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Categories of Rhythmic Organization in Xenakian Textures

In 1955, Iannis Xenakis published in the first issue of Hermann Scherchen's *Gravesaner Blätter*¹ the essay *La Crise de la Musique sérielle*, which sounds not only like a declaration of war against the serial avant-garde, but also, and perhaps mainly, against the idea of polyphony itself. Stating that »linear polyphony destroys itself by its very complexity«² and that »there is a contradiction between the polyphonic linear system and the heard result which is surface or mass«,³ Xenakis considers polyphonic writing to be obsolete for perceptual reasons, and advocates a global conception of musical composition based on texture. He also develops a vocabulary intended to describe different textural effects: for instance, ›sound masses‹, ›clouds‹,⁴ or in Greek, ›αραιά‹,⁵ which means very thin textures. In fact, by asserting the necessity of considering sonic events globally (for instance, with statistic control of the sound mass), Xenakis changes the criterion for creating compositional coherence. No longer is the elementary entity taken as the organizational basis of the musical structure; rather, the global profile of the whole now determines the temporal positions of elementary sound events. Therefore, it seems relevant to speak of a radical mutation in the hierarchy of the different parameters involved in the rhythmic organization.

Concerning rhythm, one may wonder about the consequences of this change of viewpoint: what is the function of rhythm and how is it conceived and written? We may first notice that there is a strong contrast between the complexity of the texture and the simplicity of durational values in the individual lines, which present mostly half notes, quarter notes, eighth notes, and quintuplet-eighth

1 Xenakis 1955, p. 2.

2 »La polyphonie linéaire se détruit d'elle-même par sa complexité actuelle«, *ibid.*

3 »Il y a par conséquent contradiction entre le système polyphonique linéaire et le résultat entendu, qui est surface, masse.«, *ibid.*

4 Xenakis 1992.

5 See file O.M. 33/2, *Persephassa*, f. 1, Xenakis Archives.

notes. That is the reason why some scholars have claimed that Xenakis's music lacks rhythmic interest.⁶ In fact, rhythm does not disappear at all, but rather takes on a different character, which Xenakis achieves by means of compositional techniques involving new rhythmic parameters. Among those, the notion of differential duration appears as the cornerstone of his rhythmic writing.

1. What is differential duration?

Xenakis uses this term for the first time in an analytical text on *Metastasis*, written in 1954, but unpublished until 2003 (when I published it in the *Revue de Musicologie* with the title »Metastasis-Analyse«).⁷ There, Xenakis defines differential duration as the time interval between two sounds, regardless of the polyphonic layer to which they belong. As he writes: »The proper duration of a sound has henceforth no more meaning in the musical context. What does matter is its Differential Duration with another sound«.⁸ Afterwards, he refers often to it as <τριβές ρυθμού>⁹ (<rhythmic rubbings>), and draws diagrams in sketches of later works, as in *Shaar*, where the size of the shiftings is numerically expressed, or in *Persephassa*, where shifted dots represent beat strikes.¹⁰ In fact, the parameter of differential duration allows us to describe different textures, and depending on the techniques used by Xenakis, to explain their evolution. For instance, from the mid-1950s, starting actually with *Metastasis* and continuing to the early 1970s, Xenakis uses regular shiftings in the metrical superposition of quarter-note triplets, eighth notes, and eighth-note quintuplets (Example 1).

6 See for instance Solomos 1993, p. 37: »À la rationalisation du rythme, nous pouvons donner un nom; le rythme s'étant dissous, nous parlerons à sa place de durée. (...) La durée remplace le rythme, le chronomètre, le corps... «. (»We may give a name to the rationalization of rhythm: as the rhythm has disintegrated, we will speak instead of duration. (...) Duration is substituted for rhythm, chronometer for body.«)

7 Xenakis 1954 [2003], pp. 162–187.

8 Ibid, p. 186: »Dorénavant, la durée propre d'un son n'a plus de sens dans le contexte musical. C'est sa Durée Différentielle par rapport à un autre son qui compte.«

9 See file OM 9/14, *Eonta*, f. 13, Xenakis Archives.

10 See files OM 26/8-2, *Shaar*, f. 2 and OM 33/2, *Persephassa*, f. 9, Xenakis Archives.

The image displays a musical score for Violin I (V.I.), consisting of 12 measures. The notation is written on a single staff in treble clef. The score includes various musical notations such as pizzicato (pizz.), forte (ff), and dynamic markings. It features complex rhythmic patterns with triplets and quintuplets, and includes fingerings (3, 5) and slurs. The measures are numbered 1 through 12 at the bottom of the staff. The score is oriented vertically on the page.

Example 1: *Pithoprakta*, measures 180–186, violins 1

For the basic shiftings, the following values are given:

- a) for a shifting between an eighth note and a quintuplet eighth note:
 0.25 (half note – as there are four eighths in one half note) – 0.20 (half note) = 0.05 (half note).
- b) for a shifting between a triplet quarter and an eighth note:
 0.33 (half note) – 0.25 (half note) = 0.08 (half note).
- c) for a shifting between a triplet quarter and a quintuplet eighth note:
 $0.33 - 0.20 = 0.13$ (half note).

All these values belong to the canonic Fibonacci series: 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233. For that reason, I refer to this type of polymetrical organization as *Fibonacci polometry*. Its structure is cyclical as it is in phase every half note. These very subtle shiftings bring about a high textural malleability. In this way, the global sound is shaped by this rhythmic parameter.

Beginning in the mid-1970s, Xenakis's use of differential duration changes notably as irrational durations become predominant (Example 2). Shiftings are not regular, nor is the rhythmic organization cyclic; rather, the structure is an expanding one. Then, in Xenakis's last creative period (starting in the mid-1980s), his use of durational difference as an organizational principle almost completely disappears as his rhythmic writing turns to homorhythms.



Example 2: *Ikhoor*, measures 21–23

2. Rhythmic morphologies

Affinities among different structures and their persistence from one work to another allow the analyst to suggest a typological classification based on the criterion of rhythmic morphology rather than on formalization principles used in compositional processes. This classification is strengthened by studying Xenakis's compositional sketches; while he provides few verbal descriptions of polyrhythmic structures, he does graphically represent, often allusively, these

rhythmic morphologies in diagrams where shifted dots are notated with numerical values. I propose that the different categories may be grouped under three headings: *polymetrical polyrhythmies* (henceforth to be designated simply as ›polymetries‹), *non-polymetrical polyrhythmies*, and *homorhythmies*. This systematic classification covers the evolution of Xenakis's forty-year output, with polymetries prevailing during the first fifteen to twenty years, homorhythmies becoming increasingly predominant the last fifteen years, and non-polymetrical polyrhythmies remaining constantly present. Studying these rhythmic categories in connection with both the textural categories and compositional processes used by Xenakis enables us to highlight their interaction and to explain how they are perceived.

Polymetries

Polymetries fall into two subcategories following the criterion of phase; as mentioned briefly above, in phased polymetries, the structure is cyclically repeated, and points of convergence recur regularly, while in dephased polymetries, that is not the case, resulting in an expanding system. We have seen that in Xenakis's early career (from *Pithoprakta* to *Cendrées* in 1973), Fibonaccian polymetry is the most frequent phased polymetry, superposing quarter-note triplets, eighth notes, and eighth-note quintuplets in a measure of 2/2. This Fibonaccian polymetry may be linearly stable, with each line of the polyphony displaying only one metrical structure, or alternated, with meters switching among different lines.

I will focus on linearly stable polymetry, and show how it can result in different textures. Even with this relatively rudimentary metrical structure, Xenakis manages to shape various textural configurations through his use of other parameters. For instance, when a single invariable pitch is assigned to each layer and repeated over a constant metrical structure, the distinctive layers, as well as the overall polychronous effect, are clearly perceptible. The association of a single unique pitch with each layer allows us to hear the ›streaming effect‹ described by the psycho-acoustician Albert Bregman,¹¹ an effect which is obviously reinforced by the metrical independence of each layer. This type of configuration, which shows predictable regularity with respect to both meter and pitch, could be described as a multi-layered texture.

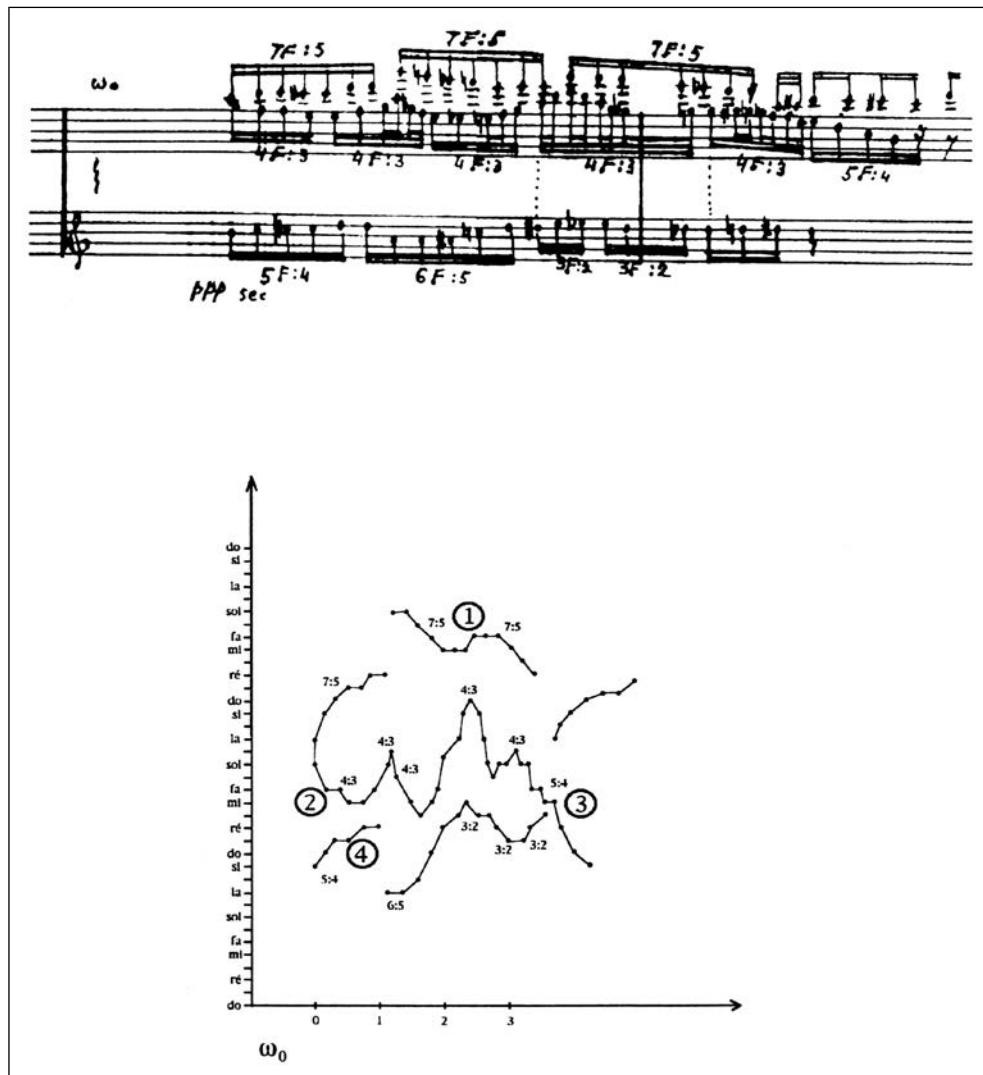
11 Bregman 1990, p. 48, explains the ›streaming effect‹ as the fact that »in a rapid sequence of high and low tones, the high tones and low tones form separate streams«.

However, factors other than pitch and rhythm may weaken the impression of clearly delineated layers, resulting in cloud-like textures. Such is the case at the very beginning of *Pithoprakta*, where all string players strike their instrument with the palm of the hand; the homogeneity of the tone prevents the perceptual differentiation of the different lines and leads rather to the perception of a cloud. Similarly, unevenly spaced accents may lead to a cloud-like texture, since the irregular structure of the accents competes perceptually against the stream's regularity. Nevertheless, in the context of a steady polymetry, cloud textures are more frequently connected with pitch variations, as in the famous glissandi and pizzicati section of *Pithoprakta* (mm. 52–59), where the micro-shiftings among different layers erase the perception of the edges of glissando lines and contribute to the impression of a unified sound mass. The use of this polymetric frame brings more rhythmic flexibility as well as more textural homogeneity, and Xenakis builds various rhythmic constructions on such steady Fibonacci polymetries with the aid of different compositional processes, such as stochastic rules, sieves, etc. Such a procedure is representative of the way he creates irregular global textures by superimposing and complexifying basic regular rhythmic structures.

Dephased polymetries are also of great interest due to their compositional fruitfulness. They are of two types: stable or evolutionary, according to whether the metrical structure of each line changes or not. Dephased polymetries begin to appear in Xenakis's output at about the same time that the dominating position of phased polymetries begins to weaken, namely in the mid-1970s. The lack of cyclical synchrony tends to increase the independence of superposed metrical layers and to give rise to multi-layered textures. In particular, evolutionary dephased polymetries are developed in connection with the use of the graphic model of arborescence, which is a heuristic and fruitful compositional tool for Xenakis during the 1970s.¹² In measures 93–94 of *Mists*, for example (Example 3), irrational durational values change according to the gradient of the branch of the arborescence. Here the multi-layered texture is a direct transcription (even in its rhythmic aspect) from a graphical model. Thus, the texture is a direct result of Xenakis's actual compositional process. Dephased polymetries also enable Xenakis to develop another type of texture that could be called monolinear texture; here the superposition of melodic lines of the same shape and

¹² One of the reasons Xenakis used dephased polymetries so much during the 1970s was that doing so allowed him to compose more quickly, a clear advantage since he was receiving many commissions at that time (see Barthel-Calvet 2015).

orientation, metrically very slightly shifted, forms a kind of ›thick melodic line‹ in which the harmonic stacking and temporal micro-shiftings keep the listener from perceiving details of the individual melodic strands.



Example 3: *Mists*, measures 93–94, score and arborescence

Non-polymetrical polyrhythmic structures

Non-polymetrical polyrhythmic structures are in fact the most common in Xenakis's output, as he most often uses simple polyrhythmies built on a metrical binary structure common to all layers. Polychronous phenomena tend to disappear as a consequence of the lack of multiple metrical units. The neutrality of the metrical frame enables conversely the emergence of manifold rhythmic and textural morphologies: clouds of regular or irregular density, and of continuous or multi-punctual weft; multi-layered structures (often derived also from arborescence); mono-linear textures; and structures of mobile sound planes taken up from the Varesian idea of ›sound-geometry‹, and characterized by the gradual deploying of sound aggregates.

Clouds are certainly the most frequent texture resulting from non-polymetrical polyrhythmy. Their structure differs significantly from those of polymetrical clouds, since the meshing, based on the same subdivisions – mostly binary subdivisions of the quarter note – is less fine and regular. Their morphology is essentially determined by two factors: the textural density and the kind of sounds used (ranging from short ›sound-points‹ to sustained or continuously moving sounds). In the case of sound-points, the emerging texture is a cloud composed of multiple sounds of very brief duration that stand out from a background of silence; with sustained sounds or glissandi, however, the texture appears as a sound mass, modulated by the polyrhythmic structure. Moreover, the mobility or the steadiness of pitches induces highly differentiated textural profiles. For instance, in measures 52–53 of *Serment-Orkos*, the absolute continuity of the glissandi lines induces a change in the textural morphology, which is no more perceived as a cloud, a dispersed and scattered structure, but rather as a moving sound mass.¹³ Conversely, in *Cendrées* (mm. 183–206, soprano and alto parts), we may observe a cloud, created from a steady cluster of three pitches, spread out over nine vocal lines. Here, the rhythm has a genuinely sculptural function in shaping the sound.

Xenakis also resorts frequently to polyrhythmic structures for multi-linear textures generated by the graphic model of arborescence, even if they are not rhythmically as flexible as polymetries. In this context and for the treatment of the graphical model, Xenakis presents two diametrically opposed options: either he proposes a glissandi's continuous structure, an exact transcription of

13 In the preceding and following bars, a rhythmization of the glissandi's attacks induces rather a cloud texture.

the model in the pitch-time Cartesian coordinate system, as in the string parts of *Erikhthon* (for instance in mm. 360–64), or he retrieves from this continuum a certain number of points that he uses to build a discontinuous multilinear texture. This is how he proceeds in *Mists* for three slightly different transcriptions of the same arborescence in measures 14–15, 22–24, and 28–30; the organization of durations depends on the way he has selected points on the continuous graphical model in order to obtain three ›variations‹ of the same structure. In this case, the polyrhythmic structure is no longer shaped by the gradient of the arborescence’s branches; rather the arborescence appears here as a ›parent structure‹ generating ›families‹ of morphologically close textures.

We may also notice the frequent use of polyrhythmic structures characterized by shifted entries of the different instruments (or voices) that become fixed on an aggregate. Edgar Varèse employed the same technique, describing it with the visual metaphor of mobile sound planes. For Xenakis, they have mostly structural functions, either introductory or concluding, as for instance in *Shaar*, which ends on the regular unfolding of the final chord.

It is surprising how Xenakis is able to generate such original and rich polyrhythmic structures within such a commonplace metrical frame. In fact, it is the neutrality of this frame that enables very diverse textures to emerge. More precisely, it allows him to create new complex ›sound objects‹, as the simplification and the ›tightening‹ in rhythmic writing reveals a change in the approach to sound: in polymetries, it is a multiple, moving entity, and in polyrhythmies, it is rather a ›nodal‹ sound, where different timbres are no more individually perceptible. This tendency will become even more prominent as Xenakis continues to develop and employ homorhythmies as a compositional tool. In this way, rhythm plays a significant role in the building and evolution of the Xenakian sonority.

Homorhythmies

Homorhythmies represent the third main rhythmic category of Xenakis’s music, and show a significant simplification of rhythmic writing. While Xenakis starts using homorhythmies more often at the end of the 1970s, they become clearly predominant in the mid-1980s. But in one special genre – that is, choral works written on classical Greek or Latin literature – Xenakis utilizes homorhythmies throughout most of his compositional career. In fact, Xenakis’s approach in those pieces is very different; for instance, in works on Sophocles’s or Aeschylus’s texts, rhythmic structure is totally dependent on the poetical prosody. Xenakis

devotes six works to ancient theater, composed at different periods of his life: *Hiketides* in 1964; *Oresteia's* trilogy in 1965–1966; *Medea Senecae* in 1967; *À Colone* and *À Hélène* in 1977, and *Les Bacchantes* in 1993. While they are distant from each other in time, they collectively form a stylistic continuity. In this homorhythmic writing, the polyphonic lines display most often parallel or independent movements, and the durational values follow more or less strictly the poetical prosody.

Moreover, homorhythmicies also appear regularly during the 1960s and 1970s, and in very diverse textural configurations, even as clouds. One example can be found in measures 146–148 in the *Métaux* section of *Pléïades*, where the spreading of pitches over a wide range prevents the listener from perceiving individual lines and results in a textural cloud. Conversely, the closeness of pitches in the lines enables the perception of a multi-layered texture, even in a homorhythmic context, as in *Evrjali*, measure 94 (Example 4), where it is linked to an arborescence.

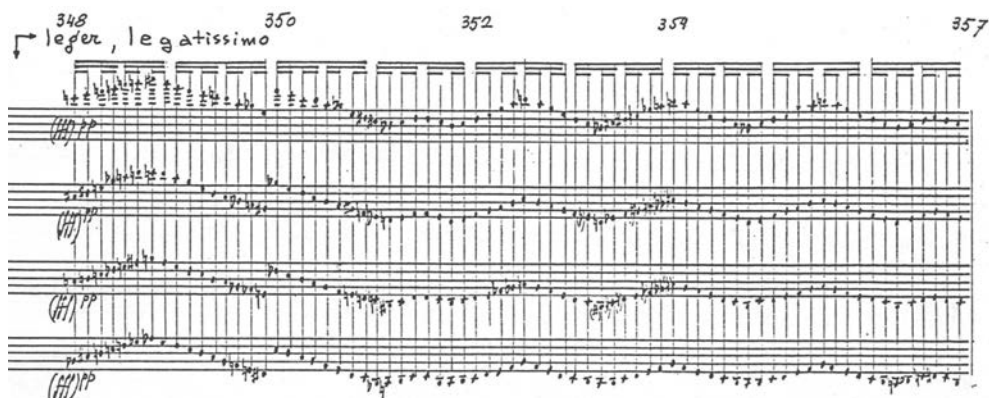


Example 4: *Evrjali*, measure 94

Nevertheless, it is from the mid-1980s onward that homorhythmicies become especially prominent in Xenakis's output, to the point of being iconic of a ›late Xenakis‹ style. Their primacy at that time may be linked with the mathematical principle of cellular automata that he uses from *Horos* (premiered in 1986) onward.¹⁴ This mathematical principle enables the composer to generate pitches and chordal sequences over a predetermined temporal grid, and induces therefore a standardization of the polyphonic rhythmic frame. As a consequence, Xenakis explores harmonic components in textures of ›sound-block‹ homorhythmicies that will become more and more frequent in the last twelve years of his career. Such textures are monolithic; they juxtapose chords whose durations are built in an additive way, starting from a basic unit – often the eighth note,

14 See Hoffmann 2002, Harley 2004, and Solomos 2006.

as, for instance, in *Horos*. Sometimes they are also superimposed with other textures with which they contrast, as dephased polymetries at measures 90–114 in *Thallein*. Homorhythmies also allow the emergence of a new approach to polyphony, as they are frequently used in a texture made of parallel melodies that merge into a complex sound element, as seen in measures 348–354 of *Tetras* (Example 5), laying out a kind of cluster in movement. With such homorhythmies, Xenakis is able to produce a new kind of mono-linear texture, marking a striking aesthetic shift within his compositional style.



Example 5: *Tetras*, marks 348–357

These various examples show that different textural categories may appear with the same rhythmic morphology. Such categories can be differentiated through specifically rhythmic criteria such as regularity or density, but also through other criteria such as pitch distribution; in fact, the emergence of one particular texture rather than another is linked to an accumulation of criteria. The cloud texture, emblematic of the Xenakian aesthetic, may be found in all types of rhythmic morphologies, including homorhythmies; it is linked to a high density of sounds as well as to irregularities in their temporal or pitch-range distribution. Conversely, a multi-layered texture typically features temporal regularity and pitch stability within the individual layers. In both cases, however, these textures are based on sound scattering. In contrast, mono-linear textures are ›sound-melting‹ textures. They depend on close parallel moving lines, whether strictly homorhythmic or involving very subtle rhythmic shifts.

While such textures are almost entirely lacking in Xenakis's early works, they progressively become more and more dominant as his career progresses. In fact, the evolution of his sound conception is intimately linked to his rhythmic writing

of sound masses, which evolves from an imperceptible polymetrical articulation, certainly stemming from architectural inspiration, towards clearly articulated homorhythmies.

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