 1664-A |
| -----  | -----  | -----  | -----  |
| 12     | 8      | 6      | 6      |
| 5      | 5      | 4      | 4      |
| 42     | 42     | 72     | 72     |
| 1.016  | 0.990  | 0.963  | 0.963  |

\*1280.0:E-(h60)

1258.7:--(h59)

1237.3:--(h58)

- 1216.0:D#(h57)

1194.7:D#(h56)

\*1173.3:--(h55)

- 1152.0:D-(h54)

1130.7:--(h53)

1109.3:D-(h52)

- 1088.0:--(h51)

\*1066.7:C#(h50)

1045.3:--(h49)

- 1024.0:C-(h48)

1002.7:--(h47)

981.3:--(h46)

- \* 960.0:B-(h45)

938.7:B-(h44)

917.3:--(h43)

- 896.0:A#(h42)

874.7:--(h41)

\* 853.3:A-(h40) \* ----->

- 832.0:--(h39)

810.7:G#(h38)

789.3:--(h37)

- 768.0:G-(h36)

\* 746.7:G-(h35) \* -

725.3:F#(h34)

- 704.0:--(h33)

682.7:F-(h32)

661.3:--(h31)

- \* 640.0:E-(h30) \* -

618.7:--(h29)

597.3:D#(h28)

- 576.0:D-(h27)

554.7:D-(h26)

\* 533.3:C#(h25) \* -

- 512.0:C-(h24)

490.7:--(h23)

469.3:B-(h22)

- 448.0:A#(h21)

\* 426.7:A-(h20) \* -

405.3:G#(h19)

- 384.0:G-(h18)

362.7:F#(h17)

341.3:F-(h16)

- \* 320.0:E-(h15) \* -

298.7:D#(h14)

277.3:D-(h13)

- 256.0:C-(h12)

234.7:B-(h11)

\* 213.3:A-(h10) \* -

- 192.0:G-(h09)

170.7:F-(h08)

149.3:D#(h07)

- 128.0:C-(h06)

R 106.7:A-(h05)R-

85.3:F-(h04)

- 64.0:C-(h03)

42.7:F-(h02)

21.3:F-(h01/H42)

Measure:005.000 A-minor (b)

\* 853.3:A-(h24) \* ----->

817.8:--(h23)

\* 782.2:G#(h22) \*

- 746.7:G-(h21)

\* 711.1:F#(h20) \* -

675.6:F-(h19)

- \* 640.0:E-(h18) \*

604.4:D#(h17)

\* 568.9:D-(h16) \* -

- 533.3:C#(h15)

\* 497.8:C-(h14) \*

462.2:B-(h13)

- \* 426.7:A-(h12) \* -

391.1:G#(h11)

\* 355.6:F#(h10) \*

- 320.0:E-(h09)

\* 284.4:D-(h08) \* -

248.9:C-(h07)

- \* 213.3:A-(h06) \*

177.8:F#(h05)

\* 142.2:D-(h04) \* -

- 106.7:A-(h03)

R 71.1:D-(h02)R

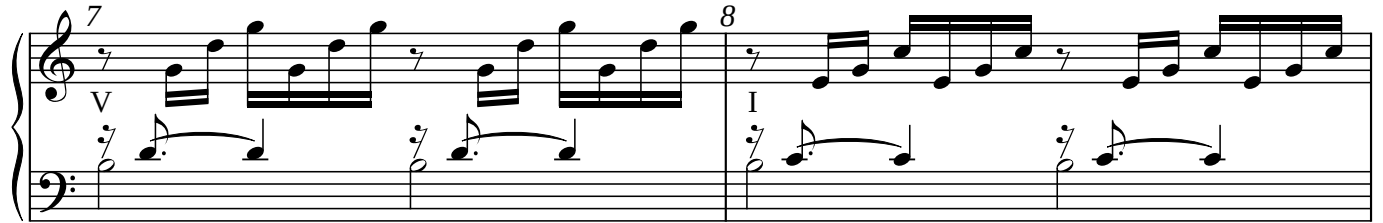
35.6:D-(h01/H72)

Measure:006.000

D-dominant seventh (d)

-6:5->(12 grps of 5) // (8 grps of 5)-3:2-----> -3:2->(12 grps of 2)-3:4----->

-3:2->(20 x three) // (8 x five)-3:5-----> -3:5->(8 x three) // (6 x four)-3:4----->

--> 6<sub>4</sub>0<sub>48</sub>0<sub>1</sub>MBN: 4<sub>4</sub>0<sub>48</sub>0<sub>1</sub> -----> 6<sub>4</sub>0<sub>32</sub>0<sub>1</sub>MBN: 10<sub>4</sub>0<sub>32</sub>0<sub>1</sub> -->

1152-D

6  
4  
48  
1

768-G

4  
4  
48  
1

768-G

6  
4  
32  
1

1280-E

10  
4  
32  
1

- 1123.7:D-(h24)  
1076.9:--(h23)  
1030.1:C#(h22)  
- 983.3:C-(h21)  
\* 936.4:B-(h20)  
889.6:A#(h19)  
- 842.8:A-(h18)  
796.0:G#(h17)  
\* 749.2:G-(h16) ----->  
- 702.3:F#(h15)  
655.5:F-(h14) -  
608.7:E-(h13)  
- \* 561.9:D-(h12)\* -  
515.0:C#(h11)  
468.2:B-(h10) -  
- 421.4:A-(h09)  
\* 374.6:G-(h08)\* -  
327.8:F-(h07)  
- 280.9:D-(h06) -  
234.1:B-(h05)  
R 187.3:G-(h04)R-  
- 140.5:D-(h03)  
93.6:G-(h02) -  
46.8:G-(h01/H48)

Measure:007.000

G-major (b)

1248.6:E-(h40)\* ----->  
1217.4:--(h39)  
1186.2:D#(h38) -  
1154.9:--(h37)  
1123.7:D-(h36)\* -  
1092.5:D-(h35)  
1061.3:C#(h34) -  
1030.1:--(h33)  
998.9:C-(h32)\* -  
967.7:--(h31)  
936.4:B-(h30) -  
905.2:--(h29)  
874.0:A#(h28)\* -  
842.8:A-(h27)  
811.6:A-(h26) -  
780.4:G#(h25)  
- \* 749.2:G-(h24)\* -  
717.9:--(h23)  
686.7:F#(h22) -  
- 655.5:F-(h21)  
\* 624.3:E-(h20)\* -  
593.1:D#(h19)  
- 561.9:D-(h18) -  
530.7:C#(h17)  
\* 499.4:C-(h16)\* -  
- 468.2:B-(h15)  
437.0:A#(h14) -  
405.8:A-(h13)  
- \* 374.6:G-(h12)\* -  
343.4:F#(h11)  
312.1:E-(h10) -  
- 280.9:D-(h09)  
\* 249.7:C-(h08)\* -  
234.1:B-( /H240)suspension...  
218.5:A#(h07)  
- 187.3:G-(h06) -  
156.1:E-(h05)  
\* 124.9:C-(h04)R-  
- 93.6:G-(h03)  
62.4:C-(h02) -  
31.2:C-(h01/H32)

Measure:008.000

C-major (a)

-3:4-&gt;(6 grps of 4) // (4grps of 4)-3:2-----&gt; -3:2-&gt;(6 grps of 4) // (10 grps of 4)-6:5-----&gt;

-3:4-&gt;(8 x three) // (8 x two)-3:2-----&gt; -3:2-&gt;(8 x three) // (20 x two)-3:2-----&gt;

-->  $9_2 0_{96} 0_1$  MBN:  $8_2 0_{96} 0_1$  ----->  $6_4 0_{64} 0_1$  MBN:  $5_4 0_{64} 0_1$  -->

1664-A 1536-G 1536-G 1280-E

9 8 6 5  
2 2 4 4  
96 96 64 64  
0.963 1 1 1

- \* 853.3:A-(h18)  
805.9:G#(h17)  
\* 758.5:G-(h16)\* -----> - \* 758.5:G-(h24)  
- 711.1:F#(h15) 726.9:--(h23)  
\* 663.7:F-(h14)\* - 695.3:F#(h22)  
- 616.3:E-(h13) - 663.7:F-(h21)  
- \* 568.9:D-(h12)\* - \* 632.1:E-(h20)\* ----->  
521.5:C#(h11) 600.5:D#(h19)  
\* 474.1:B-(h10)\* - - 568.9:D-(h18) -  
- 426.7:A-(h09) 537.3:C#(h17)  
\* 379.3:G-(h08)\* - \* 505.7:C-(h16)\* -  
331.9:F-(h07) - 474.1:B-(h15)  
- \* 284.4:D-(h06)\* - 442.5:A#(h14) -  
237.0:B-(h05) 410.9:A-(h13)  
\* 189.6:G-(h04)\* - - \* 379.3:G-(h12)\* -  
- 142.2:D-(h03) 347.7:F#(h11)  
R 94.8:G-(h02)R- 316.0:E-(h10) -  
47.4:G-(h01/H96) - 284.4:D-(h09)  
Measure:007.000 \* 252.8:C-(h08)\* -  
G-major (b) susps:B-( /H480)...  
221.2:A#(h07)  
- 189.6:G-(h06) -  
158.0:E-(h05)  
R 126.4:C-(h04)R-  
- 94.8:G-(h03)  
63.2:C-(h02) -  
31.6:C-(h01/H64)

Measure:008.000  
C-major (a)

-3:4->(9 grps of 2) // (8 grps of 2)-3:4-----> -3:4->(6 grps of 4) // (5 grps of 4)-6:5----->

-3:4->(6 x three) // (8 x two)-3:2-----> -3:2->(8 x three) // (10 x two)-3:2----->

Measures 5–8 continue the broadly similar analysis, as found in the opening four measures, with overall agreement concerning chord types and, allowing for some octave displacement, the ratios of exchange. However, although these ratios are in accord, the groupings in the aggregated series in measures 6 and 7 by which such agreement is achieved, varies. In the hand-made analysis groups of four are used whereas the computer has selected groups of two nested series elements. The reason for this lies in the choice of the lower conjunction A-h24/A-h18 – divisible by two but not four – by the computer program. Indeed, the pattern of lower conjunctions being chosen by the computer generated analysis again shows up in measure 8, where the hand-made analyst was swayed by a desire to echo the configurations found in measures 1 and 4. Note: the marking of the suspension in measures 7–8 in the computer-made analysis was add by hand.

--> 12<sub>5</sub>0<sub>21</sub>0<sub>1</sub>MBN: 8<sub>5</sub>0<sub>21</sub>0<sub>1</sub> -----> 6<sub>4</sub>0<sub>36</sub>0<sub>1</sub>MBN: 4<sub>4</sub>0<sub>36</sub>0<sub>1</sub> --->

1280-E

832-A

832-A

576-D

-----  
 12  
 5  
 21  
 1.016

-----  
 8  
 5  
 21  
 0.990

-----  
 6  
 4  
 36  
 0.963

-----  
 4  
 4  
 36  
 1

-\*1248.6:E- (h60)

1227.8:-- (h59)

1207.0:-- (h58)

- 1186.2:D# (h57)

1165.4:D# (h56)

\*1144.5:-- (h55)

- 1123.7:D- (h54)

1102.9:-- (h53)

1082.1:D- (h52)

- 1061.3:-- (h51)

\*1040.5:C# (h50)

1019.7:-- (h49)

- 998.9:C- (h48)

978.1:-- (h47)

957.3:-- (h46)

- \* 936.4:B- (h45)

915.6:B- (h44)

894.8:-- (h43)

- 874.0:A# (h42)

853.2:-- (h41)

\* 832.4:A- (h40) \* -----&gt;

- 811.6:-- (h39)

790.8:G# (h38)

770.0:-- (h37)

- 749.2:G- (h36)

\* 728.3:G- (h35) \* -

707.5:F# (h34)

- 686.7:-- (h33)

665.9:F- (h32)

645.1:-- (h31)

- \* 624.3:E- (h30) \* -

603.5:-- (h29)

582.7:D# (h28)

- 561.9:D- (h27)

541.1:D- (h26)

\* 520.2:C# (h25) \* -

- 499.4:C- (h24)

478.6:-- (h23)

457.8:B- (h22)

- 437.0:A# (h21)

\* 416.2:A- (h20) \* -

395.4:G# (h19)

- 374.6:G- (h18)

353.8:F# (h17)

333.0:F- (h16)

- \* 312.1:E- (h15) \* -

291.3:D# (h14)

270.5:D- (h13)

- 249.7:C- (h12)

228.9:B- (h11)

\* 208.1:A- (h10) \* -resolution

- 187.3:G- (h09)

166.5:F- (h08)

145.7:D# (h07)

- 124.9:C- (h06)

R 104.0:A- (h05)R-

83.2:F- (h04)

- 62.4:C- (h03)

41.6:F- (h02)

20.8:F- (h01/H21)

Measure:009.000 A-minor seventh (a)

-6:5-&gt;(12 grps of 5) // (8 grps of 5)-3:4-----&gt; -3:4-&gt;(6 grps of 4) // (4 grps of 4)-3:2-----&gt;

-3:2-&gt;(20xthree) // (8 x five)-3:5-----&gt; -3:5-&gt;(8 x three) // (8 x two)-3:2-----&gt;

\* 832.4:A- (h24)

797.7:-- (h23)

763.0:G# (h22)

- 728.3:G- (h21)

\* 693.7:F# (h20)

659.0:F- (h19)

- 624.3:E- (h18)

589.6:D# (h17)

\* 554.9:D- (h16) \* -----&gt;

- 520.2:C# (h15)

485.6:C- (h14)

450.9:B- (h13)

- \* 416.2:A- (h12) \* -

381.5:G# (h11)

346.8:F# (h10)

- 312.1:E- (h09)

\* 277.5:D- (h08) \* -

242.8:C- (h07)

- 208.1:A- (h06)

173.4:F# (h05)

R 138.7:D- (h04)R-

- 104.0:A- (h03)

69.4:D- (h02)

34.7:D- (h01/H36)

Measure:010.000

D-dominant seventh (a)

-->  $6_5 0_{42} 0_1$  MBN:  $8_5 0_{42} 0_1$  ----->  $6_4 0_{72} 0_1$  MBN:  $4_4 0_{72} 0_1$  ---->

1280-E                      1664-A                      1664-A                      1152-D

6                      8                      6                      4  
5                      5                      4                      4  
42                      42                      72                      72  
1.016                      0.990                      0.963                      1

842.8:A-(h40)\*-----> - \* 842.8:A-(h24)  
 821.7:--(h39)                      807.7:--(h23)  
 800.7:G#(h38)                      772.6:G#(h22)  
 779.6:--(h37)                      - 737.4:G-(h21)  
 758.5:G-(h36)                      \* 702.3:F#(h20)  
 737.4:G-(h35)\*-                      667.2:F-(h19)  
 716.4:F#(h34)                      - 632.1:E-(h18)  
 695.3:--(h33)                      597.0:D#(h17)  
 674.2:F-(h32)                      \* 561.9:D-(h16)\*----->  
 653.2:--(h31)                      - 526.7:C#(h15)  
 - \* 632.1:E-(h30)\*-                      491.6:C-(h14) -  
 611.0:--(h29)                      456.5:B-(h13)  
 590.0:D#(h28)                      - \* 421.4:A-(h12)\*-  
 - 568.9:D-(h27)                      386.3:G#(h11)  
 547.8:D-(h26)                      351.2:F#(h10) -  
 \* 526.7:C#(h25)\*-                      - 316.0:E-(h09)  
 - 505.7:C-(h24)                      \* 280.9:D-(h08)\*-  
 484.6:--(h23)                      245.8:C-(h07)  
 463.5:B-(h22)                      - 210.7:A-(h06) -  
 - 442.5:A#(h21)                      175.6:F#(h05)  
 \* 421.4:A-(h20)\*-                      R 140.5:D-(h04)R-  
 400.3:G#(h19)                      - 105.3:A-(h03)  
 - 379.3:G-(h18)                      70.2:D-(h02) -  
 358.2:F#(h17)                      35.1:D-(h01/H72)  
 337.1:F-(h16)  
 - \* 316.0:E-(h15)\*-  
 295.0:D#(h14)  
 273.9:D-(h13)  
 - 252.8:C-(h12)  
 231.8:B-(h11)  
 \* 210.7:A-(h10)\*- resolution  
 - 189.6:G-(h09)  
 168.6:F-(h08)  
 147.5:D#(h07)  
 - 126.4:C-(h06)  
 R 105.3:A-(h05)R-  
 84.3:F-(h04)  
 - 63.2:C-(h03)  
 42.1:F-(h02)  
 21.1:F-(h01/H42)

Measure:009.000  
 A-minor seventh (a)

Measure:010.000  
 D-dominant seventh (a)

-6:5->(6 grps of 5) // (8 grps of 5)-3:4-----> -3:4->(6 grps of 4) // (4 grps of 4)-3:2----->

-3:2->(10 x three) // (8 x five)-3:5-----> -3:5->(8 x three) // (8 x two)-3:2----->

--> 6<sub>4</sub>0<sub>24</sub>0<sub>1</sub>MBN: 6<sub>4</sub>0<sub>24</sub>0<sub>1</sub> -----> 30<sub>19</sub>0<sub>1</sub>MBN: 30<sub>19</sub>0<sub>1</sub> --->

576-D

6  
4  
24  
1

576-D

\*\*  
30  
19  
1.011

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>- * 554.9:D-(h24)* -----&gt;</p> <p>531.8:--(h23)</p> <p>508.7:C#(h22)</p> <p>- 485.6:C-(h21)</p> <p>* 462.4:B-(h20)* -</p> <p>439.3:A#(h19)</p> <p>- 416.2:A-(h18)</p> <p>393.1:G#(h17)</p> <p>* 370.0:G-(h16)* -</p> <p>- 346.8:F#(h15)</p> <p>323.7:F-(h14)</p> <p>300.6:E-(h13)</p> <p>- * 277.5:D-(h12)* -</p> <p>254.3:C#(h11)</p> <p>231.2:B-(h10)</p> <p>- 208.1:A-(h09)</p> <p>* 185.0:G-(h08)* -</p> <p>161.9:F-(h07)</p> <p>- 138.7:D-(h06)</p> <p>115.6:B-(h05)</p> <p>R 92.5:G-(h04)R-</p> <p>- 69.4:D-(h03)</p> <p>46.2:G-(h02)</p> <p>23.1:G-(h01/H24)</p> <p>Measure:011.000</p> <p>G-major (a)</p> | <p>- * 554.9:D-(h30)* -----&gt;</p> <p>536.4:--(h29)</p> <p>517.9:C#(h28)</p> <p>499.4:C-(h27) -</p> <p>480.9:C-(h26)</p> <p>- 462.4:B-(h25)</p> <p>443.9:A#(h24) -</p> <p>425.4:--(h23)</p> <p>406.9:A-(h22)</p> <p>388.5:G#(h21) -</p> <p>- 370.0:G-(h20)</p> <p>351.5:F#(h19)</p> <p>333.0:F-(h18) -</p> <p>314.5:E-(h17)</p> <p>296.0:D#(h16)</p> <p>- 277.5:D-(h15) -</p> <p>259.0:C#(h14)</p> <p>240.5:C-(h13)</p> <p>222.0:A#(h12) -</p> <p>203.5:A-(h11)</p> <p>- 185.0:G-(h10)</p> <p>166.5:F-(h09) -</p> <p>148.0:D#(h08)</p> <p>129.5:C#(h07)</p> <p>111.0:A#(h06) -</p> <p>- 92.5:G-(h05)</p> <p>74.0:D#(h04)</p> <p>55.5:A#(h03) -</p> <p>37.0:D#(h02)</p> <p>R 18.5:D#(h01/H19)R</p> <p>Measure:012.000 diminished seventh</p> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

-3:2->(6 groups of 4)-----> ...No perceived root.....

-3:2->(8 x three) - (6 x four)-5:4-----> -5:4->(6 x five) - (10 x three)-4:3----->

Measure 12: The top level aggregated series is subsumed into the middle level nested series, as no perceived root emerges from the awkward combination of ratios G-h3(×4), A#h7(×2), E-h5(×4) and C#h17(×2). Although the common factor of two (C-h2) is present between the note-ratios, the note C itself is not present in the chord and further, its existence as an implied root is countered by the dissonant presence of C# in the chord. The *txt2mos* scripts' representation of a rootless chord (shown unedited on the following page) is essentially no different from a normal rooted chord, however, due to the notes' clashing ratios no aggregation into groups of elements occurs, and the resulting large number of individual lie well beyond the ear's power to discern a root – i.e. 30 groups of 1. (The use of a single asterisk above is a shorthand for .)

-->  $6_4 0_{48} 0_1$  MBN:  $5_4 0_{48} 0_1$  ----->  $30_{32} 0_1$  MBN:  $26_{32} 0_1$  ---->

1152-D

6  
4  
48  
1

960-B

5  
4  
48  
1

960-B

\*\*  
30  
32  
1

( 1152-D )  
( \*\* )  
( 36 )  
( 32 )  
( 1 )

832-A

\*\*  
26  
32  
1

- \* 561.9:D-(h24) --(amended conjunction)-->  
538.5:--(h23)

515.0:C#(h22)

- 491.6:C-(h21)

\* 468.2:B-(h20) \* ----->

444.8:A#(h19)

- 421.4:A-(h18) -

398.0:G#(h17)

\* 374.6:G-(h16) \* -

- 351.2:F#(h15)

327.8:F-(h14) -

304.3:E-(h13)

- \* 280.9:D-(h12) \* -

257.5:C#(h11)

234.1:B-(h10) -

- 210.7:A-(h09)

\* 187.3:G-(h08) \* -

163.9:F-(h07)

- 140.5:D-(h06) -

117.1:B-(h05)

R 93.6:G-(h04)R-

- 70.2:D-(h03)

46.8:G-(h02) -

23.4:G-(h01/H48)

Measure:011.000  
G-major (a)

561.9:D-(h36)

(h35)

530.6:C#(h34)

(h33)

(h32)

(h31)

- \* 468.2:B-(h30)

\* 452.6:--(h29)

\* 437.0:A#(h28)

- \* 421.4:A-(h27)

\* 405.8:A-(h26) \* ----->

\* 390.2:G#(h25) \*

- \* 374.6:G-(h24) \*

\* 359.0:--(h23) \*

\* 343.4:F#(h22) \*

- \* 327.8:F-(h21) \*

\* 312.1:E-(h20) \*

\* 296.5:D#(h19) \*

- \* 280.9:D-(h18) \*

\* 265.3:C#(h17) \*

\* 249.7:C-(h16) \*

- \* 234.1:B-(h15) \*

\* 218.5:A#(h14) \*

\* 202.9:A-(h13) \* -

- \* 187.3:G-(h12) \*

\* 171.7:F#(h11) \*

\* 156.1:E-(h10) \*

- \* 140.5:D-(h09) \*

\* 124.9:C-(h08) \*

\* 109.3:A#(h07) \*

- \* 93.6:G-(h06) \*

\* 78.0:E-(h05) \*

\* 62.4:C-(h04) \*

- \* 46.8:G-(h03) \*

\* 31.2:C-(h02) \*

R 15.6:C-(h01/H32)R

Measure:012.000  
diminished seventh (rootless)

-3:2->(6 grps of 4) // (5 grps of 4)-6:1-----> (No perceived root, 30 grps of 1) // (26 grps of 1)-3:13----->

-3:2->(8 x three) // (10 x two)-3:2-----> -3:2->(10 x three) // (2 x thirteen)-15:13----->

Measure 12: The choice by the *txt2mos* script of a conjunction (B-h30) below the top note of the chord is due to an internal restriction of aggregated series to no more than 32 ratios of the harmonic series. The conjunction would normally be amended upward when editing the *txt2mos* output file – as shown above. This situation recurs in measures 13–14.

--> 8<sub>5</sub>0<sub>14</sub>0<sub>1</sub>MBN: 40<sub>14</sub>0<sub>1</sub>-----> 40<sub>14</sub>0<sub>1</sub>MBN: 36<sub>14</sub>0<sub>1</sub> --->

13 ii 14 dim7

576-D 576-D 512-C

8 5 14 1.029

36 14 1.016

|                            |                          |
|----------------------------|--------------------------|
| - * 554.9:D- (h40) *-----> | - * 554.9:D- (h40)       |
| 541.1:-- (h39) -           | - 541.1:-- (h39)         |
| 527.2:C#(h38) -            | - 527.2:C#(h38)          |
| 513.3:-- (h37) -           | - 513.3:-- (h37)         |
| - 499.4:C- (h36) -         | - 499.4:C- (h36) *-----> |
| * 485.6:C- (h35) *-        | - 485.6:C- (h35)         |
| 471.7:B- (h34) -           | - 471.7:B- (h34)         |
| 457.8:-- (h33) -           | - 457.8:-- (h33)         |
| - 443.9:A#(h32) -          | - 443.9:A#(h32)          |
| 430.1:-- (h31) -           | - 430.1:-- (h31)         |
| * 416.2:A- (h30) *-        | - 416.2:A- (h30)         |
| 402.3:-- (h29) -           | - 402.3:-- (h29)         |
| - 388.5:G#(h28) -          | - 388.5:G#(h28)          |
| 374.6:G- (h27) -           | - 374.6:G- (h27) -       |
| 360.7:G- (h26) -           | - 360.7:G- (h26)         |
| * 346.8:F#(h25) *-         | - 346.8:F#(h25)          |
| - 333.0:F- (h24) -         | - 333.0:F- (h24)         |
| 319.1:-- (h23) -           | - 319.1:-- (h23)         |
| 305.2:E- (h22) -           | - 305.2:E- (h22)         |
| 291.3:D#(h21) -            | - 291.3:D#(h21)          |
| - * 277.5:D- (h20) -       | - 277.5:D- (h20)         |
| 263.6:C#(h19) -            | - 263.6:C#(h19)          |
| 249.7:C- (h18) -           | - 249.7:C- (h18) -       |
| 235.8:B- (h17) -           | - 235.8:B- (h17)         |
| - 222.0:A#(h16) -          | - 222.0:A#(h16)          |
| * 208.1:A- (h15) *-        | - 208.1:A- (h15)         |
| 194.2:G#(h14) -            | - 194.2:G#(h14)          |
| 180.4:G- (h13) -           | - 180.4:G- (h13)         |
| - 166.5:F- (h12) -         | - 166.5:F- (h12)         |
| 152.6:E- (h11) -           | - 152.6:E- (h11)         |
| * 138.7:D- (h10) *-        | - 138.7:D- (h10)         |
| 124.9:C- (h09) -           | - 124.9:C- (h09) -       |
| - 111.0:A#(h08) -          | - 111.0:A#(h08)          |
| 97.1:G#(h07) -             | - 97.1:G#(h07)           |
| 83.2:F- (h06) -            | - 83.2:F- (h06)          |
| R 69.4:D- (h05)R-          | - 69.4:D- (h05)          |
| - 55.5:A#(h04) -           | - 55.5:A#(h04)           |
| 41.6:F- (h03) -            | - 41.6:F- (h03)          |
| 27.7:A#(h02) -             | - 27.7:A#(h02)           |
| 13.9:A#(h01/H14) -         | -R 13.9:A#(h01/H14)R     |

Measure:013.000

D-minor (b)

Measure:014.000

diminished seventh (rootless)

-4:3-&gt;(8 groups of 5)-----&gt; ...No perceived root.....

-4:3-&gt;(10 x four) // (40 x one)-----1:1-----&gt; -1:1-&gt;(40 x one) // (4 x nine)-----8:9-----&gt;



--> 6<sub>5</sub>0<sub>28</sub>0<sub>1</sub> MBN: 30<sub>28</sub>0<sub>1</sub>-----> 30<sub>28</sub>0<sub>1</sub> MBN: 26<sub>28</sub>0<sub>1</sub> ---->

832-A 832-A 768-G

6 5 28 0.990 \*\* 30 28 0.990 \*\* 26 28 1.055

|                                         |                               |
|-----------------------------------------|-------------------------------|
| 541.0:D-(h40)--(amended conjunction)--> | 541.0:D-(h40)                 |
| (h39)                                   | (h39)                         |
| (h38)                                   | (h38)                         |
| (h37)                                   | (h37)                         |
| (h36)                                   | (h36)                         |
| (h35)                                   | (h35)                         |
| (h34)                                   | 460.0:B-(h34)                 |
| (h33)                                   | (h33)                         |
| (h32)                                   | (h32)                         |
| (h31)                                   | (h31)                         |
| - * 405.8:A-(h30)*----->                | - * 405.8:A-(h30)             |
| 392.3:--(h29) -                         | - * 392.3:--(h29)             |
| 378.7:G#(h28) -                         | - * 378.7:G#(h28)             |
| 365.2:G-(h27) -                         | - * 365.2:G-(h27)             |
| 351.7:G-(h26) -                         | - * 351.7:G-(h26)*----->      |
| * 338.2:F#(h25)*                        | - * 338.2:F#(h25)*            |
| 324.6:F-(h24) -                         | - * 324.6:F-(h24)*            |
| 311.1:--(h23) -                         | - * 311.1:--(h23)*            |
| 297.6:E-(h22) -                         | - * 297.6:E-(h22)*            |
| 284.1:D#(h21) -                         | - * 284.1:D#(h21)*            |
| * 270.5:D-(h20)*                        | - * 270.5:D-(h20)*            |
| 257.0:C#(h19) -                         | - * 257.0:C#(h19)*            |
| 243.5:C-(h18) -                         | - * 243.5:C-(h18)*            |
| 229.9:B-(h17) -                         | - * 229.9:B-(h17)*            |
| 216.4:A#(h16) -                         | - * 216.4:A#(h16)*            |
| - * 202.9:A-(h15)*                      | - * 202.9:A-(h15)*            |
| 189.4:G#(h14) -                         | - * 189.4:G#(h14)*            |
| 175.8:G-(h13) -                         | - * 175.8:G-(h13)*            |
| 162.3:F-(h12) -                         | - * 162.3:F-(h12)*            |
| 148.8:E-(h11) -                         | - * 148.8:E-(h11)*            |
| * 135.3:D-(h10)*                        | - * 135.3:D-(h10)*            |
| 121.7:C-(h09) -                         | - * 121.7:C-(h09)*            |
| 108.2:A#(h08) -                         | - * 108.2:A#(h08)*            |
| 94.7:G#(h07) -                          | - * 94.7:G#(h07)*             |
| 81.2:F-(h06) -                          | - * 81.2:F-(h06)*             |
| R 67.6:D-(h05)R-                        | - * 67.6:D-(h05)*             |
| 54.1:A#(h04) -                          | - * 54.1:A#(h04)*             |
| 40.6:F-(h03) -                          | - * 40.6:F-(h03)*             |
| 27.1:A#(h02) -                          | - * 27.1:A#(h02)*             |
| 13.5:A#(h01/H28) -                      | -R 13.5:A#(h01/H28)R          |
| Measure:013.000                         | Measure:014.000               |
| D-minor (b)                             | diminished seventh (rootless) |

-3:13->(6 grps of 5)-5:1-----> (No perceived root, 30 grps of 1) // (26 grps of 1)-3:13----->

-15:13->(2 x fifteen) // (30 x one)-1:1-----> -1:1->(30 x one) // (2 x thirteen)-12:13----->

--> 4<sub>8</sub>0<sub>16</sub>0<sub>1</sub>MBN: 4<sub>8</sub>0<sub>16</sub>0<sub>1</sub> -----> 6<sub>6</sub>0<sub>14</sub>0<sub>1</sub>MBN: 5<sub>6</sub>0<sub>14</sub>0<sub>1</sub> ---->

512-C

512-C

416-A

4  
8  
16  
1

6  
6  
14  
1.016

5  
6  
14  
0.990

- \* 499.4:C-(h32)\* -----> - \* 499.4:C-(h36)

483.8:--(h31) 485.6:C-(h35)

468.2:B-(h30) 471.7:B-(h34)

452.6:--(h29) 457.8:--(h33)

437.0:A#(h28) 443.9:A#(h32)

421.4:A-(h27) 430.1:--(h31)

405.8:A-(h26) \* 416.2:A-(h30)\* ----->

390.2:G#(h25) 402.3:--(h29) -

- \* 374.6:G-(h24)\* - 388.5:G#(h28) -

359.0:--(h23) - 374.6:G-(h27) -

343.4:F#(h22) 360.7:G-(h26) -

327.8:F-(h21) 346.8:F#(h25) -

312.1:E-(h20) \* 333.0:F-(h24)\* -

296.5:D#(h19) 319.1:--(h23) -

280.9:D-(h18) 305.2:E-(h22) -

265.3:C#(h17) 291.3:D#(h21) -

- \* 249.7:C-(h16)\* - 277.5:D-(h20) -

234.1:B-(h15) 263.6:C#(h19) -

218.5:A#(h14) - \* 249.7:C-(h18)\* -

202.9:A-(h13) 235.8:B-(h17) -

187.3:G-(h12) 222.0:A#(h16) -

171.7:F#(h11) 208.1:A-(h15) -

156.1:E-(h10) 194.2:G#(h14) -

140.5:D-(h09) 180.4:G-(h13) -

-R 124.9:C-(h08)R- \* 166.5:F-(h12) -

109.3:A#(h07) 152.6:E-(h11) -

93.6:G-(h06) 138.7:D-(h10) -

78.0:E-(h05) - 124.9:C-(h09) -

62.4:C-(h04) 111.0:A#(h08) -

46.8:G-(h03) 97.1:G#(h07) -

31.2:C-(h02) R 83.2:F-(h06)R-

15.6:C-(h01/H16) 69.4:D-(h05) -

Measure:015.000 55.5:A#(h04) -

C-major (b) 41.6:F-(h03) -

27.7:A#(h02) -

13.9:A#(h01/H14) -

Measure:016.000  
F-major seventh

.....(4 groups of 8)-3:2-----> -3:2->(6 grps of 6) // (5 grps of 6)-6:5----->

-8:9->(4 x eight)-9:8-----> -9:8->(4 x nine) // (30 x one)-1:1----->

Measure 16 is the only place where the chord identification diverge in the two analyses, with the human analyst choosing F-major seventh. The suspended E has been identified by the *txt2mos* script and the chord type is therefore set to that of D-minor, the chord of resolution found in measure 17, in accordance with its internal rules. Goldman (1965, p170) gives both these interpretations analysis: ii<sup>7</sup> (E suspended) or IV<sup>7</sup>.



--> 6<sub>5</sub>0<sub>14</sub>0<sub>1</sub>MBN: 8<sub>5</sub>0<sub>14</sub>0<sub>1</sub> -----> 6<sub>4</sub>0<sub>24</sub>0<sub>1</sub>MBN: 4<sub>4</sub>0<sub>24</sub>0<sub>1</sub> --->

416-A  
6  
5  
14  
0.990

576-D  
8  
5  
14  
1.029

576-D  
6  
4  
24  
1

384-G  
4  
4  
24  
1

554.9:D-(h40)\*-----> - \* 554.9:D-(h24)  
 541.1:--(h39) 531.8:--(h23)  
 527.2:C#(h38) 508.7:C#(h22)  
 513.3:--(h37) - 485.6:C-(h21)  
 499.4:C-(h36) \* 462.4:B-(h20)  
 485.6:C-(h35)\*- 439.3:A#(h19)  
 471.7:B-(h34) - 416.2:A-(h18)  
 457.8:--(h33) 393.1:G#(h17)  
 443.9:A#(h32) \* 370.0:G-(h16)\*----->  
 430.1:--(h31) - 346.8:F#(h15)  
 - \* 416.2:A-(h30)\*- 323.7:F-(h14)  
 - 402.3:--(h29) 300.6:E-(h13)  
 - 388.5:G#(h28) - \* 277.5:D-(h12)\*-  
 - 374.6:G-(h27) 254.3:C#(h11)  
 - 360.7:G-(h26) 231.2:B-(h10)  
 - \* 346.8:F#(h25)\*- - 208.1:A-(h09)  
 - 333.0:F-(h24) \* 185.0:G-(h08)\*-  
 - 319.1:--(h23) 161.9:F-(h07)  
 - 305.2:E-(h22) - 138.7:D-(h06)  
 - 291.3:D#(h21) 115.6:B-(h05)  
 - \* 277.5:D-(h20)\*- R 92.5:G-(h04)R-  
 - 263.6:C#(h19) - 69.4:D-(h03)  
 - 249.7:C-(h18) 46.2:G-(h02)  
 - 235.8:B-(h17) 23.1:G-(h01/H24)  
 - 222.0:A#(h16)  
 - \* 208.1:A-(h15)\*-  
 - 194.2:G#(h14)  
 - 180.4:G-(h13)  
 - 166.5:F-(h12)  
 - 152.6:E-(h11)  
 - \* 138.7:D-(h10)\*-  
 - 124.9:C-(h09)  
 - 111.0:A#(h08)  
 - 97.1:G#(h07)  
 - 83.2:F-(h06)  
 -R 69.4:D-(h05)R-  
 - 55.5:A#(h04)  
 - 41.6:F-(h03)  
 - 27.7:A#(h02)  
 - 13.9:A#(h01/H14)

Measure:017.000

D-minor seventh (a)

Measure 018.000

G-dominant seventh (a)

-6:5-&gt;(6 grps of 5) // (8 grps of 5)-3:4-----&gt; -3:4-&gt;(6 grps of 4) // (4 grps of 4)-----&gt;3:4-----&gt;

-1:1-&gt;(30 x one) // (8 x five)-3:5-----&gt; -3:5-&gt;(8 x three) // (4 x four)-----&gt;3:4-----&gt;

--> 6<sub>5</sub>0<sub>28</sub>0<sub>1</sub>MBN: 8<sub>5</sub>0<sub>28</sub>0<sub>1</sub> -----> 6<sub>4</sub>0<sub>48</sub>0<sub>1</sub>MBN: 4<sub>4</sub>0<sub>48</sub>0<sub>1</sub> --->

832-A

6  
5  
28  
0.990

1152-D

8  
5  
28  
1.029

1152-D

6  
4  
48  
1

768-G

4  
4  
48  
1

527.5:D-(h40)\*-----> - \* 527.5:D-(h24)  
 514.3:--(h39) 505.5:--(h23)  
 501.2:C#(h38) 483.6:C#(h22)  
 488.0:--(h37) - 461.6:C-(h21)  
 474.8:C-(h36) \* 439.6:B-(h20)  
 461.6:C-(h35)\*- 417.6:A#(h19)  
 448.4:B-(h34) - 395.6:A-(h18)  
 435.2:--(h33) - 373.7:G#(h17)  
 422.0:A#(h32) \* 351.7:G-(h16)\*----->  
 408.8:--(h31) - 329.7:F#(h15)  
 - \* 395.6:A-(h30)\*- 307.7:F-(h14)  
 - 382.5:--(h29) 285.7:E-(h13)  
 - 369.3:G#(h28) - \* 263.8:D-(h12)\*-  
 - 356.1:G-(h27) 241.8:C#(h11)  
 - 342.9:G-(h26) 219.8:B-(h10)  
 - \* 329.7:F#(h25)\*- 197.8:A-(h09)  
 - 316.5:F-(h24) \* 175.8:G-(h08)\*-  
 - 303.3:--(h23) 153.9:F-(h07)  
 - 290.1:E-(h22) - 131.9:D-(h06)  
 - 277.0:D#(h21) 109.9:B-(h05)  
 - \* 263.8:D-(h20)\*- R 87.9:G-(h04)R-  
 - 250.6:C#(h19) - 65.9:D-(h03)  
 - 237.4:C-(h18) 44.0:G-(h02)  
 - 224.2:B-(h17) 22.0:G-(h01/H48)  
 - 211.0:A#(h16) Measure:018.000  
 - \* 197.8:A-(h15)\*- G-dominant seventh (a)  
 - 184.6:G#(h14)  
 - 171.4:G-(h13)  
 - 158.3:F-(h12)  
 - 145.1:E-(h11)  
 - \* 131.9:D-(h10)\*-  
 - 118.7:C-(h09)  
 - 105.5:A#(h08)  
 - 92.3:G#(h07)  
 - 79.1:F-(h06)  
 -R 65.9:D-(h05)R-  
 - 52.8:A#(h04)  
 - 39.6:F-(h03)  
 - 26.4:A#(h02)  
 - 13.2:A#(h01/H28)  
 Measure:017.000  
 D-minor seventh (a)

-1:1-&gt;(6 grps of 5) // (8 grps of 5)-3:4-----&gt; -3:4-&gt;(6 grps of 4) // (4 grps of 4)-----&gt;3:2-----&gt;

-1:1-&gt;(30 x one) // (8 x five)-----&gt;3:5-----&gt; -3:5-&gt;(8 x three) // (4 x four)-----&gt;3:4-----&gt;

-->  $3_4 0_{32} 0_1$ MBN:  $3_4 0_{32} 0_1$  ----->  $6_4 0_{16} 0_1$ MBN:  $6_4 0_{16} 0_1$  ---->

19

20

384-G

384-G

3  
4  
32  
1

6  
4  
16  
1

|                           |                           |
|---------------------------|---------------------------|
| - * 370.0:G-(h12)* -----> | - * 370.0:G-(h24)* -----> |
| 339.1:F#(h11) -           | 354.5:--(h23)             |
| 308.3:E-(h10) -           | - 339.1:F#(h22)           |
| - 277.5:D-(h09) -         | 323.7:F-(h21)             |
| * 246.6:C-(h08)* -        | - * 308.3:E-(h20)* -      |
| 215.8:A#(h07) -           | 292.9:D#(h19)             |
| - 185.0:G-(h06) -         | - 277.5:D-(h18)           |
| 154.1:E-(h05) -           | 262.0:C#(h17)             |
| R 123.3:C-(h04)R-         | - * 246.6:C-(h16)* -      |
| - 92.5:G-(h03) -          | 231.2:B-(h15)             |
| 61.7:C-(h02) -            | - 215.8:A#(h14)           |
| 30.8:C-(h01/H32) -        | 200.4:A-(h13)             |
|                           | - * 185.0:G-(h12)* -      |
|                           | 169.6:F#(h11)             |
|                           | - 154.1:E-(h10)           |
|                           | 138.7:D-(h09)             |
|                           | - * 123.3:C-(h08)* -      |
|                           | 107.9:A#(h07)             |
|                           | - 92.5:G-(h06)            |
|                           | 77.1:E-(h05)              |
|                           | -R 61.7:C-(h04)R-         |
|                           | 46.2:G-(h03)              |
|                           | - 30.8:C-(h02)            |
|                           | 15.4:C-(h01/H16)          |
| Measure:019.000           | Measure:020.000           |
| C-major (a)               | C-dominant seventh (a)    |

-3:4->(3 grps of 4)-2:1----->      -2:1->(6 grps of 4)-3:2----->

-3:4->(4 x three) // (12 x one)-2:1----->      -2:1->(12 x two) // (6 x four)-3:4----->

Measures 16–20 follow remarkably similar paths with identical conjunctions from measure 16 outgoing to measure 19 incoming. In the exchange from measure 18–19 the automatic computer analysis moves the root downward by changing the grouping in the aggregate series from groups of 4 to groups of 2, foreshadowing the octave leap in the hand-made analysis in measure 19–20.

--> 6<sub>2</sub>0<sub>64</sub>0<sub>1</sub>MBN: 5<sub>2</sub>0<sub>64</sub>0<sub>1</sub> -----> 5<sub>2</sub>0<sub>64</sub>0<sub>1</sub>MBN: 8<sub>2</sub>0<sub>64</sub>0<sub>1</sub> ---->

Measure 19: 768-G, 640-E, 640-E, 1024-C

Measure 20: 468.9:C-(h16)\*, 439.6:B-(h15), 410.3:A#(h14)\*, 381.0:A-(h13), 351.7:G-(h12)\*, 322.4:F#(h11), 293.1:E-(h10)\*, 263.8:D-(h09), 234.5:C-(h08)\*, 205.2:A#(h07), 175.8:G-(h06)\*, 146.5:E-(h05), 117.2:C-(h04)\*, 87.9:G-(h03), 58.6:C-(h02)R, 29.3:C-(h01/H64)

- \* 351.7:G-(h12)

322.4:F#(h11)

\* 293.1:E-(h10)\* -----&gt;

- 263.8:D-(h09) -

\* 234.5:C-(h08)\* -

205.2:A#(h07) -

- \* 175.8:G-(h06)\* -

146.5:E-(h05) -

\* 117.2:C-(h04)\* -

- 87.9:G-(h03) -

R 58.6:C-(h02)R-

29.3:C-(h01/H64) -

Measure:019.000

C-major (a)

-3:2-&gt;(6 grps of 2) // (5 grps of 2)-1:1-----&gt;

-3:4-&gt;(4 x three) // (10 x one)-1:1-----&gt;

468.9:C-(h16)\* -----&gt;

439.6:B-(h15)

410.3:A#(h14)\* -

381.0:A-(h13)

351.7:G-(h12)\* -

322.4:F#(h11)

- \* 293.1:E-(h10)\* -

- 263.8:D-(h09)

- \* 234.5:C-(h08)\* -

- 205.2:A#(h07)

- \* 175.8:G-(h06)\* -

- 146.5:E-(h05)

- \* 117.2:C-(h04)\* -

- 87.9:G-(h03)

-R 58.6:C-(h02)R-

- 29.3:C-(h01/H64)

Measure:020.000

C-dominant seventh (b)

-1:1-&gt;(5 grps of 2) // (8 grps of 2)-3:2-----&gt;

-1:1-&gt;(10 x one) // (8 x two)-3:2-----&gt;

Measures 1–35: In the production of the column data by the *mos2col* script the frequencies (first figure in the column) are rounded to one decimal place for compactness, this may at times effect the exactitude of the numbers on occasion.

--> 9<sub>2</sub>0<sub>21</sub>0<sub>1</sub>MBN: 9<sub>2</sub>0<sub>21</sub>0<sub>1</sub> -----> 48<sub>8</sub>0<sub>1</sub>MBN: 48<sub>8</sub>0<sub>1</sub> ---->

21  
IV7

22  
dim7

384-G  
-----  
9  
2  
21  
1.016

384-G  
-----  
\*\*  
48  
8  
1

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>- * 370.0:G-(h18)* -----&gt;</p> <p>349.4:F#(h17)</p> <p>* 328.8:F-(h16)*</p> <p>- 308.3:E-(h15) -</p> <p>* 287.7:D#(h14)*</p> <p>267.2:D-(h13)</p> <p>- * 246.6:C-(h12)* -</p> <p>226.1:B-(h11)</p> <p>* 205.5:A-(h10)*</p> <p>- 185.0:G-(h09) -</p> <p>* 164.4:F-(h08)*</p> <p>143.9:D#(h07)</p> <p>- * 123.3:C-(h06)* -</p> <p>102.8:A-(h05)</p> <p>* 82.2:F-(h04)*</p> <p>- 61.7:C-(h03) -</p> <p>R 41.1:F-(h02)R</p> <p>20.6:F-(h01/H21)</p> <p>Measure:021.000</p> <p>F-major seventh (a)</p> | <p>- * 370.0:G-(h48)* -----&gt;</p> <p>362.2:--(h47)</p> <p>354.5:--(h46)</p> <p>346.8:F#(h45)</p> <p>339.1:F#(h44)</p> <p>331.4:--(h43)</p> <p>323.7:F-(h42)</p> <p>316.0:--(h41)</p> <p>- 308.3:E-(h40)</p> <p>300.6:--(h39)</p> <p>292.9:D#(h38)</p> <p>285.2:--(h37)</p> <p>277.5:D-(h36)</p> <p>269.8:D-(h35)</p> <p>262.0:C#(h34)</p> <p>254.3:--(h33)</p> <p>- 246.6:C-(h32) -</p> <p>238.9:--(h31)</p> <p>231.2:B-(h30)</p> <p>223.5:--(h29)</p> <p>215.8:A#(h28)</p> <p>208.1:A-(h27)</p> <p>200.4:A-(h26)</p> <p>192.7:G#(h25)</p> <p>- 185.0:G-(h24)</p> <p>177.3:--(h23)</p> <p>169.6:F#(h22)</p> <p>161.9:F-(h21)</p> <p>154.1:E-(h20)</p> <p>146.4:D#(h19)</p> <p>138.7:D-(h18)</p> <p>131.0:C#(h17)</p> <p>- 123.3:C-(h16) -</p> <p>115.6:B-(h15)</p> <p>107.9:A#(h14)</p> <p>100.2:A-(h13)</p> <p>92.5:G-(h12)</p> <p>84.8:F#(h11)</p> <p>77.1:E-(h10)</p> <p>69.4:D-(h09)</p> <p>- 61.7:C-(h08)</p> <p>54.0:A#(h07)</p> <p>46.2:G-(h06)</p> <p>38.5:E-(h05)</p> <p>30.8:C-(h04)</p> <p>23.1:G-(h03)</p> <p>15.4:C-(h02)</p> <p>R 7.7:C-(h01/H8)R</p> <p>Measure:022.000</p> <p>diminished seventh</p> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

-3:2->(9 grps of 2)..... *...No perceived root.....*

-3:4->(6 x three)-8:3-----> -8:3->(6 x eight) // (3 x sixteen)-9:16----->

Measure 22–23: The automatic computer processing of an exchange involving a rootless chord is quite straightforward. The period of the combined note frequencies of the rootless chord is taken to be the fundamental tone of the middle level nested series and, nominally, the root of the aggregated series. In effect the top level aggregated series becomes the same as its underlying nested series. The root ‘R’ is technically



-->  $12_2 0_{42} 0_1$  MBN:  $10_2 0_{42} 0_1$  ----->  $24_{36} 0_1$  MBN:  $30_{36} 0_1$  ----->

1024-C  
 $\frac{12}{2} \frac{42}{42}$   
 1.016

832-A  
 $\frac{10}{2} \frac{42}{42}$   
 0.930

832-A  
 $\frac{24}{36} \frac{36}{36}$   
 0.963

1088-C#  
 $\frac{30}{36} \frac{36}{36}$   
 1.007

- \* 468.9:C-(h24)  
 449.4:--(h23)  
 \* 429.8:B-(h22)  
 - 410.3:A#(h21)  
 \* 390.8:A-(h20) \* ----->  
 371.2:G#(h19)  
 - \* 351.7:G-(h18) \*  
 332.1:F#(h17)  
 \* 312.6:F-(h16) \*  
 - 293.1:E-(h15) -  
 \* 273.5:D#(h14) \*  
 254.0:D-(h13)  
 - \* 234.5:C-(h12) \*  
 214.9:B-(h11)  
 \* 195.4:A-(h10) \* -  
 - 175.8:G-(h09)  
 \* 156.3:F-(h08) \*  
 136.8:D#(h07)  
 - \* 117.2:C-(h06) \*  
 97.7:A-(h05) -  
 \* 78.2:F-(h04) \*  
 - 58.6:C-(h03)  
 R 39.1:F-(h02)R  
 19.5:F-(h01/H42)

Measure:021.000

F-major seventh (a)

488.5:C#(h30) \* ----->  
 472.2:--(h29) \*  
 455.9:C-(h28) \*  
 439.6:B-(h27) \*  
 423.3:B-(h26) \*  
 407.0:A#(h25) \*  
 - \* 390.8:A-(h24) \*  
 \* 374.5:--(h23) \*  
 \* 358.2:G#(h22) \*  
 \* 341.9:G-(h21) \*  
 \* 325.6:F#(h20) \*  
 \* 309.4:F-(h19) \*  
 - \* 293.1:E-(h18) \*  
 \* 276.8:D#(h17) \*  
 \* 260.5:D-(h16) \*  
 \* 244.2:C#(h15) \* -  
 \* 227.9:C-(h14) \*  
 \* 211.7:B-(h13) \*  
 - \* 195.4:A-(h12) \*  
 \* 179.1:G#(h11) \*  
 \* 162.8:F#(h10) \*  
 \* 146.5:E-(h09) \*  
 \* 130.3:D-(h08) \*  
 \* 114.0:C-(h07) \*  
 - \* 97.7:A-(h06) \*  
 \* 81.4:F#(h05) \*  
 \* 65.1:D-(h04) \*  
 \* 48.8:A-(h03) \*  
 \* 32.6:D-(h02) \*  
 R 16.3:D-(h01/H36)R

Measure:022.000

diminished seventh (rootless)

-3:2->(12 grps of 2) // (10 grps of 2)-12:5-----> (No perceived root, 24 grps of 1) // (30 grps of 1)-16:15----->

-3:2->(8 x three) // (4 x five)-6:5-----> -6:5->(4 x six) // (2 x fifteen)-16:15----->

still there (as shown above) but is buried far beyond the ear's grasp. In measures 22 and 23 the periods of the chords are found to be D-H36 and C#H34 respectively and it is the jagged collections of note-ratios to these two fundamental periods that both give the diminished-seventh its characteristic quality while also depriving it of an audible root (i.e. a regular grouping of nested series elements commensurable with the chord's note frequencies). Having established the periods of the chords in measures 22 and 23, the automatic analysis then simply calculates the proportion that will convert D into C# below. The ratio is 16:15. This computer approach can produce awkward proportions going into and coming out of rootless chords – which the hand-made analysis glosses over by omission – but it is, overall, a more accurate representation of the mechanism.

---> 27<sub>14</sub>0<sub>1</sub>MBN: 40<sub>14</sub>0<sub>1</sub> -----> 6<sub>4</sub>0<sub>24</sub>0<sub>1</sub>MBN: 4<sub>4</sub>0<sub>24</sub>0<sub>1</sub> --->

23 24

dim7 V7

384-G 576-D 576-D 384-G

\*\* \*\* 6 4

27 40 4 4

14 14 24 24

1.016 1.029 1 1

548.1:D-(h40)\*-----> \* 548.1:D-(h24)-

534.4:--(h39) 525.2:--(h23)

520.7:C#(h38) 502.4:C#(h22)

507.0:--(h37) - 479.6:C-(h21)

493.3:C-(h36) \* 456.7:B-(h20)-

479.6:C-(h35) - 433.9:A#(h19)

465.9:B-(h34) - 411.1:A-(h18)

452.2:--(h33) 388.2:G#(h17)

438.5:A#(h32) \* 365.4:G-(h16)\*----->

424.8:--(h31) - 342.5:F#(h15)

411.1:A-(h30) - 319.7:F-(h14)

397.4:--(h29) 296.9:E-(h13)

383.7:G#(h28) - \* 274.0:D-(h12)\*-

- \* 370.0:G-(h27) 251.2:C#(h11)

356.3:G-(h26) -----> 228.4:B-(h10)resolution

342.5:F#(h25) - 205.5:A-(h09)

328.8:F-(h24) \* 182.7:G-(h08)\*-

315.1:--(h23) 159.9:F-(h07)

301.4:E-(h22) - 137.0:D-(h06)

287.7:D#(h21) 114.2:B-(h05)

274.0:D-(h20) - R 91.3:G-(h04)R-

260.3:C#(h19) - 68.5:D-(h03)

- 246.6:C-(h18)suspension---- 45.7:G-(h02)

232.9:B-(h17) 22.8:G-(h01/H24)

219.2:A#(h16)

205.5:A-(h15) -

191.8:G#(h14)

178.1:G-(h13)

164.4:F-(h12)

150.7:E-(h11)

137.0:D-(h10) -

- 123.3:C-(h09)

109.6:A#(h08)

95.9:G#(h07)

82.2:F-(h06)

68.5:D-(h05) -

54.8:A#(h04)

41.1:F-(h03)

27.4:A#(h02)

R 13.7:A#(h01/H14)R

Measure:023.000

diminished seventh (rootless)

...No perceived root.....

...(6 grps of 4) // (4 grps of 4)-3:4-----&gt;

-9:16-&gt;(3 x nine) // (8 x five)-3:5-----&gt;

-3:5-&gt;(8 x three) // (4 x four)-3:4-----&gt;

---> 32<sub>34</sub>0<sub>1</sub> MBN: 28<sub>34</sub>0<sub>1</sub> -----> 10<sub>2</sub>0<sub>48</sub>0<sub>1</sub> MBN: 8<sub>2</sub>0<sub>48</sub>0<sub>1</sub> --->

1088-C# 960-D 960-D 768-G

32 28 10 8  
34 2 48 2  
1 1 48 1

```

- * 488.5:C#(h32)
* 473.2:--(h31)
* 457.9:C-(h30)
* 442.7:--(h29)
* 427.4:B-(h28) -----> - * 427.4:B-(h20)
* 412.1:A#(h27) * 406.0:A#(h19)
* 396.9:A#(h26) * 384.7:A-(h18)
* 381.6:A-(h25) * 363.3:G#(h17)
* 366.3:G#(h24) * 341.9:G-(h16) * ----->
* 351.1:--(h23) * - 320.5:F#(h15)
* 335.8:G-(h22) * 299.2:F-(h14) *
* 320.5:F#(h21) * - 277.8:E-(h13)
* 305.3:F-(h20) * 256.4:D-(h12) * -
* 290.0:E-(h19) * 235.1:C#(h11)
* 274.8:D#(h18) * -----> - * 213.7:B-(h10) * resolution
* 259.5:D-(h17) * | 192.3:A-(h09)
- * 244.2:C#(h16) * | * 171.0:G-(h08) * -
* 229.0:C-(h15) * (suspension) --- | 149.6:F-(h07)
* 213.7:B-(h14) * - * 128.2:D-(h06) *
* 198.4:A#(h13) * - 106.8:B-(h05)
* 183.2:G#(h12) * * 85.5:G-(h04) * -
* 167.9:G-(h11) * 64.1:D-(h03)
* 152.6:F-(h10) * R 42.7:G-(h02)R
* 137.4:D#(h09) * 21.4:G-(h01/H48)
* 122.1:C#(h08) *
* 106.8:B-(h07) * -
* 91.6:G#(h06) *
* 76.3:F-(h05) *
* 61.1:C#(h04) *
* 45.8:G#(h03) *
* 30.5:C#(h02) *
R 15.3:C#(h01/H34)R

```

Measure:023.000

diminished seventh (rootless)

Measure:024.000

G-dominant seventh (a)

(No perceived root, 32 grps of 1) // (28 grps of 1)-5:14---&gt; -5:14-&gt;(10 grps of 2) // (8 grps of 2)-3:4-----&gt;

-16:15-&gt;(2 x sixteen) // (4 x seven)-5:7-----&gt; -5:7-&gt;(4 x five) // (4 x four)-3:4-----&gt;

--> 3<sub>4</sub>0<sub>32</sub>0<sub>1</sub>MBN: 3<sub>4</sub>0<sub>32</sub>0<sub>1</sub> -----> 4<sub>4</sub>0<sub>24</sub>0<sub>1</sub>MBN: 4<sub>4</sub>0<sub>24</sub>0<sub>1</sub> ---->

25 26

I V7

384-G 384-G

3 4 32 1 4 4 24 1

|                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>- * 365.4:G-(h12)* -----&gt;</p> <p>334.9:F#(h11)</p> <p>304.5:E-(h10)</p> <p>- 274.0:D-(h09) -</p> <p>* 243.6:C-(h08)*</p> <p>213.1:A#(h07)</p> <p>- 182.7:G-(h06) -</p> <p>152.2:E-(h05)</p> <p>R 121.8:C-(h04)R</p> <p>- 91.3:G-(h03) -</p> <p>60.9:C-(h02)</p> <p>30.4:C-(h01/H32)</p> <p>Measure:025.000</p> <p>C-major (c)</p> | <p>- * 365.4:G-(h16)* -----&gt;</p> <p>342.5:F#(h15) -</p> <p>319.7:F-(h14) -</p> <p>296.9:E-(h13) -</p> <p>- * 274.0:D-(h12)* -</p> <p>251.2:C#(h11) -</p> <p>susps:C-( /H256)...</p> <p>228.4:B-(h10) -</p> <p>205.5:A-(h09) -</p> <p>- * 182.7:G-(h08)* -</p> <p>159.9:F-(h07) -</p> <p>137.0:D-(h06) -</p> <p>114.2:B-(h05) -</p> <p>- * 91.3:G-(h04)R-</p> <p>68.5:D-(h03) -</p> <p>45.7:G-(h02) -</p> <p>22.8:G-(h01/H24) -</p> <p>Measure:026.000</p> <p>G-dominant seventh (a)</p> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

-3:4->(3 grps of 4)-4:3-----> -4:3->(4 groups of 4)----->

-3:4->(4 x three)-4:3-----> -4:3->(4 x four) // (16 x one)-1:1----->

Measures 24–33: Through these measures the two analyses share identical conjunctions and similar interpretation of the harmony.

-->  $6_2 0_{64} 0_1$  MBN:  $6_2 0_{64} 0_1$  ----->  $4_2 0_{96} 0_1$  MBN:  $4_2 0_{96} 0_1$  ---->

Measure:025.000  
C-major (c)

Measure:026.000  
unidentified (a) (susp?)

-3:4->(6 grps of 2)-2:3-----> -2:3->(4 groups of 2)-1:1----->  
-3:4->(4 x three)-2:3-----> -2:3->(4 x two) // (8 x one)-1:1----->

Measure 26: Here again the automatic computer analysis has identified the suspended note C and assigned the chord type to that of the resolution in measure 27.

--> 4<sub>4</sub>0<sub>24</sub>0<sub>1</sub>MBN: 4<sub>4</sub>0<sub>24</sub>0<sub>1</sub> -----> 20<sub>19</sub>0<sub>1</sub>MBN: 20<sub>19</sub>0<sub>1</sub> ---->

27

V7

384-G

4

4

24

1

28

dim7

384-G

\*\*

20

19

1.011

|                            |                            |
|----------------------------|----------------------------|
| - * 365.4:G-(h16) * -----> | - * 365.4:G-(h20) * -----> |
| - 342.5:F#(h15)            | 347.1:F#(h19)              |
| - 319.7:F-(h14)            | 328.8:F-(h18)              |
| - 296.9:E-(h13)            | 310.6:E-(h17)              |
| - * 274.0:D-(h12) * -      | 292.3:D#(h16)              |
| - 251.2:C#(h11)            | - 274.0:D-(h15) -          |
| - 228.4:B-(h10) resolution | 255.8:C#(h14)              |
| - 205.5:A-(h09)            | 237.5:C-(h13)              |
| - * 182.7:G-(h08) * -      | 219.2:A#(h12)              |
| - 159.9:F-(h07)            | 201.0:A-(h11)              |
| - 137.0:D-(h06)            | - 182.7:G-(h10) -          |
| - 114.2:B-(h05)            | 164.4:F-(h09)              |
| -R 91.3:G-(h04)R-          | 146.2:D#(h08)              |
| - 68.5:D-(h03)             | 127.9:C#(h07)              |
| - 45.7:G-(h02)             | 109.6:A#(h06)              |
| - 22.8:G-(h01/H24)         | - 91.3:G-(h05) -           |
|                            | 73.1:D#(h04)               |
|                            | 54.8:A#(h03)               |
|                            | 36.5:D#(h02)               |
|                            | R 18.3:D#(h01/H19)R        |

Measure:027.000

G-dominant seventh

Measure 028.000

diminished seventh

--&gt;(4 groups of 4).....

...No perceived root.....

-1:1-&gt;(16 x one) - (4 x four)-5:4-----&gt;

-5:4-&gt;(4 x five)-6:5-----&gt;

-->  $4_2 0_{96} 0_1$  MBN:  $4_2 0_{96} 0_1$  ----->  $6_2 0_{64} 0_1$  MBN:  $6_2 0_{64} 0_1$  ---->

27 28

V7 dim7

768-G 768-G 768-G 768-G

4 4 6 6  
2 2 2 2  
96 96 64 64  
1 1 1 1

- \* 341.9:G-(h08)\* ----->  
 - 299.2:F-(h07)  
 - \* 256.4:D-(h06)\* -  
 - 213.7:B-(h05) resolution  
 - \* 171.0:G-(h04)\* -  
 - 128.2:D-(h03)  
 -R 85.5:G-(h02)R-  
 - 42.7:G-(h01/H96)

Measure:027.000

G-dominant seventh (a)

- \* 341.9:G-(h12)\* ----->  
 - 313.4:F#(h11) -  
 \* 284.9:E-(h10)\* -  
 - 256.4:D-(h09) -  
 \* 227.9:C-(h08)\* -  
 - 199.5:A#(h07) -  
 - \* 171.0:G-(h06)\* -  
 - 142.5:E-(h05) -  
 \* 114.0:C-(h04)\* -  
 - 85.5:G-(h03) -  
 R 57.0:C-(h02)R-  
 28.5:C-(h01/H64) -

Measure:028.000

unidentified (c) (susp?)

-->(4 grps of 2)-3:2-----> -3:2->(6 grps of 2)-1:1----->

-1:1->(8 x one) // (4 x two)-3:2-----> -3:2->(4 x three) // (12 x one)-1:1----->

Measure 28: In this measure the *txt2mos* script has not been able to recognise the diminished seventh chord overlaying a pedal bass and has adopted the nested arrangement of measure 29. Measure 28 requires the intervention of the analyst to correct this interpretation in the *txt2mos* output file.

--> 6<sub>4</sub>0<sub>16</sub>0<sub>1</sub>MBN: 6<sub>4</sub>0<sub>16</sub>0<sub>1</sub> -----> 8<sub>3</sub>0<sub>16</sub>0<sub>1</sub>MBN: 8<sub>3</sub>0<sub>16</sub>0<sub>1</sub> ---->

29 30

I V7

384-G 384-G

6 8  
4 3  
16 16  
1 1

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>- * 365.4:G-(h24)*-----&gt;</p> <p>350.2:--(h23) -</p> <p>334.9:F#(h22) -</p> <p>319.7:F-(h21) -</p> <p>* 304.5:E-(h20)*-</p> <p>289.3:D#(h19) -</p> <p>- 274.0:D-(h18) -</p> <p>258.8:C#(h17) -</p> <p>* 243.6:C-(h16)*-</p> <p>228.4:B-(h15) -</p> <p>213.1:A#(h14) -</p> <p>197.9:A-(h13) -</p> <p>- * 182.7:G-(h12)*-</p> <p>167.5:F#(h11) -</p> <p>152.2:E-(h10) -</p> <p>137.0:D-(h09) -</p> <p>* 121.8:C-(h08)*-</p> <p>106.6:A#(h07) -</p> <p>- 91.3:G-(h06) -</p> <p>76.1:E-(h05) -</p> <p>* 60.9:C-(h04)R-</p> <p>45.7:G-(h03) -</p> <p>30.4:C-(h02) -</p> <p>15.2:C-(h01/H16) -</p> | <p>- * 365.4:G-(h24)*-----&gt;</p> <p>- 350.2:--(h23)</p> <p>- 334.9:F#(h22)</p> <p>- * 319.7:F-(h21)*-</p> <p>- 304.5:E-(h20)</p> <p>- 289.3:D#(h19)</p> <p>- * 274.0:D-(h18)*-</p> <p>- 258.8:C#(h17)</p> <p>- 243.6:C-(h16)suspension...</p> <p>- * 228.4:B-(h15)*-</p> <p>- 213.1:A#(h14)</p> <p>- 197.9:A-(h13)</p> <p>- * 182.7:G-(h12)*-</p> <p>- 167.5:F#(h11)</p> <p>- 152.2:E-(h10)</p> <p>- * 137.0:D-(h09)*-</p> <p>- 121.8:C-(h08)</p> <p>- 106.6:A#(h07)</p> <p>- * 91.3:G-(h06)*-</p> <p>- 76.1:E-(h05)</p> <p>- 60.9:C-(h04)</p> <p>-R 45.7:G-(h03)R-</p> <p>- 30.4:C-(h02)</p> <p>- 15.2:C-(h01/H16)</p> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Measure:029.000

C-major (c)

Measure:030.000

G-dominant seventh (a)

.....(6 groups of 4)-4:3-----&gt; -4:3-&gt;(8 groups of 3)-----&gt;

-6:5-&gt;(4 x six) // (24 x one)-1:1-----&gt; -1:1-&gt;(24 x one) // (8 x three)-2:3-----&gt;

Measure 30: With the flexibility available in a hand-made analysis, measure 30 above has been assigned a nested series build on the fundamental C-H16 which allows the suspended note C to appear within an aggregated series based on G! This option, not to say slight-of-hand, is not within the repertoire of the computer-made analysis, which determines the fundamental period of the middle level nested series from the combination of the objective note frequencies – as suggested by Beament 2005, Appendix 7, page 159.



-->  $6_2 0_{64} 0_1$  MBN:  $6_2 0_{64} 0_1$  ----->  $4_2 0_{96} 0_1$  MBN:  $4_2 0_{96} 0_1$  ---->

29 30

768-G 768-G 768-G 768-G

6 6 4 4  
2 2 2 2  
64 64 96 96  
1 1 1 1

- \* 341.9:G-(h12) \* -----> - \* 341.9:G-(h08) \* ----->  
 - 313.4:F#-(h11) 299.2:F-(h07) -  
 - \* 284.9:E-(h10) \* - \* 256.4:D-(h06) \* -  
 - 256.4:D-(h09) - susp:C-( /H512) ...  
 - \* 227.9:C-(h08) \* 213.7:B-(h05) -  
 - 199.5:A#(h07) - \* 171.0:G-(h04) \* -  
 - \* 171.0:G-(h06) \* - 128.2:D-(h03) -  
 - 142.5:E-(h05) -R 85.5:G-(h02)R-  
 - \* 114.0:C-(h04) \* 42.7:G-(h01/H96) -  
 - 85.5:G-(h03) -  
 -R 57.0:C-(h02)R  
 - 28.5:C-(h01/H64)

Measure:029.000  
C-major (c)

Measure:030.000  
unidentified (a) (susp?)

-1:1->(6 grps of 2)-2:3----->  
 -1:1->(12 x one) // (4 x three)-2:3----->  
 -4:3->(4 grps of 2)-1:1----->  
 -2:3->(4 x two) // (8 x one)-2:1----->

Measure 30: All the suspensions shown in the columns of the computer-made analysis have been added with their position in the fundamental series by hand. Because of the presence of the suspended note in the chord the *txt2mos* script is unable to identify with certainty the chord type. The script therefore marks the chord as unidentified and proceeds to determine as best it can if there is a passing note or suspension, by means of relating the collection of notes to the preceding and succeeding chords.

Measures 31–33: Although this comment is tied to these specific measures so as to provide concrete examples, the principle outlined here applies to all measures, indeed, to all MOS analyses. The principle is that ideally *the conjunction should have a strong and objective relationship with the chords it purports to conjoin*. When first looking at a MOS analysis it is quite easy to be blinded by the amount of detail presented and not to immediately appreciate the close connection between the conjunction frequencies (illuminated by a gray band) and the objective notes of the composition (underlined). Picking out these two salient features from the background detail of a complex and dynamic nested system illustrates how the simple and direct aurally perceived structure is embedded within an overarching mathematical mechanism. For example, in

--> 8<sub>2</sub>0<sub>24</sub>0<sub>1</sub>MBN: 8<sub>2</sub>0<sub>24</sub>0<sub>1</sub> -----> 6<sub>2</sub>0<sub>32</sub>0<sub>1</sub>MBN: 6<sub>2</sub>0<sub>32</sub>0<sub>1</sub> --->

31 32

V7 I7

384-G 384-G

8 6  
2 2  
24 32  
1 1

|                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>- * 365.4:G-(h16)* -----&gt;</p> <p>342.5:F#(h15)</p> <p>- * 319.7:F-(h14)*</p> <p>296.9:E-(h13)</p> <p>- * 274.0:D-(h12)* -</p> <p>251.2:C#(h11)</p> <p>- * 228.4:B-(h10)* resolution</p> <p>205.5:A-(h09)</p> <p>- * 182.7:G-(h08)* -</p> <p>159.9:F-(h07)</p> <p>- * 137.0:D-(h06)*</p> <p>114.2:B-(h05)</p> <p>- * 91.3:G-(h04)* -</p> <p>68.5:D-(h03)</p> <p>-R 45.7:G-(h02)R</p> <p>22.8:G-(h01/H24)</p> | <p>- * 365.4:G-(h12)* -----&gt;</p> <p>334.9:F#(h11)</p> <p>* 304.5:E-(h10)* -</p> <p>- 274.0:D-(h09)</p> <p>* 243.6:C-(h08)* -</p> <p>213.1:A#(h07)</p> <p>- * 182.7:G-(h06)* -</p> <p>152.2:E-(h05)</p> <p>* 121.8:C-(h04)* -</p> <p>- 91.3:G-(h03)</p> <p>R 60.9:C-(h02)R-</p> <p>30.4:C-(h01/H32)</p> |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Measure:031.000

G-dominant seventh (a)

Measure:032.000

C-dominant seventh (a)

-1:1->(8 groups of 2)-3:4----->      -3:4->(6 groups of 2)-3:2----->

-2:3->(8 x two) - (4 x four)-3:4----->      -3:4->(4 x three) - (6 x two)-3:2----->

measure 31 (left) the conjunction frequency G-365.4Hz is the h2 harmonic of note G-182.7Hz and h4 of note G-91.3Hz. That is, the conjunction that joins measure 30 to measure 31 and measure 31 to measure 32 is an objective harmonic component of the two notes G-91.3Hz and G-182.7Hz – objectively present in the compound tones and well within the reach of the ear. Although on the face of the full MOS analysis the conjunction is G-h16 in the middle level nested series and an astronomic G-H384 in the fundamental series, these figures represent the mathematics underlying the immediate and close aural relationship of h2 and h4 apprehended by the ear. Even at the extreme stretch in the complex mathematical underpinning, in measure 33 of the computer-made analysis, where the conjunction (F# 633.2Hz) has been placed at h100 in the middle level nested series, the direct aural relationship between root note in the chord and the conjunction translates to that of h5 – the fifth harmonic of the compound tone D-126.6Hz. A table of the harmonic links between the notes and conjunctions is given overleaf and these numbers are typical of the prelude overall.

--> 4<sub>4</sub>0<sub>48</sub>0<sub>1</sub>MBN: 4<sub>4</sub>0<sub>48</sub>0<sub>1</sub> -----> 6<sub>4</sub>0<sub>32</sub>0<sub>1</sub>MBN: 6<sub>4</sub>0<sub>32</sub>0<sub>1</sub> ---->

768-G

768-G

768-G

768-G

- \* 341.9:G-(h16)\* ----->

320.5:F#(h15)

- 299.2:F-(h14) -

277.8:E-(h13)

- \* 256.4:D-(h12)\* -

235.1:C#(h11)

- 213.7:B-(h10) - resolution

192.3:A-(h09)

- \* 171.0:G-(h08)\* -

149.6:F-(h07)

- 128.2:D-(h06) -

106.8:B-(h05)

-R 85.5:G-(h04)R-

64.1:D-(h03)

- 42.7:G-(h02) -

21.4:G-(h01/H48)

Measure:031.000

G-dominant seventh (a)

- \* 341.9:G-(h24)\* ----->

327.7:--(h23)

313.4:F#(h22) -

- 299.2:F-(h21)

\* 284.9:E-(h20)\* -

270.7:D#(h19)

- 256.4:D-(h18) -

242.2:C#(h17)

\* 227.9:C-(h16)\* -

- 213.7:B-(h15)

199.5:A#(h14) -

185.2:A-(h13)

- \* 171.0:G-(h12)\* -

156.7:F#(h11)

142.5:E-(h10) -

- 128.2:D-(h09)

\* 114.0:C-(h08)\* -

99.7:A#(h07)

- 85.5:G-(h06) -

71.2:E-(h05)

R 57.0:C-(h04)R-

- 42.7:G-(h03)

28.5:C-(h02) -

14.2:C-(h01/H32)

Measure:032.000

C-dominant seventh (a)

-1:1-&gt;(4 grps of 4)-3:2-----&gt; -3:2-&gt;(6 grps of 4)-3:2-----&gt;

-2:1-&gt;(8 x two)-3:2-----&gt; -3:2-&gt;(8 x three) // (12 x two)-3:2-----&gt;

| Measure                     | Conjunctions (Hz) | Harmonic of Objective Notes (Hz)         |
|-----------------------------|-------------------|------------------------------------------|
| 31 (left page)              | G-365.4           | h2 of G-182.7 h4 of G-91.3               |
| 31 (right page)             | G-341.9           | h2 of G-171.0 h4 of G-85.5               |
| 32 (left page)              | G-365.4           | h2 of G-182.7 h3 of C-121.8 h6 of C-60.9 |
| 32 (right page)             | G-341.9           | h2 of G-171.0 h3 of C-114.0 h6 of C-57.0 |
| 33.0 (left page, incoming)  | G-365.4           | h3 of C-121.8 h6 of C-60.9               |
| 33.0 (left page, outgoing)  | A-406.0           | h2 of A-203.0                            |
| 33.0 (right page, incoming) | G-341.9           | h3 of C-114.0 h6 of C-57.0               |
| 33.0 (right page, outgoing) | A-379.9           | h2 of A-190.0                            |
| 33.5 (left page, incoming)  | A-406.0           | h2 of A-203.0 h3 of D-135.3              |
| 33.5 (left page, outgoing)  | D-541.3           | h4 of D-135.3                            |
| 33.5 (right page, incoming) | A-379.9           | h4 of A-95.0 h6 of D-63.3                |
| 33.5 (right page, outgoing) | F#633.2           | h5 of D-126.6                            |

-> 9<sub>2</sub>0<sub>21</sub>0<sub>1</sub>MBN: 10<sub>2</sub>0<sub>21</sub>0<sub>1</sub> -----> 6<sub>5</sub>0<sub>14</sub>0<sub>1</sub>MBN: 8<sub>5</sub>0<sub>14</sub>0<sub>1</sub> -->

33

IV- ii

|       |       |       |       |
|-------|-------|-------|-------|
| 384-G | 416-A | 416-A | 576-D |
| 9     | 10    | 6     | 8     |
| 2     | 2     | 5     | 5     |
| 21    | 21    | 14    | 14    |
| 1.016 | 0.990 | 0.990 | 1.029 |

541.3:D-(h40)\*----->

527.8:--(h39)

514.2:C#(h38)

500.7:--(h37)

487.2:C-(h36)

473.6:C-(h35)\*-

460.1:B-(h34)

446.6:--(h33)

433.0:A#(h32)

419.5:--(h31)

406.0:A-(h20)\*-----> - \* 406.0:A-(h30)\*-

385.7:G#(h19)

- \* 365.4:G-(h18)\*-

345.1:F#(h17)

- 365.4:G-(h27)

\* 324.8:F-(h16)\*-

- 351.9:G-(h26)

- 304.5:E-(h15)

\* 338.3:F#(h25)\*-

\* 284.2:D#(h14)\*-

- 324.8:F-(h24)

263.9:D-(h13)

311.3:--(h23)

- \* 243.6:C-(h12)\*-

297.7:E-(h22)

223.3:B-(h11)

- 284.2:D#(h21)

\* 203.0:A-(h10)\*-

\* 270.7:D-(h20)\*-

- 182.7:G-(h09)

257.1:C#(h19)

\* 162.4:F-(h08)\*-

- 243.6:C-(h18)

142.1:D#(h07)

230.1:B-(h17)

- \* 121.8:C-(h06)\*-

216.5:A#(h16)

101.5:A-(h05)

- \* 203.0:A-(h15)\*-

\* 81.2:F-(h04)\*-

189.5:G#(h14)

- 60.9:C-(h03)

175.9:G-(h13)

R 40.6:F-(h02)R-

- 162.4:F-(h12)

20.3:F-(h01/H21)

148.9:E-(h11)

\* 135.3:D-(h10)\*-

- 121.8:C-(h09)

108.3:A#(h08)

94.7:G#(h07)

- 81.2:F-(h06)

R 67.7:D-(h05)R-

60.9:C-( /H64)

54.1:A#(h04)

- 40.6:F-(h03)

27.1:A#(h02)

13.5:A#(h01/H14)

Measure:033.000

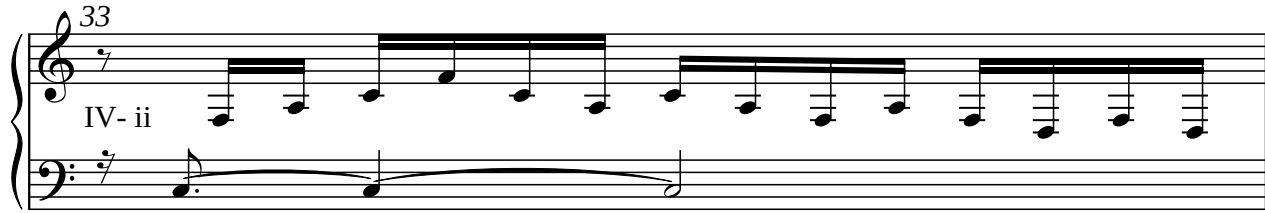
F-major (c)

Measure:033.500

D-minor seventh (d)

-3:2-&gt;(9 grps of 2) // (10 grps of 2)-3:5-----&gt; -3:5-&gt;(6 grps of 5) // (8 grps of 5)-3:4-----&gt;

-3:2-&gt;(6 x three) // (10 x two)-3:2-----&gt; -3:2-&gt;(10 x three) // (8 x five)-3:5-----&gt;

--> 9<sub>4</sub>0<sub>21</sub>0<sub>1</sub>MBN: 10<sub>4</sub>0<sub>21</sub>0<sub>1</sub> ---> 12<sub>5</sub>0<sub>14</sub>0<sub>1</sub>MBN: 20<sub>5</sub>0<sub>14</sub>0<sub>1</sub> -->

|       |       |       |         |
|-------|-------|-------|---------|
| 768-G | 832-A | 832-A | 1408-F# |
| 9     | 10    | 12    | 20      |
| 2     | 2     | 5     | 5       |
| 21    | 21    | 14    | 14      |
| 1.016 | 0.990 | 0.990 | 1.006   |

|                      |                   |                       |
|----------------------|-------------------|-----------------------|
| 379.9:A-(h40)*-----> | * 379.9:A-(h60)*- | 633.2:F#(h100)*-----> |
| 370.4:--(h39)        | 373.6:--(h59)     | 626.8:--(h99)         |
| 360.9:G#(h38) -      | 367.2:--(h58)     | 620.5:--(h98)         |
| 351.4:--(h37)        | - 360.9:G#(h57)   | 614.2:--(h97)         |
| * 341.9:G-(h36)*-    | 354.6:G#(h56)     | 607.9:F-(h96)         |
| 332.4:G-(h35)        | * 348.2:--(h55)*- | 601.5:F-(h95)*-       |
| 322.9:F#(h34) -      | - 341.9:G-(h54)   | 595.2:F-(h94)         |
| - 313.4:--(h33)      | 335.6:--(h53)     | 588.9:--(h93)         |
| * 303.9:F-(h32)*-    | 329.3:G-(h52)     | 582.5:--(h92)         |
| 294.4:--(h31)        | - 322.9:--(h51)   | 576.2:--(h91)         |
| - 284.9:E-(h30) -    | * 316.6:F#(h50)*- | 569.9:E-(h90)*-       |
| 275.4:--(h29)        | 310.3:--(h49)     | 563.5:--(h89)         |
| * 265.9:D#(h28)*-    | - 303.9:F-(h48)   | 557.2:E-(h88)         |
| - 256.4:D-(h27)      | 297.6:--(h47)     | 550.9:--(h87)         |
| 246.9:D-(h26) -      | 291.3:--(h46)     | 544.5:--(h86)         |
| 237.4:C#(h25)        | * 284.9:E-(h45)*- | 538.2:D#(h85)*-       |
| - * 227.9:C-(h24)*-  | 278.6:E-(h44)     | 531.9:D#(h84)         |
| 218.4:--(h23)        | 272.3:--(h43)     | 525.5:--(h83)         |
| 208.9:B-(h22) -      | - 265.9:D#(h42)   | 519.2:--(h82)         |
| - 199.5:A#(h21)      | 259.6:--(h41)     | 512.9:D-(h81)         |
| * 190.0:A-(h20)*-    | * 253.3:D-(h40)*- | 506.5:D-(h80)*-       |
| 180.5:G#(h19)        | - 246.9:--(h39)   | 500.2:--(h79)         |
| - 171.0:G-(h18) -    | 240.6:C#(h38)     | 493.9:--(h78)         |
| 161.5:F#(h17)        | 234.3:--(h37)     | 487.5:--(h77)         |
| * 152.0:F-(h16)*-    | - 227.9:C-(h36)   | 481.2:C#(h76)         |
| - 142.5:E-(h15)      | * 221.6:C-(h35)*- | 474.9:C#(h75)*-       |
| 133.0:D#(h14) -      | 215.3:B-(h34)     | 468.6:--(h74)         |
| 123.5:D-(h13)        | - 208.9:--(h33)   | 462.2:--(h73)         |
| - * 114.0:C-(h12)*-  | 202.6:A#(h32)     | 455.9:C-(h72)         |
| 104.5:B-(h11)        | 196.3:--(h31)     | 449.6:--(h71)         |
| 95.0:A-(h10) -       | * 190.0:A-(h30)*- | 443.2:C-(h70)*-       |
| - 85.5:G-(h09)       | 183.6:--(h29)     | 436.9:--(h69)         |
| * 76.0:F-(h08)*-     | 177.3:G#(h28)     | 430.6:B-(h68)         |
| 66.5:D#(h07)         | - 171.0:G-(h27)   | 424.2:--(h67)         |
| - 57.0:C-(h06)       | 164.6:G-(h26)     | 417.9:--(h66)         |
| 47.5:A-(h05)         | * 158.3:F#(h25)*- | 411.6:--(h65)*-       |
| R 38.0:F-(h04)R-     | - 152.0:F-(h24)   | 405.2:A#(h64)         |
| - 28.5:C-(h03)       | 145.6:--(h23)     | 398.9:A#(h63)         |
| 19.0:F-(h02) -       | 139.3:E-(h22)     | 392.6:--(h62)         |
| 9.5:F-(h01/H21)      | - 133.0:D#(h21)   | 386.2:--(h61)         |
|                      | * 126.6:D-(h20)*- |                       |
|                      | 120.3:C#(h19)     |                       |
|                      | - 114.0:C-(h18)   |                       |
|                      | 107.6:B-(h17)     |                       |
|                      | 101.3:A#(h16)     |                       |
|                      | * 95.0:A-(h15)*-  |                       |
|                      | 88.6:G#(h14)      |                       |
|                      | 82.3:G-(h13)      |                       |
|                      | - 76.0:F-(h12)    |                       |
|                      | 69.6:E-(h11)      |                       |
|                      | * 63.3:D-(h10)*-  |                       |
|                      | - 57.0:C-(h09)    |                       |
|                      | 50.7:A#(h08)      |                       |
|                      | 44.3:G#(h07)      |                       |
|                      | - 38.0:F-(h06)    |                       |
|                      | R 31.7:D-(h05)R-  |                       |
|                      | 25.3:A#(h04)      |                       |
|                      | - 19.0:F-(h03)    |                       |
|                      | 12.7:A#(h02)      |                       |
|                      | 6.3:A#(h01/H14)   |                       |

(continued from left)

Measure:033.500 D-minor seventh (d)

-3:2-&gt;(9 grps of 4) // (10 grps of 4)-6:5-----&gt; -6:5-&gt;(12 grps of 5) // (20 grps of 5)-3:4-----&gt;

-3:2-&gt;(12 x three) // (20 x two)-3:2-----&gt; -3:2-&gt;(20 x three) // (20 x five)-3:5-----&gt;

-->  $6_4 0_{24} 0_1$ MBN:  $8_4 0_{24} 0_1$  ----->  $12_2 0_{32} 0_1$ 

34

V7

576-D

6  
4  
24  
1

768-G

8  
4  
24  
1

35

I

768-G

12  
2  
32  
1

721.7:G-(h32)\*-----> \* 721.7:G-(h24)  
 699.2:--(h31) 691.7:--(h23)  
 676.6:F#(h30) \* 661.6:F#(h22)  
 654.1:--(h29) - 631.5:F-(h21)  
 631.5:F-(h28)\* - \* 601.5:E-(h20)  
 609.0:E-(h27) 571.4:D#(h19)  
 586.4:E-(h26) - \* 541.3:D-(h18)  
 563.9:D#(h25) 511.2:C#(h17)  
 - \* 541.3:D-(h24)\* - \* 481.2:C-(h16)  
 518.8:--(h23) - 451.1:B-(h15)  
 496.2:C#(h22) \* 421.0:A#(h14)  
 - 473.6:C-(h21) 390.9:A-(h13)  
 \* 451.1:B-(h20)\* - - \* 360.9:G-(h12)  
 428.5:A#(h19) 330.8:F#(h11)  
 - 406.0:A-(h18) \* 300.7:E-(h10)  
 383.4:G#(h17) - 270.7:D-(h09)  
 \* 360.9:G-(h16)\* - \* 240.6:C-(h08)  
 - 338.3:F#(h15) 210.5:A#(h07)  
 315.8:F-(h14) - \* 180.4:G-(h06)  
 293.2:E-(h13) 150.4:E-(h05)  
 - \* 270.7:D-(h12)\* - 120.3:C-(h04)  
 248.1:C#(h11) - 90.2:G-(h03)  
 225.5:B-(h10) R 60.1:C-(h02)  
 - 203.0:A-(h09) 30.1:C-(h01/H32)  
 \* 180.4:G-(h08)\* -  
 157.9:F-(h07)  
 - 135.3:D-(h06)  
 112.8:B-(h05)  
 R 90.2:G-(h04)R-  
 - 67.7:D-(h03)  
 60.9:C-( /H64)  
 45.1:G-(h02)  
 22.6:G-(h01/H24)

Measure:034.500

G-dominant seventh (b)

Measure:035.000

C-major (a)

-3:4-&gt;(6 grps of 4) // (8 grps of 4)-3:2-----&gt; -3:2-&gt;(12 groups of 2)

-3:5-&gt;(8 x three) // (8 x four)-3:4-----&gt; -3:4-&gt;(8 x three)

--> 15<sub>4</sub>0<sub>24</sub>0<sub>1</sub>MBN: 14<sub>4</sub>0<sub>24</sub>0<sub>1</sub> --> 14<sub>2</sub>0<sub>48</sub>0<sub>1</sub>MBN: 12<sub>2</sub>0<sub>48</sub>0<sub>1</sub> --> 18<sub>2</sub>0<sub>32</sub>0<sub>1</sub>

34 V7 1408-F# 1344-F 1344-F 1152-D 1152-D

15 14 14 12 18  
4 4 4 2 2  
24 24 48 48 32  
0.978 1 1 1 1

|                           |                           |                   |
|---------------------------|---------------------------|-------------------|
| - * 633.2:F#(h60)         | - * 591.0:F-(h28)         | - * 506.5:D-(h36) |
| 622.6:--(h59)             | - 569.9:E-(h27)           | 492.5:D-(h35)     |
| 612.1:--(h58)             | - * 548.8:E-(h26)         | * 478.4:C#(h34)   |
| - 601.5:F-(h57)           | - 527.6:D#(h25)           | - 464.3:--(h33)   |
| - * 591.0:F-(h56) *-----> | - * 506.5:D-(h24) *-----> | * 450.3:C-(h32)   |
| 580.4:--(h55)             | - 485.4:--(h23)           | 436.2:--(h31)     |
| - 569.9:E-(h54)           | - * 464.3:C#(h22) *       | - * 422.1:B-(h30) |
| 559.3:--(h53)             | - 443.2:C-(h21)           | 408.0:--(h29)     |
| - * 548.8:E-(h52) *       | - 422.1:B-(h20) *         | * 394.0:A#(h28)   |
| - 538.2:--(h51)           | - 401.0:A#(h19)           | - 379.9:A-(h27)   |
| 527.6:D#(h50)             | - * 379.9:A-(h18) *       | * 365.8:A-(h26)   |
| 517.1:--(h49)             | - 358.8:G#(h17)           | 351.8:G#(h25)     |
| - * 506.5:D-(h48) *       | - * 337.7:G-(h16) *       | - * 337.7:G-(h24) |
| 496.0:--(h47)             | - 316.6:F#(h15)           | 323.6:--(h23)     |
| - 485.4:--(h46)           | - * 295.5:F-(h14) *       | * 309.6:F#(h22)   |
| - 474.9:C#(h45)           | - 274.4:E-(h13)           | - 295.5:F-(h21)   |
| * 464.3:C#(h44) *         | - * 253.3:D-(h12) *       | * 281.4:E-(h20)   |
| 453.8:--(h43)             | - 232.2:C#(h11)           | 267.3:D#(h19)     |
| - 443.2:C-(h42)           | - * 211.1:B-(h10) *       | - * 253.3:D-(h18) |
| 432.7:--(h41)             | - 190.0:A-(h09)           | 239.2:C#(h17)     |
| - * 422.1:B-(h40) *       | - * 168.8:G-(h08) *       | * 225.1:C-(h16)   |
| - 411.6:--(h39)           | - 147.7:F-(h07)           | - 211.1:B-(h15)   |
| 401.0:A#(h38)             | - * 126.6:D-(h06) *       | * 197.0:A#(h14)   |
| - 390.5:--(h37)           | - 105.5:B-(h05)           | 182.9:A-(h13)     |
| - * 379.9:A-(h36) *       | - * 84.4:G-(h04) *        | - * 168.8:G-(h12) |
| 369.4:A-(h35)             | - 63.3:D-(h03)            | 154.8:F#(h11)     |
| - 358.8:G#(h34)           | -R 42.2:G-(h02)R-         | * 140.7:E-(h10)   |
| - 348.2:--(h33)           | - 21.1:G-(h01/H48)        | - 126.6:D-(h09)   |
| * 337.7:G-(h32) *         |                           | * 112.6:C-(h08)   |
| 327.1:--(h31)             |                           | 98.5:A#(h07)      |
| - 316.6:F#(h30)           |                           | - * 84.4:G-(h06)  |
| 306.0:--(h29)             |                           | 70.4:E-(h05)      |
| - * 295.5:F-(h28) *       |                           | * 56.3:C-(h04)    |
| - 284.9:E-(h27)           |                           | - 42.2:G-(h03)    |
| 274.4:E-(h26)             |                           | R 28.1:C-(h02)    |
| - 263.8:D#(h25)           |                           | 14.1:C-(h01/H32)  |
| - * 253.3:D-(h24) *       |                           |                   |
| 242.7:--(h23)             |                           |                   |
| - 232.2:C#(h22)           |                           |                   |
| - 221.6:C-(h21)           |                           |                   |
| * 211.1:B-(h20) *         |                           |                   |
| 200.5:A#(h19)             |                           |                   |
| - 190.0:A-(h18)           |                           |                   |
| 179.4:G#(h17)             |                           |                   |
| - * 168.8:G-(h16) *       |                           |                   |
| - 158.3:F#(h15)           |                           |                   |
| 147.7:F-(h14)             |                           |                   |
| - 137.2:E-(h13)           |                           |                   |
| - * 126.6:D-(h12) *       |                           |                   |
| 116.1:C#(h11)             |                           |                   |
| - 105.5:B-(h10)           |                           |                   |
| - 95.0:A-(h09)            |                           |                   |
| * 84.4:G-(h08) *          |                           |                   |
| 73.9:F-(h07)              |                           |                   |
| - 63.3:D-(h06)            |                           |                   |
| 52.8:B-(h05)              |                           |                   |
| R 42.2:G-(h04)R-          |                           |                   |
| - 31.7:D-(h03)            |                           |                   |
| 21.1:G-(h02)              |                           |                   |
| 10.6:G-(h01/H24)          |                           |                   |

Measure:034.000 G-dominant seventh (b)

Measure:034.000 G-dominant seventh (b)

Measure:035.000 C-major (a)

-3:4-&gt;(15 grps of 4) // (14 grps of 4)-1:1-----&gt; -1:1-&gt;(14 groups of 2) // (12 grps of 2)-3:2----&gt; -3:2-&gt;(18 groups of 2)

-3:5-&gt;&gt;(20 x three) // (28 x two)-1:2-----&gt; -1:2-&gt;(28 x one) // (12 x two)-3:2-----&gt; -3:2-&gt;&gt;(12 x three)

Measure 1–2: The ‘hand-made’ analysis was constructed early in the development of the MOS model, when I had rather limited appreciation of the nature of the interaction between the proportions of exchanges and the grouping of elements in top level aggregated series. The effect of these inter-relationships between different parts of a nested system are particularly critical when the fundamental tones of the top and middle level series move in contrary motion by small steps – as they do in measures 1 to 2 by a tone in opposite directions. Over time it has become increasingly apparent that the need to integrate the grouping in the aggregated series with the ratios of exchange of both the top and middle level series restricts the overall choice of possible proportions. For example on the face of it, the proportion C-32Hz 8:7 A#28Hz for the nested series in measure 1–2 would appear logical in harmonic series terms: h8 → h7. But when the full implications of an 8:7 exchange in the middle level nested series is worked through to the top level aggregated series the effect of the groups of four in measure 1 and groups of five in measure 2, interacting with the 8:7 exchange, confine the aggregated ratio of exchange to 32:35 while also forcing the conjunction frequency to the astronomic height of D-4480Hz – where 35 groups of 4 are exchanged for 32 groups of 5!

Clearly this is untenable – the ear could not in practice grasp the thirty-fifth or thirty-second harmonic – as well as being mathematically inelegant. In the early days of developing the MOS model I began by working from the bottom up, from the fixed point of absolute fundamental H1. But a better way (the way the *txt2mos* script does it) is to work from the top down. The gist of the harmony is (mostly) contained in the top level aggregated series and it is this series which should first be assigned the proportion of exchange that best matches the harmonic motion of the chords. Notionally, it is this top-most level of nesting, the aggregated series, which is ‘driving’ the whole nested system forward as it advances from chord to chord. Thus in measures 1–2 the analysis should begin by assigning a sesquioctava 8:9 exchange between the two aggregated series that encompass the chord progression from C-major to D-minor. Then afterward, ask what exchange might this imply for the middle level nested series? This procedure is undertaken in the *txt2mos* script, and the answer found is that a sesquioctava 8:9 exchange in the aggregated series implies a sesquinona 10:9 exchange in the supporting middle level nested series.

Had I appreciated at the time the original analysis was made that the conjunction frequency in an exchange, equally with the absolute fundamental tone, provides a fixed point from which it is possible to navigate through the chord progression from above rather than attacking it from below, and had I been less keen to reflect the chords’ notes in the conjunction chosen, I might not have inverted proportions in the first harmonic exchange of the analysis.

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Measures 1–35: In conclusion, while there remain many areas in which the operation of the automatic computer generated MOS analysis could be improved or refined; nevertheless, taken overall, the similitude of the two analyses give some ground for believing that the modulating oscillatory system approach to music analysis does indeed grasp concrete and objective phenomena in tonal music and that this analytical method is, to some degree, capable of exposing and encapsulating the true and fundamental nature of western musical art.