

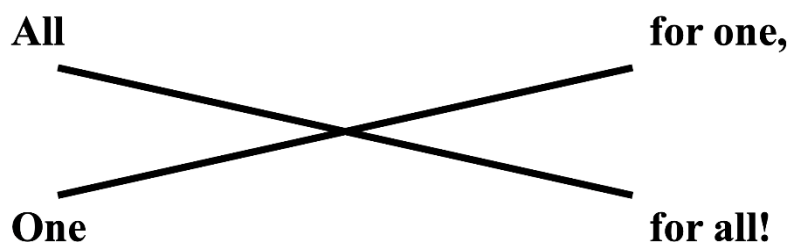


MTO 31.3 Examples: Chang, Symmetrical Structures in Xenakis's *Okho*

(Note: audio, video, and other interactive examples are only available online)

<https://www.mtosmt.org/issues/mto.25.31.3/mto.25.31.3.chang.html>

Example 1. Diagram representing chiastic structure from the phrase “all for one, one for all” in *The Three Musketeers*



Example 2. Reproduction of Gibson's Example 6.1 (2011, 104) analyzing an excerpt of *Persephassa* (m. 222)



Example 3. Reproduction of Gibson's example (2011, 45) of the rhythmic pattern from *Synaphai*



Example 4. Reproduction of Gibson's Example 3.7 (2011, 46), drawing parallel between *Persephassa* and *Antikhthon*

(a) *Persephassa*, m. 164

Diagram (a) shows six staves (A-F) representing musical notation for *Persephassa*, m. 164. The notation uses numbers 1-5 and dots on a five-line staff to represent pitch and rhythm.

Staff A: 5, 8, 21, 4, 1 1 2 3 4 5

Staff B: 5, 4, 3, 2, 1 1, 15

Staff C: 3, 2, 1 1 4, 1 1 2, 15, 8, 5

Staff D: 1 1 2 3 4 5, 21, 8, 5, 4

Staff E: 5, 4, 3, 15, 2, 1 1 4, 1 1 2 3 4

Staff F: 5, 4, 3, 2, 1 1, [21], 8, 5, 10

(b) *Persephassa*, m. 164

Diagram (b) shows six staves (A-F) representing musical notation for *Persephassa*, m. 164. The notation uses standard musical notation (notes, rests, and bar lines) on a five-line staff. The tempo is marked as $\text{♩} = 60$. The dynamics are marked as *ff*.

(c) Excerpt from *Antikhthon*, m. 212

Diagram (c) shows six staves (vn I, vn II, va, vc, db) representing musical notation for an excerpt from *Antikhthon*, m. 212. The notation uses standard musical notation (notes, rests, and bar lines) on a five-line staff. The tempo is marked as $\text{♩} = 60$. The dynamics are marked as *ffff*. A note is present on the vn I staff.

Example 5. Reproduction of Gibson’s Example 3.11 (2011, 54), drawing the pattern T_i of *Idmen B*



Example 6. Types of symmetrical structures presented according to their orders

Type	Order	Characteristics	Reference
Palindromic	1st	Each timbre is considered individually in the analysis when calculating sieve sequences	Gibson, Example 3.7
Chiastic Palindromic	2nd	Groups of timbres are incorporated into the analysis when calculating sieve sequences	Gibson, Example 3.11, 3.13
Chiastic	3rd	Large-scale structures combining multiple secondary order structures	

Example 7. Two primary striking spots on the drum. The green dots indicate its precise location. The palm strikes the center of the djembe to emit the fundamental frequency in the bass range. For *Bord* notes, only the finger strikes the edge to emit the upper partials of the drum.



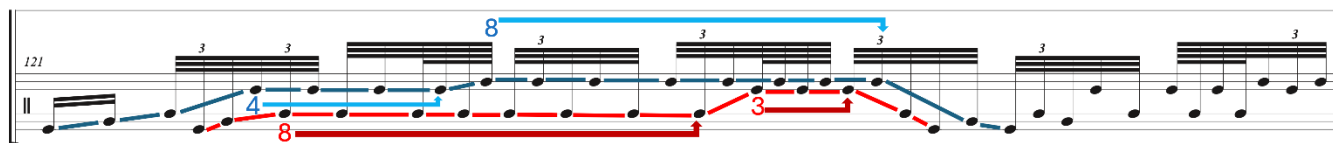
Example 8. First 10 measures of *Okho* (1989). Note the change of timbre for player A when player B finishes in m. 1. Also note the one-note extension after player C ends their first gesture in m. 3.

Example 8 shows the first 10 measures of *Okho* (1989). The score is for three percussion parts: Perc A, Perc B, and Perc C. The tempo is marked as $\text{♩} = 120$. The time signature is 4/4. Perc A plays a continuous pattern of eighth notes, with a change in timbre indicated by a blue vertical line in measure 1. Perc B and Perc C have sparse, gestural entries. Red numbers 1 through 15 mark specific measures. Blue vertical lines indicate measure boundaries. An orange circle highlights a note in measure 4. A bracket labeled "Extra Notes" spans measures 4-6.

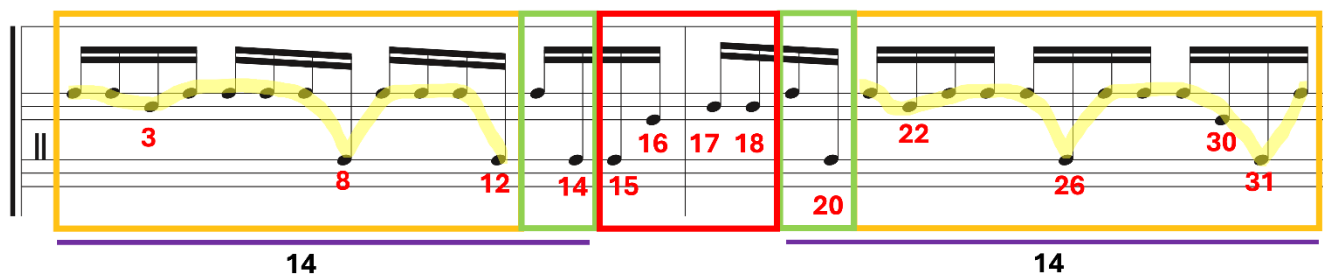
Example 9. Palindromic sequence hidden within player A in mm. 10–13. The distance between each *bord claqué résonnant* is marked by light blue lines and is represented numerically corresponding to the number of sixteenths.

Example 9 shows a palindromic sequence hidden within player A in measures 10–13. The distance between each *bord claqué résonnant* is marked by light blue lines and is represented numerically corresponding to the number of sixteenths. The sequence of distances is 9, 10, 10, 9, forming a palindromic structure.

Example 10. The final symmetrical structure for player C in m. 121. The two arcs reveal a similar number of repeating timbres. Numeric sequences formed by the upper and lower arcs are almost opposed to each other.



Example 11. Chiastic structure embedded in the solo part for player B in mm. 16–17. The red numbers indicate the position of each sixteenth note relative to the beginning of m. 16. The yellow rectangles reflect thematic similarity based on sporadic deviations of timbres from the uppermost line. The two sixteenth notes in green boxes surround the core of the chiasmus, indicated by the red box. The purple line and the number below represent the total number of sixteenths before and after the red segment (14).



Example 12. Chiastic structure embedded within three parts in mm. 25–26. In m. 25, there are three eighth notes from the edge of the chiasmus to the center. In m. 26, the rhythmic elements of chiasmus are highlighted with a black box.

Example 13. Chiasmus embedded within player A and B in m. 32. Numbers of notes played in each 8-note grouping are marked below their rhythms. Note the difference in how rhythms are manipulated to avoid unison textures between parts. An example is the fifth eighth-note segment, which has 5, 6, 6 for each player, but the rhythms are arranged differently for players B and C.

65

II

1 2 3 5 8 13 8 5 3 2 1

Large Scale Palindromic Structure

The chart displays the palindromic structure for three players, Player A, Player B, and Player C. The x-axis represents a scale from 60 to 72. Each bar is divided into segments of different colors, with red text labels above them indicating values.

Player	Segment 1 (Orange)	Segment 2 (Yellow)	Segment 3 (Green)	Segment 4 (Blue)	Segment 5 (Dark Blue)	Segment 6 (Purple)	Segment 7 (Red)
Player A	21 21	13 13	8 13	8 13	8 13	8 5	
Player B	21 21	13 13	8 13	8 8	5 8	5 5	
Player C	21 21	13 13	8 13	8 5	5 8		

Example 16. Analysis of player C from mm. 80–83. Timbre changes are indicated in green. The numbers represent how many thirty second note-durations there are before the next *basse* note. Note that 32nd-note durations may be represented by two 64th notes, contrary to the beginning where the durations are unified as one 16th note.

Example 16 shows a musical score for measures 80–83. The tempo is marked as 66. The score is written on a grand staff. Blue arrows and numbers (4, 5, 6, 3, 4, 5, 4, 3, 5, 4, 5, 4) indicate the number of thirty-second note durations between successive *basse* notes. Green wavy lines above the notes indicate timbre changes. A red vertical line marks the end of measure 83.

Example 17. The primary structure shown through player B's solo in m. 83. The blue numbers represent intervallic structures starting from each *basse* pitches.

Example 17 shows a musical score for measure 83. The score is written on a grand staff. Blue arrows and numbers (5, 4, 6, 4, 7, 4, 4, 5, 5, 5) indicate the intervallic structures starting from each *basse* pitch. Red brackets mark the beginning and end of the solo line.

Example 18. Larger chiastic structure in mm. 83–88. The yellow and green structures exhibit similarities between intervallic structures. The green structure will be repeated in the subsequent example.

The musical score for Example 18, measures 83–88, is presented in three systems. Each system consists of three staves. The first system (measures 83–84) features a yellow-shaded intervallic structure in the middle staff, labeled with the sequence (5, 4, 6, 4, 7, 4, 4, 5, 5, 5). The second system (measures 85–86) features a yellow-shaded intervallic structure in the middle staff, labeled with the sequence (5, 5, 6, 4, 7, 4, 4, 5, 5, 5), and a green-shaded intervallic structure in the bottom staff, labeled with the sequence (5, 5, 6, 5, 7, 5, 4, 6, 5, 6). The third system (measures 87–88) features a yellow-shaded intervallic structure in the top staff, labeled with the sequence (5, 4, 6, 4, 7, 4, 4, 5, 5, 5), and a green-shaded intervallic structure in the bottom staff, labeled with the sequence (5, 5, 6, 5, 6, 5, 4, 6, 5, 6) followed by an arrow pointing to the right. The green structure in the bottom staff of the third system is labeled as the 'Opening Sequence (m. 80)'.

83 (5, 4, 6, 4, 7, 4, 4, 5, 5, 5)

85 (5, 5, 6, 4, 7, 4, 4, 5, 5, 5) (5, 5, 6, 5, 7, 5, 4, 6, 5, 6)

87 (5, 4, 6, 4, 7, 4, 4, 5, 5, 5) (5, 5, 6, 5, 6, 5, 4, 6, 5, 6) -> Opening Sequence (m. 80)

Example 19. Continuation from previous example from mm. 89–94. Player C's green structure embeds the identical intervallic structure in Example 10. The turquoise structure performed by player A in mm. 91–92 is copied directly to player B in m. 93. In this section, player A additionally embeds a mirrored sequence of *basse* sounds.

8

89 (6, 5, 7, 5, 8, 5, 5, 6, 6)

91 (6, 6, 7, 6, 8, 6, 5, 7, 6, 7)

93 (6, 6, 7, 6, 8, 6, 5, 7, 6, 7)

(5, 5, 6, 5, 7, 5, 4, 6, 5, 6)

Example 20. Final large-scale symmetric structure from m. 96. Here, Xenakis emphasizes a contrast in texture through employing unison tutti, or solo passages with similar material. Identical intervallic sequences are found between structures highlighted in green, and others highlighted in turquoise.

95

(5, 4, 6, 4, 7, 4, 4, 5, 5, 6)

97

(4, 3, 5, 3, 6, 3, 3, 4, 4, 5)

(3, 2, 4, 2, 5, 2, 2, 3, 3, 4)

99

(3, 2, 4, 2, 5, 2, 2, 3, 3, 4)

(4, 3, 5, 3, 6, 3, 3, 4, 4, 5)

Example 21. Continuation of final large-scale symmetric structure. The green and turquoise highlights display identical intervallic structures from Example 13. Player B's solo part at mm. 102–3 keeps this structure from becoming a complete chiasmus.

The musical score for Example 21 consists of two systems of three staves each. The first system covers measures 101 and 102, while the second system covers measures 103 and 104. Red vertical lines are placed at the beginning and end of measure 101 in the first system, and at the beginning and end of measure 103 in the second system. Green highlights are present on the first two staves of measure 101 in the first system, and on the first two staves of measure 103 in the second system. Turquoise highlights are present on the third staff of measure 102 in the first system, and on the third staff of measure 104 in the second system. Intervallic structures are labeled in red text above and below the staves.

Intervallic structures (measures 101–102):

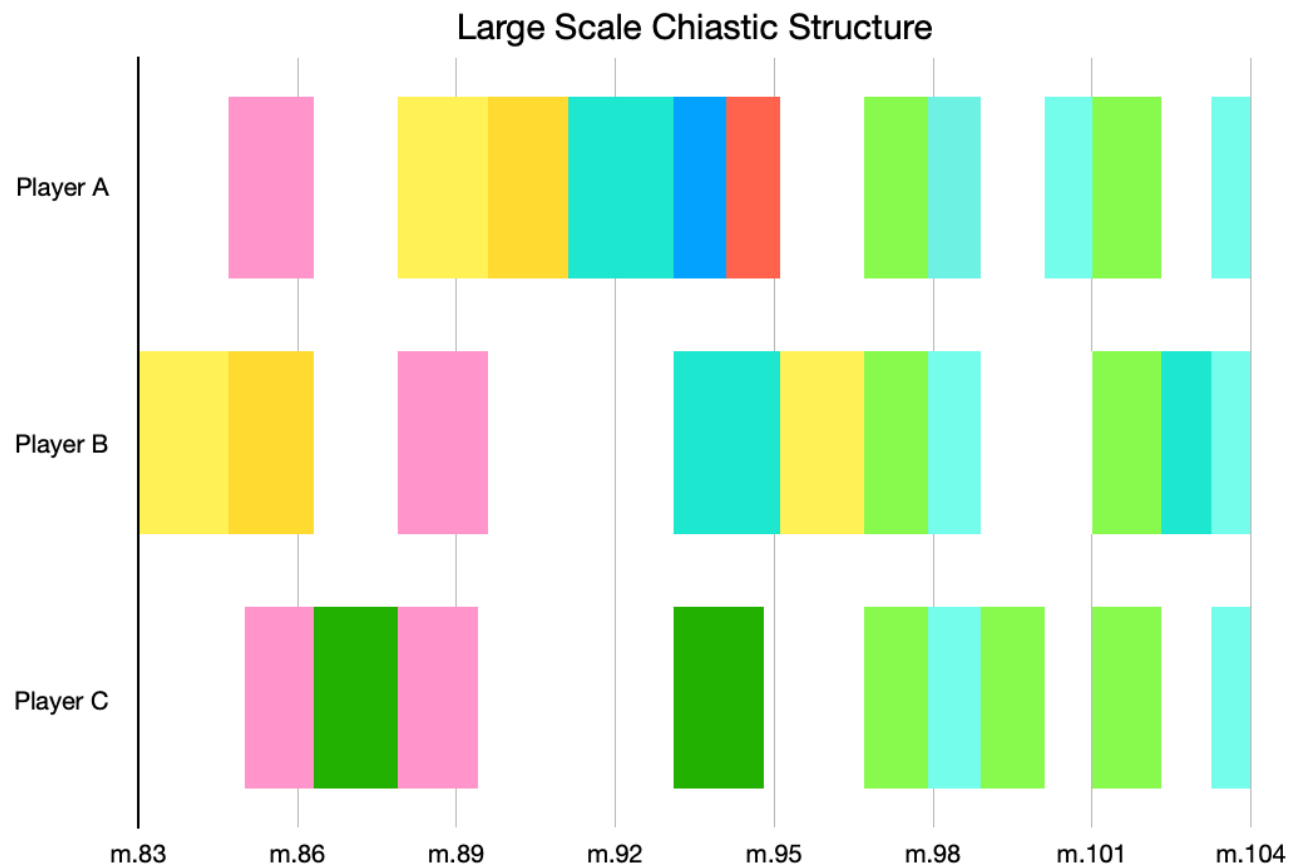
- Staff 1 (Measure 101): (4, 3, 5, 3, 6, 3, 3, 4, 4, 5)
- Staff 3 (Measure 102): (3, 2, 4, 2, 5, 2, 2, 3, 3, 4)

Intervallic structures (measures 103–104):

- Staff 1 (Measure 103): (3, 2, 4, 2, 5, 2, 2, 3, 3, 4)

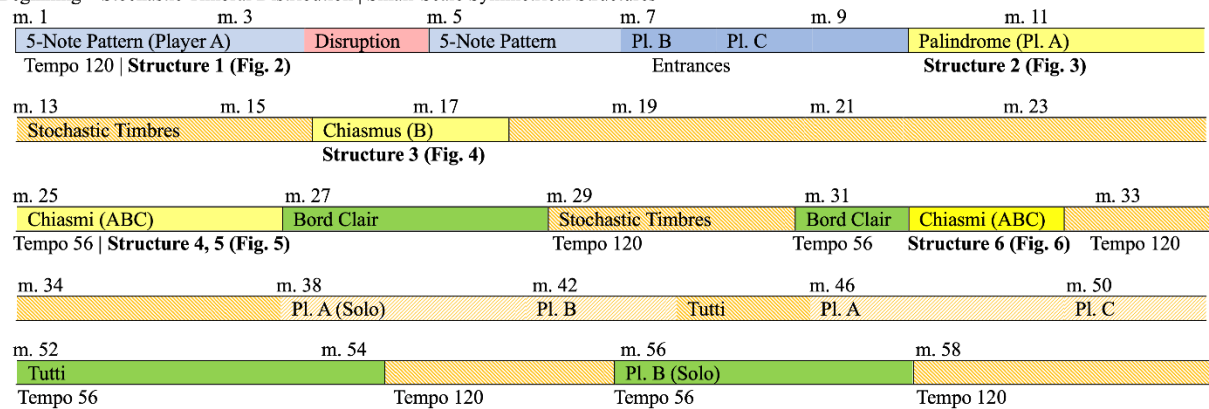
A tempo marking of $\text{♩} = 92$ is present above the first staff of measure 104.

Example 22. A chart summarizing large scale symmetrical structures from Examples 11–14. The x-axis indicates measure numbers, and the y-axis indicates performers. The larger green boxes denote chiastic structure, encapsulating the bridge structure boxed in red. The colors used in this example are similar hues from the previous example. One exception is the color pink, which indicates unrelated intervallic structures. The blue and red hues colored for player A additionally denote the palindromic structure in mm. 93–94.

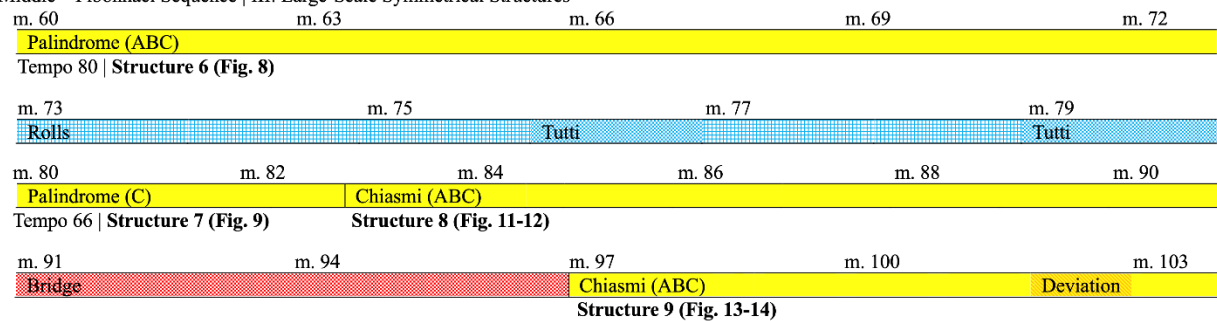


Example 23. Formal diagram of *Okho*

I. Beginning – Stochastic Timbral Distribution | Small-Scale Symmetrical Structures



II. Middle – Fibonacci Sequence | III. Large-Scale Symmetrical Structures



IV. End – Stochastic Distribution and “Chaos” | Deconstruction of Symmetrical Structures

