Expanded Modal Rhythm[1]

Luigi Antonio Irlandini[2]

Universidade do Estado de Santa Catarina | Brazil

Abstract: This article is written by a composer on his own music. It describes a set of rhythmic organization principles used in my compositional research since 1989. These principles greately expand what is traditionally known as "modal rhythm", which appears for the first time in the music of the 12th century polyphonists of the Notre Dame School: Leoninus and Perotinus. For this reason, I call this group of rhythmic principles "expanded modal rhythm". They are a part of a larger context of temporal organization principles designed to generating ametric textures, complex polyrhythm and cross rhythms, and certain desired types or rhythmic flow. I use examples taken from four of my compositions.

Keywords: modal rhythm, number and music, compositional process, temporal organization, rhythm

[1] Submitted on: 30/04/2017. Approved on: 09/06/2017.

[2] Composer and performer (piano and shakuhachi), born in Rio de Janeiro, is a professor at UDESC since 2010. Works recently in evidence are *Peace, my Heart*, for choir a cappella, on a poem by Rabindranath Tagore (Prêmio Funarte de 2016), *Thirteen Moons on Turtle's Back*, for piano and violoncello, premiered at the 22º Rio International Cello Encounter in 2016, and *Phoînix* (from the series *Bestiarium*, vol. 1): the chamber version was premiered at the 50º Festival Música Nova Gilberto Mendes in 2016, and the original orchestral version at the Festival Tinta Fresca, in Belo Horizonte, 2012. Irlandini received his Ph.D. in Composition from the University of California, Santa Barbara (UCSB), where he also worked in post-doctoral research in computer music at the Center for Research in Electronic Art Technology (CREATE, UCSB). For more information and samples of his works, go to https://sites.google.com/site/cosmofonialai/.
E-mail: cosmofonia.lai@gmail.com

The term[3] "modal rhythm" traditionally refers to the six rhythmic patterns described in the treatise *De mensurabili musica*, dated around 1240 and attributed to French theorist Johannes de Garlandia (fl. Ca. 1270-1320), concerning polyphonic music written by Notre-Dame composers Léonin and Pérotin (end of 12th-century and beginning of the 13th). The patterns of rhythmic modes may have had their origin in the feet or meter (the two terms are used here interchangeably) of ancient Greek and Latin poetry, but musicologists have not yet been able to clarify the specific role of poetry in the development of rhythmic modes (ROESNER, 2007-2017).

By "expanded modal rhythm" I mean a set of rhythmic and temporal[4] organization principles I have developed for composition starting in 1989,[5] which expand some of 12th-century basic modal rhythmic premises. They are a part of a larger context of organizational principles designed to generating ametric textures, complex polyrhythm and cross rhythms, and certain desired types of rhythmic flow, and which include many other aspects that should be discussed in another essay (such as *tāla* structures and other rhythmic principles inherited from classical Indian music and from ancient Greek music theory and Vedic and Classical Sanskrit language meters—*chandas*—found respectively in the Ṛg Veda and later Hindu texts). I used Greek feet intuitively in my music since the composition *Numen*[6] (1986). To my knowledge, there is no attempt at developing modal rhythm in a similar way in the work of other 20th- and 21st-century composers. Olivier Messiaen, because of his interest in Greek feet, might be the one whose rhythmic ideas most closely resemble those described here as expanded modal rhythm.

This article is concerned only with describing expanded modal rhythmic organization principles. Therefore, it is not a complete exposition of the entire rhythmic *cosmology* in my musical works. I avoid the term "system" and prefer the term "cosmology" to describe them. A musical cosmology is the *rationale* underlying the creation and structure of a musical work or style, very much like the natural laws of the physical universe in the natural sciences. The musical piece becomes analogous to a *kosmos*, a universe of sounds. (IRLANDINI, 2012). The cosmology of a composition is a set of prescriptive principles or compositional processes, not a theory or analysis of the music, and the principles of

---

[3] This article presents the academic findings of a research stage concerned with the documentation of compositional processes in the field of temporal and rhythmic organization in contemporary music composition, with a focus on my own work as a composer. This research stage is part of the Research Project entitled "Ancient and Non-European Contents in 20th- and 21st Century Music Composition", which is currently coordinated by Prof. Dr. Luigi Antonio Irlandini within the Research Group "Processos Músico-Instrumentais", in the Research Line "Processos Criativos em Interpretação e Composição Musical" of the graduate studies program PPGMUS at the Universidade do Estado de Santa Catarina (UDESC).

[4] Rhythmic organization takes care of rhythm as it appears locally in the foreground and middleground levels of a composition. Temporal organization relates to rhythm in the level of larger morphological units such as phrases, sections and the macroform, as well as rhythmic aspects that remain in the background level.

[5] I still use the rhythmic principles established since then, although in a less strict way than in the first 10 years.

[6] *Numen*, originally entitled *Música Antiga*, 1986, first performance: MAM-RJ (Museu de Arte Moderna do Rio de Janeiro) August 31st, 1986, Rio de Janeiro, Brazil. The piece has three movements (*Dronos*, *Mysterion*, *Dithyrambos*), and requires at least six musicians performing several world instruments.

expanded modal rhythm outlined in this article are a part of the cosmology of my compositions[7]. I will use examples taken from four of my compositions[8]: *Dithyrambos*[9] (third movement of the above mentioned *Numen), "…nature loves to hide…" ("…a natureza ama esconder-se…")* [10](1989, for oboe, trumpet and cello), *Mojave*[11] (1989, for piano and two percussionists), and *Archipelago*[12] (1990, for three percussionists playing indeterminate pitch instruments).

Essentials of modal rhythm

I start focusing on the medieval rhythmic modes in order to identify the essential characteristics that tradition has regarded to be modal in rhythm. I follow the basic standard texts on the subject written by Sachs (1953), Hoppin (1978) and Roesner (2007-2017), as well as Garlandia's *De mesurabili musica* as provided by Reimert's edition (1972). The essential characteristics of modal rhythm may be formulated as just one: rhythmic patterns made of long and short durations under a specific ratio; but can be broken into three items: 1) duration measurement; 2) duration proportion (long:short); 3) groupings, combinations or successions of short and long durations.

Since *De mesurabili musica* translates as *On measurable music*, Garlandia's treatise title immediately reveals the first essential trait of modal rhythm: duration measurement, i.e., that modal rhythm is measured. Quantification rules rhythmic durations, establishing a direct relationship between duration and number. Rhythmic flow is determined by the quantities by which it is created.

Furthermore, quantification engenders quality of motion. Garlandia defines these qualities as *modus* or *maneries*, as "that which flows concurrently by the measurement of time, that is, by longs or by shorts" (REIMERT, 1972: 36)[13]. As the term *modus* means mode, type, or kind, it becomes, in relation to rhythm, the quality or type of rhythm and, therefore, of motion, if one agrees that rhythm determines musical motion.

The second essential trait is the basic dualism of durations: duration proportion, i.e., that, if durations are not the same, they are different and, therefore, one is necessarily longer (or shorter) than the other. The dualism of short (U) and long (__) syllables is present in Greek poetry, which flows

---

[7] Garlandia's treatise is a theory about a 12th-century compositional practice; in its theoretical research, it goes beyond what was practiced by Leoninus and Perotinus. The fact that a theory becomes part of a later cosmology of composition only shows the existing feedback between theory and compositional practice: they feed off each other.

[8] Please find the available recordings for listening at https://www.soundcloud.com/luigi-antonio-irlandini

[9] In this movement, the instrumentation is several drum parts, gong, tam-tam, cymbals, so-na, piano, electronic keyboard, and voice.

[10] *"...nature loves to hide..."* : first performance: CalArts (California Institute of the Arts), April 11st, 1989 (conductor: Stephen L. Mosko; cello: Erika Duke Kirkpatrick; oboe: Allan Vogel; trumpet Craig Simmons.

[11] *Mojave* : first performance: CalArts, November 9th, 1990 (conductor: Robert Lawson; percussionists: Kirk Brundage and Jean-Pierre Bedoyan, piano: the comporser).

[12] *Archipelago*: first performance: Palazzo Chigi Saracini, Accademia di Musica Chigiana in Siena, Italy, August 28th, 1990, Gruppo Octandre, conducted by Paolo Bighignoli.

[13] *"Maneries eius appellatur, quidquid mensuratione temporis, videlicet per longas vel per breves, concurrit."* (Reimert, 1972: 36)

according to patterns or combinations of short and long syllables at a given ratio (long:short), namely, the 2:1 ratio, as in Sanskrit or Latin. In the first and second medieval modes, the short note (*brevis recta*) measured one time unit (*tempus*), while the normal long (*longa recta*) measured two *tempora*. The sixth mode, which only included short notes, was called, together with the first and second, *modi recti* because they only used the simple 2:1 ratio. In the third and fourth modes, the ratio is 3:2:1: the long was "beyond the measure" (*ultra mensuram*) because was equal to three *tempora*, while the short would be equal to one *tempus* when it was the first short in the pattern, or to two *tempora*, when it was the second. The fifth mode was the only one made exclusively of three-*tempora* long notes (BENT, 1980: 825).

The third essential trait is the rhythmic pattern itself, i.e., the succession of long and short syllables in abstract, dissociated from an assigned ratio. This is somehow related to the feet of Greek poetry, although, historically, no one knows really how for sure, and is an issue that is none of this article's concern because I am dealing here with practical contemporary compositional applications of the modal approach to rhythm. Walther Dürr suggests one should stay away from attempting to establish an exact correspondence of classical poetry feet with Notre-Dame polyphony rhythmic modes (DÜRR, 1980: 812). Here, I present the medieval rhythmic modes associated to Greek feet as presented by Hoppin or Sachs, as this correspondence does not suggest necessarily that the former were derived from the latter (HOPPIN, 1978: 222) (SACHS, 1953: 160). The relationship is that of structural resemblance or identity, and not of historical derivation.

Table 1, below, shows the six rhythmic modes of Notre-Dame polyphony. In the first column,

	Greek foot's syllabic structure	Greek foot in musical notation	Greek foot's name
1.	— U	♩ ♪	trochaic (*trochaios*)
2.	U —	♪ ♩	iambic (*íambos*)
3.	— U U	♩ ♪ ♩	dactylic (*dáktylos*)
4.	U U —	♪ ♩ ♩	anapaestic (*anápaistos)*
5.	— —	♩. ♩.	spondaic (*spondaiós*)
6.	U U U	♪♪♪	tribachic (*tribachýs*)

Table 1. The six 12th-century rhythmic modes

they appear as rhythmic patterns of syllables. In the second, they appear in equivalent modern notation; in the third are the patterns' corresponding names as Greek feet (according to Hoppin or Sachs), again, a correspondence not implying derivation.

Longer morphological units (phrases) in the music were formed by reiterations of these rhythmic patterns. For example, a succession of three *ordines* in the first mode would be ♩ ♪ | ♩ ♪ | ♩ ♪ | ♩ 𝄾 | (Bent, 1980). Naturally, composers were not limited to the simple reiteration of a pattern without changing it, a procedure which would quickly lead to boredom, as one would have been condemned to writing only trochaic *ostinati*, anapestic *ostinati*, etc... Among other means, variety was obtained by procedures such as combining adjacent notes into a larger duration, or subdividing a long into breves, replacing a ternary long by a long and a breve, or subdividing breves into semibreves (*fractio modi*) (HOPPIN, 1978: 225). These procedures have the effect of generating variations in the musical surface by throwing the syllabic structure to the background. As a result, the note durations we see in the music score sometimes do not correspond to the note durations of the modal patterns, because they have become, at that point, "abstract". It is customary to differentiate, in the literature, between syllables and durations where *syllables* apply to syllables of a word in metrified poetry of Greek, Latin and Sanskrit (where syllables have differentiable durations), while *durations* apply to the note durations in music. I will retain the use of the term *syllable* to refer to a musical duration value *in the rhythmic pattern which constitutes the mode*, because the concept of syllable helps talking about the original syllable duration which has been transformed in the musical surface by, say, for example, the practice of *fractio modi*. In this case, the term *note duration* refers only to the notes in the musical surface, and it is clear that these durations may or may not be equivalent to a syllable in the rhythmic pattern.

The point here in the identification of the third essential trait of modal rhythm consists in recognizing the rhythmic pattern as a combination of long and short syllables. Trochaic, iambic, dactylic, anapestic, spondaic and tribachic are Greek feet, i.e., combinations of long and short syllables already available traditionally. However, for the sake of composing contemporary music, one needs not be attached to Greek feet and their beautiful names, no matter how charming they might be. Once they are viewed as specific combinations of long/short syllables that were in use in Greece, it is possible to create new combinations of long and short syllables in feet with 2 syllables, 3 syllables, 4 syllables, 11 syllables... This idea brings to existence a much larger number of rhythmic feet to be used in music than the already big number of traditional feet in Greek poetry. Mathematics are brought to action to "proliferate the material", as it is usually said, by creating combinations of long/short syllables by means of permutation. I will return to this issue further ahead, as this, in fact, is one of the ways of expanding modal rhythm.

Chronos protos

At this point, it is possible to look at each of these traits that define modal rhythm and expand them into a set of organization principles useful for composition, a musical cosmology. The first step in my research on modal rhythm in contemporary composition was the establishment of a time unit for the measurement of rhythmic syllables. This time unit must not be mistaken with Western music's idea of time unit in the measure; it is the time unit that gives duration to syllables (notes) forming local rhythms in the music's surface, according to an additive principle: a syllable is made of one, two, three, or any number of units, at least in theory, practicality defining, later, what is useful and was it not. The idea is familiar from music of the 1950s, in which composers started serializing rhythm, or from the music of Olivier Messiaen immediately before that. In his *Mode des valeurs et d'intensités* (MESSIAEN: 1949: 2), he uses the thirty-second note as a "chromatic duration" (in textural layer *Division I)* to generate 12 durations, each equal to 1, 2, 3… until 12 thirty-second notes. The other textural layers use the sixteenth note *(Division II)* and the eighth-note *(Division III)* as chromatic durations. Because the sixteenth and the eighth notes are binary multiples of the thirty-second note, this system generates only a total of 24 different chromatic durations ranging from 1 to 24 thirty second notes.

Messiaen's chromatic durations are called "chromatic" because of the compromise with dodecaphonic serialism that existed at that time. They were created in the image of the twelve notes, the total chromatic. Here, however, there is no such limitation. Fourth-century B.C.E. music theorist Aristoxenus of Tarentum (born ca. 370 B.C.E.) speaks of a "primary time unit", the *chronos protos* (χρόνος πρωτος), which he defines, in Lewis Rowell's translation, as "that which can be divided by none of the rhythmic substances" (ROWELL, 1979: 72). I took this idea of a "first" *(protos,* in Greek, means first in the sense of original) and smallest pulse to define the time unit generating musical syllables in expanded modal rhythm, and will refer to them hereinafter as *chronos protos* (cp). The cp is not necessarily the smallest time value in the music, but it is the smallest time value within a certain context (which can be, for a while, a rhythmic line, a section, a textural layer), and it cannot be subdivided: it can only be added. In principle, any time value can work as a cp, determining different *continua* of rhythmic impulses underlying the music's time values, very much in the same way that Messiaen's concept of chromatic durations applies to three different layered time units. It is interesting to keep it this way, since it allows greater flexibility in the composition, as exemplified by Messiaen's durations in *Mode des valeurs et d'intensités*: each textural layer moves in a different speed, so to speak, and all the rhythms are bound to a same generating code, namely, the chromatic duration.

There is a limitation (without charging this word with a judgment) in Messiaen's piece, which consists in the fact that all durations in it are multiples of the thirty-second note, as mentioned above. While searching for a rhythmic cosmology that would allow for the greatest flexibility in kinetic movement *(tempi)*, it was desirable to be able to work with different cp-s[14] that were not only those bound to each other as binary (or ternary or whatever) multiples. I wanted to be able, for example, to superimpose a layer of music using a regular eight note as cp to another layer using a triplet, or a quintuplet to a sextuplet. I found that, to reach this goal, the chronos protos should belong to a larger context, namely, that created by a unifying time unit which would, therefore, be divisible in the same way as in western classical music, where it is possible to use triplets, quintuplets, sextuplets, and so on.

The unifying time unit is called "primordial time unit" (P.U.), works as a *tactus*, and is set around 60 – 72 beats per minute[15]. Within this range one can write the same rhythms at the speed of a quarter note or at that of a sextuplet or even at that of the seventuplet (time value augmentation or diminution becomes possible in new ways), and still have them performed accurately (after some training, if the writing poses new skills to be acquired by the musician). When the primordial time unit is faster than 76 in the metronome, the writing should avoid septuplets or even sextuplets for the sake of performability.

In order to describe the entire collection of cp-s, it is easier to start with those smaller than, or equal to, the primordial time unit because of the limitation imposed by performability due to the consequent increase of rhythmic density or speed when the P.U. is divided by larger numbers. Below, Table 2 shows the possible cp-s within the primordial unit, represented by the ♩, and fixed at the kinetic

cp	kinetic value	cp:P.U. ratio
𝅘𝅥𝅯7	420	7:1
𝅘𝅥𝅯6	360	6:1
𝅘𝅥𝅯5	300	5:1
𝅘𝅥𝅯4	240	4:1
♪3	180	3:1
♪2	120	2:1
♩	60	1:1

Table 2: Simple cp-s and their kinetic values

value (metronomic speed) of MM = 60, each with their corresponding kinetic value in the second column. They correspond respectively to one septuplet, one sextuplet, one quintuplet, one quadruplet

[14] I am using the plural form cp-s because the Greek words *chronos protoi* would not be correctly set in plural by simply adding an "s".

[15] This is why most of my compositions have the sometimes unchanging *tempo* mark of a quarter-note at MM= 60 – 72 in their score. Because of the difficulty involved in the performance of certain rhythms originating from this writing, other score time units with different metronome marks have been also introduced, by means of metrical modulation, while the music still follows the organization given by the P.U. at 60 – 72.

(sixteenth note), one triplet, one duplet (eighth note), and one quarter note. Because seventuplets constitute a subdivision of the quarter-note in a number smaller than 8 (i.e, 7 parts), and 8 subdivisions of a quarter note triggers the use of the thirty-second note, the cp notation below uses the sixteenth note to represent subdivisions of the quarter-note in 4, 5, 6 and 7 parts. To differentiate them, the sixteenth note receives an index number (n) therefore, as 𝅘𝅥𝅯^{n}, which indicates how many parts are dividing the quarter note. For subdivisions in 2 and 3 notes, the eighth note is used, with the corresponding index number. These are the "simple cp-s", since they are made of one single unit of a time value. The ratio between the cp and the P.U. is given in the third column of Table 2.

"Compound cp-s" are made up by more than one unit of a cp but are still shorter than (or equal to) the P.U. . Table 3, below, shows all compound cp-s with their corresponding kinetic value in parenthesis. The list separates the compound cp-s by "streams". The "cp stream" is the collection of cp-s under the same subdivision of the P.U. because it is defined by the same "n", the index value.

2𝅘𝅥𝅯^{7} (210) / 3𝅘𝅥𝅯^{7} (140) / 4𝅘𝅥𝅯^{7} (105) / 5𝅘𝅥𝅯^{7} (84) / 6𝅘𝅥𝅯^{7} (70) / 7𝅘𝅥𝅯^{7} (60)
2𝅘𝅥𝅯^{6} (180) / 3𝅘𝅥𝅯^{6} (120) / 4𝅘𝅥𝅯^{6} (90) / 5𝅘𝅥𝅯^{6} (72) / 6𝅘𝅥𝅯^{6} (60)
2𝅘𝅥𝅯^{5} (150) / 3𝅘𝅥𝅯^{5} (100) / 4𝅘𝅥𝅯^{5} (75) / 5𝅘𝅥𝅯^{5} (60)
2𝅘𝅥𝅯^{4} (120) / 3𝅘𝅥𝅯^{4} (80) / 4𝅘𝅥𝅯^{4} (60)
2𝅘𝅥𝅮^{3} (90) / 3𝅘𝅥𝅮^{3} (60)
2𝅘𝅥𝅮^{2} (60)

Table 3. Compound cp-s with respective kinetic values listed by cp stream

Therefore, the seventuplet stream has six compound cp-s, the sextuplet stream has five, the quintuplet stream has four, the quadruplet stream has three, the triplet stream has two, and the duplet stream one. Notice that the list above shows one less cp in each stream because it does not include the simple cp-s that originate each stream. A complete list of cp-s per cp streams would have to include them, but the above list is a list of compound cp-s organized per stream.

It is also noticeable that the cp is defined by the expression x𝅘𝅥𝅯^{n} . The "x" represents the number of time unit values (subdivisions of the P.U.) that make up the duration of the cp and of the syllable made from it. For example, 3𝅘𝅥𝅯^{4} is equal to 𝅘𝅥𝅮. , a dotted eight note, which may be a cp or an entire syllable. In simple cp-s, $x = 1$. In compound cp-s $x \neq 1$.

The last cp in each stream (Table 3) is always equivalent to the quarter note, which is the P.U. at MM. 60, because their number of time units (the "x") is equal to "n", the time unit index. In other words, two duplets are equal to three triplets, four quadruplets, five quintuples, six sextuplets and seven seventuplets. This means that they all have the same kinetic value, but this does not make them equivalent for a certain other purpose to be discussed further ahead.

Furthermore, because triplets are multiples of sextuplets and eighth-notes are multiples of sixteenth notes, it turns out that the kinetic value 180 is shared by cp-s: 2𝅘𝅥𝅯^{6} and 𝅘𝅥𝅮^{3} ; the kinetic value 120 is shared by cp-s 3𝅘𝅥𝅯^{6}, 2𝅘𝅥𝅯^{4}, and 𝅘𝅥𝅮^{2}; and MM=90 is shared by cp-s 4𝅘𝅥𝅯^{6} and 2𝅘𝅥𝅮^{3}.

cp - (kinetic value) – cp:P.U. ratio	cp - (kinetic value) – cp:P.U. ratio
♩ (60) 1:1	3𝅘𝅥𝅯^{6}=2𝅘𝅥𝅯^{4}=𝅘𝅥𝅮^{2} (120) 2:1
6𝅘𝅥𝅯^{7} (70) 7/6:1	3𝅘𝅥𝅯^{7} (140) 7/3:1
5𝅘𝅥𝅯^{6} (72) 6/5:1	2𝅘𝅥𝅯^{5} (150) 5/2:1
4𝅘𝅥𝅯^{5} (75) 5/4:1	2𝅘𝅥𝅯^{6}=𝅘𝅥𝅮^{3} (180) 3:1
3𝅘𝅥𝅯^{4} (80) 4/3:1	2𝅘𝅥𝅯^{7} (210) 7/2:1
5𝅘𝅥𝅯^{7} (84) 7/5:1	𝅘𝅥𝅯^{4} (240) 4:1
4𝅘𝅥𝅯^{6}=2𝅘𝅥𝅮^{3} (90) 3/2:1	𝅘𝅥𝅯^{5} (300) 5:1
3𝅘𝅥𝅯^{5} (100) 5/3:1	𝅘𝅥𝅯^{6} (360) 6:1
4𝅘𝅥𝅯^{7} (105) 7/4:1	𝅘𝅥𝅯^{7} (420) 7:1

Table 4. The 18 cp-s within the Primordial Unit

Table 4, above, shows that there are, in total, 18 different cp-s (or kinetic values) (the difference between a cp and its kinetic value will be explained later on in this article) within the P.U. (this means smaller or equal to the P.U.), of which 7 are simple and 11 are compound. Table 4 shows them with their corresponding cp:P.U. ratio[16], and organized in ascending order of their speed.

The cp-s that exceed the duration of the primordial time unit are obtained by the same procedure of adding one simple cp to the value equivalent to the P.U. in each cp stream. This is done here until the kinetic level (metronome mark) 30 is reached, as shown in Table 5, below:

[16] All cp:P.U. ratios read like the amount of cp-s that fit inside one primordial time unit. For example: 7:1 means there are 7 cp-s in one P.U. . For all compound cp-s, the cp:P.U. ratio also indicates how many cp-s fit inside a P.U., but this number involves a fraction. For example, the ratio 4/3:1 indicates that 1,333... (4/3) fits inside one P.U., when it is clear that the cp in question is ¾ of the P.U. . In fact, the duration of three sixteenth notes is ¾ of the quarter note. A quarter note equals a little more than one unit of three sixteenth notes plus the third part of that same unit (one more sixteenth note, which, in the case, is the remaining 0,333). The same applies for all other fractions.

8♪^{7} (52.5) / 9♪^{7} (46.7) / 10♪^{7} (42) / 11♪^{7} (38.2) / 12♪^{7} (35) / 13♪^{7} (32.3) / 14♪^{7} (30) / ...
7♪^{6} (51.4) / 8♪^{6} (45) / 9♪^{6} (40) / 10♪^{6} (36) / 11♪^{6} (32.7) / 12♪^{6} (30) / ...
6♪^{5} (50) / 7♪^{5} (42.8) / 8♪^{5} (37.5) / 9♪^{5} (33.3) / 10♪^{5} (30) / ...
5♪^{4} (48) / 6♪^{4} (40) / 7♪^{4} (34.3) / 8♪^{4} (30) / ...
4♪^{3} (45) / 5♪^{3} (36) / 6♪^{3} (30) / ...
3♪^{2} (40) / 4♪^{2} (30) / ...

Table 5. Compound cp-s larger than the Primordial Unit arranged per stream and by decreasing kinetic value

There is no need to continue generating longer, slower cp-s, since what is important here is to understand the principle that generates them. Because there are no performability issues with longer durations, there are no constraints regarding how long a cp should be[17]. What the above cp-s show is that, by adding one cp until reaching the value of a half note in each stream, the lowest kinetic value of a cp arrives at 30 beats per minute. At the level of the dotted half note, the kinetic value equals 20. Our traditional pendulum metronome's lowest mark is MM = 40. How far should this go on?

The question of how long a cp should be remits us back to the definition of the chronos protos: first and smallest pulse used to define the time unit generating musical syllables in expanded modal rhythm. What sense would there be in a rhythm based on a cp of kinetic value equal to 1 (MM = 1 means one beat per minute)? For example, a tribachic *ostinato* (a pattern made of three short syllables) performed unaccented is perceived as a continuum of pulses at the speed MM = 60, but would it still be perceived as a pulse at the speed MM = 1? And what about a trochaic *ostinato* at 2:1 ratio at that same speed? Would our ear relate the two-minute long syllable to the one-minute short and configure them into a trochaic rhythm in our perception? Even if the answer to these questions is "no, the listener cannot connect time values of that great length and identify their form by feeling and/or intellect", there still is a sense in using such a very long cp in a composition. The sense lies in the fact that the compositional principle used to generate rhythm (therefore, musical motion, kinesis) is capable of producing certain sound phenomena that, although they may not be perceived as what they are by the listener, such as an extremely slow pulsating rhythm, they remain, nevertheless, structurally coherent to the whole. These sound phenomena may be extremely interesting musically, probably exactly because our perception is bewildered by them. For this reason, I have not set a limit concerning

[17] Limitations occur only in the case of one performer alone on a wind instrument without circular breathing. Long notes can be sustained indefinitely in wind instruments by at least two players breathing alternately. Another point is that, the duration does not necessarily have to be sustained all the way through; duration could be limited to the moment of its attack, typically on a bass drum without rolling, for example, but really in any instrument or instrumental combination assigned to the line ruled by the long cp.

how long a cp should be; this limit remains open, and finds its definition according to the needs of each piece.

One more thing should be mentioned about the kinetic aspect of cp-s: its similarity to the concept of *laykārī* in classical Hindustani music. The general meaning of the term is simply "variation", but the most common of its specific meanings is that of "divisive *laykārī",* a rhythmic variation technique which involves what Martin Clayton calls "*lay* ratio" (CLAYTON, 2000: 154). *Lay* is the Hindustani term for *tempo* (but also rhythm), therefore referring to speed degree. Variation of *lay* ratio is obtained by means of subdividing the *mātrā* (*tactus* or beat) and, therefore, increasing rhythmic density from 2 notes per beat to 3, 4, 5 ...6, 7, 8... 12... notes per beat. The *lay* ratio expresses the number of subdivisions of the beat against the beat, just as the cp:P.U. ratio shown above. In Hindustani music, divisions of 5 and 7 and their multiples are less common than those of 2, 3 or 4 and their multiples. The Hindustani usage of this technique allows for the performance of any rhythmic pattern typically using the *mātrā* as its time unit to be reproduced at any of the above mentioned time units subdividing the *mātrā*, therefore, increasing the speed of the music and its rhythmic density. Speeds slower than the *mātrā* are equally possible. Depending on the length and accentuation of the pattern, its occurrence in different speeds may result in cross-rhythms and polyrhythm. This is where the following investigation on syllabic ratio and patterns of long/short syllables leads to.

Syllabic meters

As mentioned before, modal rhythms involve long and short syllables but do not exclude patterns made of only long or only short syllables. The reiteration of spondaic or tribachic feet (corresponding respectively to only long and only short syllables), is seen in 12th-century Notre-Dame polyphony. These feet result in simple, regularly pulsating rhythms and were avoided in the first works using expanded modal principles. At the time, 1989 and 1990, I was more interested in complex non-pulsating polyrhythm and aperiodicity than in regular meters or pulse, in contrast with the works of previous years, *Numen* (1986) and *O Olhar de Orfeu (The Gaze of Orpheus)* (1987)[18]. When pulsating rhythms are produced by such equal syllables, the speed of pulse depends on the length of the cp being used within the given primordial time unit and on the number of cp-s that make up the syllable. Ultimately, in this case, in the context of expanded modal rhythm, it really does not matter whether the syllables are long or short, because they are equal: they become an individual category of rhythms, that of *pulse rhythms*, as opposed to what is called *syllabic rhythms*.

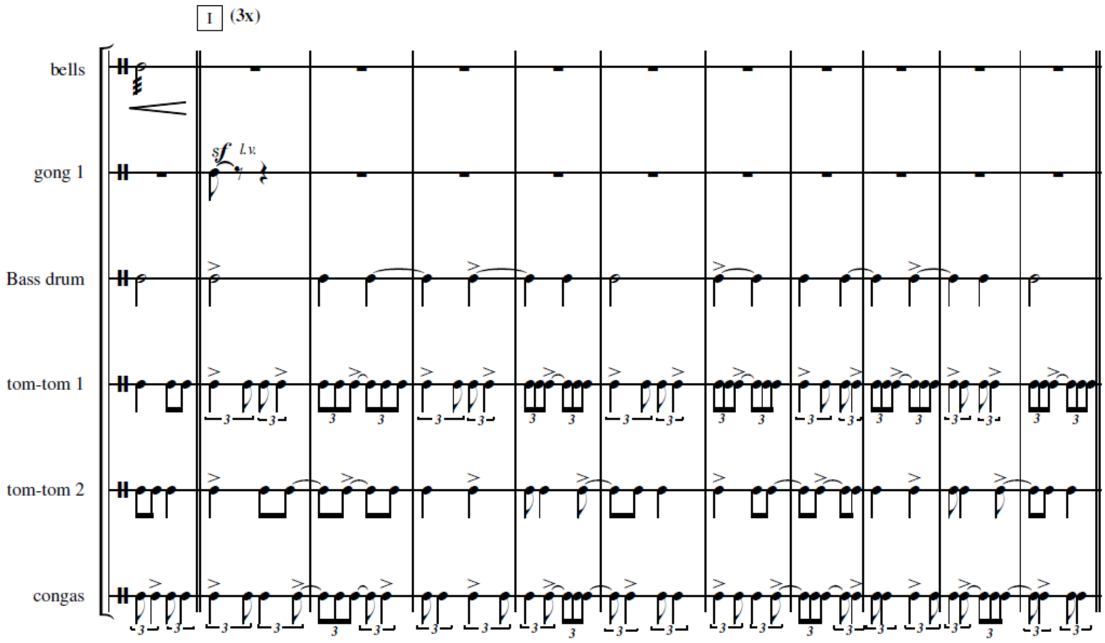
---

[18] *The Gaze of Orpheus*, theatrical performance (director: Antonio Guedes), Rio de Janeiro, November 8th, 1987. Reduced concert version for two actors and four musicians playing several instruments, *Quatro Cenas d'O Olhar de Orfeu* (*Four Scenes from The Gaze of Orpheus)*, first performance: VII Bienal da Música Brasileira Contemporânea, Rio de Janeiro, 1987.

Dithyrambos (third movement of *Numen*) pioneered the principles of expanded modal rhythm by the use of Greek feet with different kinetic values in a polyphonic texture, but not yet conceived in the above mentioned systematic proliferation of cp-s within a given P.U., which was established in 1989. The composition of *Numen* happened in 1986 as a first moment of *tabula rasa* concerning my compositional methods, which needed to be recreated (or even just created), and started to include conceptions from non-western cultures and other time periods. A search for spiritual, primordial, primal, even tribal contents (a characteristic that remains present in my work until today) led to this sort of sacred music without religion, in which musical time is static and ecstatic: the first movement, *Dronos*, relates to meditation, while the second, *Mysterion*, turns to litany. Textures in both movements are ametric, with unmeasured durations that depend on the performers' breathing. Certain sounds are required to synchronize with others in different ways: some must start or end together, others must start so that they cut a previous sound or resonance. There is no conducting; players must find the timing of musical events, almost as in a guided improvisation, and integrate themselves in the whole of musical becomingness[19]. It is in the third movement, *Dithyrambos*, related to trance, that Greek feet are used together to form a polyphony of rhythmic lines in the drums and percussion. Here, the Greek feet are always accented at their first syllable and put together to form modules—twelve, in total—of different polymetric textures of repetitive rhythms which are gradually intensified by the increasing speed of their time units. Polymetric modules go from E to P in the score.

Example 1, in the next page, shows module I, which superimposes *krétikos* in 2:1 ratio with the quarter note as cp in the bass drum line, *dáktylos* in 2:1 with one triplet eigth note as cp in the tom-tom 1 line, *krétikos* in 2:1 with one duplet eigth note as cp in tom-tom 2, and *krétikos* in 2:1 with one triplet eigth note as cp in the congas line.

[19] The musical flow; the term *becomingness* might be rare to find in English, but I use it as the closest translation for *devir* (Portuguese) or *devenir* (French or Portuguese), which is a wonderful word for the passing of time and for which, unfortunately, there is no English translation.

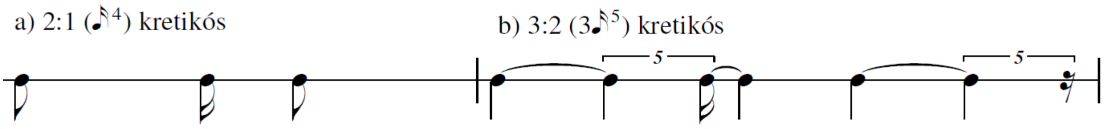


Example 1. *Dithyrambos/Numen*, module I

A second moment of *tabula rasa,* which consisted of the definition of basic compositional elements and principles, and a commitment to stay with them so that they would be further developed gradually, piece by piece, adequating them to the specific needs of each piece, began with *"…nature loves to hide…"*, written in 1989. Next came, chronologically, *Mojave*, *Archipelago*, *Kali Yuga* [20] (1990) for four trumpets, four trombones and five percussionists. As mentioned before, these works exclude pulsating rhythms regulated by syllables of the same length. However, pulsating rhythms are found in *Mojave* and derive from subdivided syllables, a procedure (equivalent to the *fractio modi* of medieval modes) that was not allowed in *"…nature loves to hide…"*, to be discussed further ahead.

The syllabic ratio, represented by the expression __:U, is important because it decides a large part of the quality of motion in the rhythmic line, the other part being decided by the actual pattern of alternation of long and short syllables. The actual length of syllables in the music depends on a syllabic ratio pre-determined specifically for each rhythmic line. For example, the syllabic ratio 2:1 means that the long syllable (__) equals 2 cp-s, and the short (U), one cp; this will be maintained until something changes that set up to a different one. Example 2 below shows two ways, (a) with a simple cp, (b) with a compound cp, in which the Greek foot *kretikós*, __U__, might appear:

[20] *Kali Yuga*: first performance: CalArts, December 9th, 1990, conductor: Stephen L. Mosko.



Example 2. Greek feet examples with attributed syllabic ratios and cp-s.

The repertory of syllabic ratios in the 1989/1990 works mentioned above was determined according to the needs of each one of them; it was not pre-defined as a general principle in the rhythmic cosmology. In the first and second sections of *"…nature loves to hide…"* there is a superimposition of different kinetic levels of 2:1 Greek feet; the third section, superimposes ratios 5:3, 3:2 and 4:3 also at different kinetic levels. The use of different values of x in the x♪^{n} cp formula led to the occurrence of multiple forms of these same ratios. In *Mojave*, all rhythms use simple cp-s. The syllabic ratios are defined as 3:2, 2:1 and the 2:1 multiples 4:2, 6:3 and 8:4. *Archipelago* makes use of 2:1 and 3:2 ratios in polymetrical textures, while the a-metric section is built on ratios like 25:5, 21:7, 19:9, 17:7, 15:9, 13:5 among others.

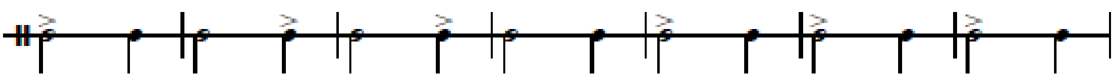
A limit on the repertory of syllabic ratios that could be used in composition was not determined until 1995, while working on *Marriage of Heaven and Earth* (*Matrimônio do Céu e da Terra)*[21] because of the new interest in organizing and exploring rhythmic periodicities, i.e., meter and polymeter. Until then, the syllabic rhythmic patterns were still conceived as Greek feet, and were juxtaposed in a way to avoid metric regularity. *Marriage of Heaven and Earth* inaugurated a new way of thinking modal rhythm by replacing the notion of Greek feet with that of syllabic meters obtained by combinatoriality, and juxtaposing them to obtain a more stable metric regularity in the line.

Because syllabic rhythms derived from Greek or Sanskrit meters become, in the context of modal rhythm, musical patterns with a fixed syllabic ratio potentially defined by any combination of whole numbers, their relationship with prosody and language ceases to be important. The search for musical variety and polyrhythmic potential demands the vocabulary of meters to be expanded to their maximum by combinatoriality. For this reason, I decided to replace Greek meters with the notion of syllabic meters, which includes syllabic successions such as, for example, __U__ __UU__, that do not exist in the classical meters.

[21] *Marriage of Heaven and Earth* the original version (1995), for English horn/oboe, tablā, two guitars and Tybetan cymbals (first performance: Santa Barbara, CA, May 31st, 1995 conductor: the composer). Chamber version (May 3rd, 1998), for English horn/oboe and percussion concertante, two string trios (vn., vla., vc., spatially separated), and Tibetan cymbals (first performance: Santa Barbara, 1998, conductor: Jeremy Haladyna. A 1996 withdrawn chamber orchestra version was premiered in Rio de Janeiro at the XII Bienal da Música Brasileira Contemporânea, in October 27th, 1997, conducted by Ricardo Wilson da Rocha.

Greek, Latin, and Sanskrit feet are also referred to as *meters* in the literature about poetry because they are responsible for generating a certain regularity in the rhythmic flow of the text. However, once they become musical material, they (Greek meters) do not come with any implied metrical accent whatsoever; they are just successions of short and long quantities such as: __ U , __ __ U , UU__ __, and so on, to which one can assign diverse codes of accentuation. Considered simply as such successions of long/short syllables with a fixed syllabic ratio, a given Greek meter results in a fixed quantity of cp-s equal to the sum total of all syllables' cp-s: for example, a 2:1 (𝅘𝅥𝅯^{4}) *trochaios* (__ U) = (♪ 𝅘𝅥𝅯) , 2 + 1 = 3, results in a 3-beat long pattern where the sixteenth note is the beat. The reiteration of the same *trochaios* forming an *ostinato* generates a regularity in terms of time spans (the total length of the meter) which is a fundamental aspect of meter in its role of measuring time: periodicity. This is the measuring unit used to measure greater lengths, very much like one centimeter or one meter measures space length. Combined with a proposed code of accentuation such as "always accent the first syllable" or "always accent the second syllable", the reiterated syllabic pattern obtains accentual regularity, thus creating the sense of metric regularity, simply called "meter". This is the simplest way these syllabic meters can be used, as was done in *Dithyrambos* (as shown in Example 1), by always accenting the first syllable of each reiterated Greek foot, the length of which was maintained throughout a line within a polymetric module.

In general, if the performance is strictly homogeneous on the same pitch or on an unpitched percussion without any given stress or emphasis[22], there is a tendency to hear the long syllable as accented. But this is just a tendency, and it can be avoided by an accentual code that contradicts the total length of the meter, such as in the following example, a 2:1 (♩) *trochaios* (__ U):



Example 3. Relationship between accentual code and the length of the meter.

In Example 3, the stresses (proposed accents), indicated by the accent marks, contradict the ternary flow of the metric periodicity in a way that one perceives a succession of different lengths of time: 5♩, 3♩, 4♩, 3♩, 3♩ ... Metric regularity, in this example, appears only in the last three measures.

22 Stress is a given emphasis on a note; accent is the metric accent, the "strong beat" in a Western measure. (COOPER, 1963:8)

Shifted accents, i.e., proposed stresses over metrically unaccented beats, may produce the effects of cross-rhythm, metric contradiction, or polymeter, as the music of Stravinsky (*Le Sacre du Printemps*, *L'Histoire du Soldat*) or Ligeti (Piano Ètudes, Concerto for Piano and Orchetra) have done.

All this serves the purpose of showing that the syllabic structure of Greek meters alone does not necessarily result in metric regularity or periodicity in music. It only provides a quality of movement by its succession of long and short syllables (the syllabic structure, or syllabic pattern). I will not discuss this in reference to poetry, but only in reference to music, and say that musical meter occurs when there is reiteration of the same combination of length (same quantity of equal pulses) and accentual codes applied to pulses. This is clear in traditional classical-romantic western music, where meter consists of the recurrence of a given accentual pattern of 2, 3 or 4 beats formed by a beat which carries the "weight" of the metric accent and the following other, unaccented beats. The binary meter reiterates the alternation of weight and impulse; the ternary meter, weight, impulse and impulse; and the quaternary meter, weight, impulse, half-weight, impulse[23]. Concerning modal rhythm, there is a difficulty in terminology, because the inherited expressions "Greek meter", Greek foot", or even "syllabic meter", already assign to the syllabic structure the role of a meter, while they actually are only referring to the pattern or succession of long and short syllables. Since the relationship between syllabic structure of a pattern and its length depends on the given syllabic ratio, kept the same for a while so that the total number of chronos protos of the pattern remains constant, meter, in modal rhythm, occurs when the length of the pattern remains constant while the accentual code results always in the sense of weight (metric accent) at regular time spans (same quantities of chronos protos). Once this is understood, even the succession of long/short syllables may vary, provided that they have the same total length (see table of periodicity/syllabic meter/syllabic ratio at the end of this section).

A syllabic meter is the combination or succession of a number of long and/or short syllables forming a pattern of rhythmic movement. The syllabic meters still include Greek feet, but these are now part of a larger collection obtained by combinatoriality. Like Greek feet, syllabic meters function as rhythmic archetypes, purely qualitative structures, that only become manifest when a specific syllabic ratio confers to them a quantity of time units. At that moment, that of manifestation, they also "receive", as a consequence of the specific syllabic ratio, a total length, called *period* or *periodicity*. Periodicity is represented by the symbol $\boldsymbol{\pi}$ and equals to the total length of a syllabic meter in terms of the sum total of cp-s in all its syllables. Evidently, such total length only becomes a real periodicity by means of reiteration and the proposed accent at regular quantities of cp-s. When different total lengths are juxtaposed, or accents fall at irregular time spans, the resulting phenomenon is comparable to

[23] I am translating the terminology used by Brazilian composer and theorist Esther Scliar (1926-1978): she uses the Portuguese term "apoio" (translated here as "weight", even though "apoio" means "support") for the metric accent, and "impulso" ("impulse") for the unaccented beats of the meter (SCLIAR, 1986: 49).

"additive rhythms", or "alternate meters". Although the term meter is inadequate to describe the "archetypal" syllabic meter (i.e., the syllabic succession of long and short syllables), I will keep using it, since *the pattern will be given a syllabic ratio* so that it becomes manifest in the music. The term "meter" is inherited from classical tradition, so this recalls its origin. It is also worthwhile distinguishing the syllabic ratio from the syllabic succession of long and short syllables, as a given syllabic meter can "receive" different long/short ratios. Therefore, syllabic succession will be called hereinafter *syllabic structure*. After all, these terms syllabic meter, structure, pattern, combination, or permutation, all refer to the same thing, but *syllabic structure* focuses on the succession of long/short syllables, while *syllabic meter* refers to a collection of patterns that is not limited to the classical Greek, Latin, and Sanskrit feet.

First I turn to the syllabic structure in syllabic meters and will speak of syllabic ratios and periodicities immediately after. Following the need to proliferate the repertory of syllabic structures by combinatoriality, there was also the need to establish limits to it, so that it could be used in music (at the time, *Marriage of Heaven and Earth*). This led first to limiting syllabic meters to those made up of only two, three, and four syllables. Because of this limitation, the total number of possible syllabic meters obtainable through combinatoriality of long and/or short syllables is 12. Considering the permutations of syllables in these meters that allow permutations (as can be seen below, meters 1, 2, 4, 5, 8 and 9 do not allow permutations), the total number of permutations of the 12 syllabic meters is equal to 28. The 12 syllabic meters in all their 28 permutations are shown in Table 6:

Meters with two syllables	1	__ __
	2	U U
	3a	__ U
	3b	U __
Meters with three syllables	4	__ __ __
	5	U U U
	6a	__ __ U
	6b	__ U __
	6c	U __ __
	7a	__ U U
	7b	U U __
	7c	U __ U
Meters with four syllables	8	__ __ __ __
	9	U U U U
	10a	__ __ __ U
	10b	__ __ U __
	10c	__ U __ __
	10d	U __ __ __
	11a	__ __ U U
	11b	__ U U __
	11c	U U __ __
	11d	U __ __ U
	11e	U __ U __
	11f	__ U __ U
	12a	__ U U U
	12b	U U U __
	12c	U U __ U
	12d	U __ U U

Table 6. Syllabic meters with two, three, and four syllables

The vocabulary of syllabic ratios was also limited to those involving only the first seven whole numbers, because the greater are the values in a super particular ratio x:y (super particular ratios are such that x = y + 1), the smallest becomes the difference between the durations of the syllables: the durations tend more and more to be of the same value or, in other words, the ratios tend to be equal to 1:1, and, therefore, are not rhythmically interesting. Ratio 7:6 was established as the smallest difference between a long and a short syllable worth working with (7:6 = 1.1666667) because the syllabic structure in this ratio is practically perceived as a series of identical durations. As a consequence of this limit, the syllables within a syllabic meter have 7:1 as the maximum ratio, i.e., a relationship in which the short syllable is seven times smaller than the long. The maximum ratio limit (7:1) is a consequence of establishing the minimum ratio limit (7:6) according to the principle of the perception of these durations in a given line. The total vocabulary of syllabic ratios could have been defined according to other ideas, and it does exclude several potentially interesting ratios that even had already been used in previous music. But this was the train of thought that led to *Marriage of Heaven and Earth*. The following are the syllabic ratios in use accordingly:

7:6	6:5	5:4	4:3	3:2	2:1
7:5	6:4	5:3	4:2	3:1	
7:4	6:3	5:2	4:1		
7:3	6:2	5:1			
7:2	6:1				
7:1					

Table 7. Reduced list of syllabic ratios to be used in composition

Periodicities are the result of the association of a syllabic meter with a syllabic ratio, the former providing some quality of movement by means of the number of constituting syllables and the syllabic structure, the latter providing something more in the quality of the movement by means of the quantification of the syllables. For example, a trochaic meter in the 6:3 ratio produces a periodicity $\boldsymbol{\pi}$ 9, since it has a total length of 9 cp-s (6+3). As a consequence of establishing only 12 syllabic meters and ratios involving only the first seven whole numbers, there is a total of 27 periodicities, from the shortest period with 2 cp-s to the largest with 28.

These periodicities already make up enough material for an enormous amount of rhythmic variation. Evidently, the composition activity may re-evaluate the material of syllabic meters, ratios and periodicities at any time, so that to include desired possibilities not available in the presently described limitations. For example, at some point one might find it interesting to work with 5-syllable meters, which are not included in the present material. The purpose of the limitations here established is nothing more than that of organizing the general formative principles in the form a compositional cosmology.

Thus, once a certain periodicity is assigned to a line or layer in a composition, it is possible to have it articulated internally in several ways, according to the syllabic meters in specific ratios. A table containing all 27 periodicities with the complete list of which combinations of syllabic meters and syllabic ratios produce each periodicity is too long to be included here. The example of periodicity **π** 5 given in Table 8 will suffice for the sake of space economy in this article.

π (periodicity)	Syllabic meter	Syllabic ratios
5 cp-s	#3 (__U and permutations)	3:2 – 4:1
	#6 (__ __ U and permutations)	2:1
	#7 (__ U U and permutations)	3:1
	#12 (__ U U U and permutations)	2:1

Table 8. Example of syllabic meters and ratios forming periodicity of 5 cp-s

The data in the Table 8 should be read as follows: syllabic meter #3 in the ratios 3:2 and 4:1 results in a 5-beat periodicity. Notice that this table is good only for meters with the same chronos protos, as the actual length of the period changes with different cp-s. For example, meter #3 in 2:1 with the quintuplet cp results in a total duration of three quintuplets, while with the triplet as cp it results in three triplets. Three triplets are equivalent to a quarter note, while three quintuplets equal a shorter value. Therefore, a next step in this study could be, if one desired, to find out the relationships between cp-s establishing which and how many cp-s of one stream are equivalent to which and how many of another.

It is worthwhile repeating that the limitations imposed to the material are not permanent decisions for the rest of the composer's productive life. They serve only to set boundaries or parameters to determine the basic characteristics and potentialities of the material. Once these are known, the material can be expanded or even shrunken to meet the compositional purposes, one piece at a time.

Syllable subdivision, chronos protos enharmonization, and time cycles

There is one aspect of the syllable that has not been discussed yet. The syllable, long or short, was initially conceived in relationship to Greek prosody. This implied that a syllable would be "filled" by a single sound, preserving the syllabic characteristic of Greek meters. All Greek meters in *Numen* retain this feature. In the same manner, in *"…nature loves to hide…"* the syllables of the Greek meters remain entire, i.e., not subdivided, so that a note with a duration really corresponds to a syllable, except, of course, when the syllable is too long to be represented by a single note or time value, and required tied notes.

The subdivision of a syllable became acceptable in *Mojave*, and is similar to the *fractio modi* of the 12th-century. A syllable may be subdivided in the continuum of cp-s of which it is formed, a procedure that results in a pulsating rhythm for the entire duration of the syllable being subdivided. This subject has been mentioned in passing in the paragraph following Example 1 above, concerning pulsating rhythms not generated by meters with only long or short syllables. Example 4, from *Mojave*, shows the syllabic ratio of 3:2 in the timpani line. The syllables are articulated in their sextuplet cp continuum resulting in pulsating rhythms.

Example 4: *Mojave*, mm.29-30

Another subject that had been postponed for further discussion concerns the difference between a cp and its kinetic value. There are different cp-s with the same kinetic value. For example, all those where x = n in the cp formula x♪^{n} are equivalent to the quarter note, the P.U. . At first, the cp 6♪^{6} should not be subdivided in 5 quintuplets, since it does not belong to the quintuplet stream. However, such "enharmonic" equivalences might result in interesting rhythms when the syllable equals to one cp and admits different subdivisions. This procedure is called cp enharmonization, and allows for a change of cp without a change on the actual duration of the syllables involved.

Finally, there is one important remark about expanded modal rhythm. Because of my interest in aperiodic music, the first pieces did not make use of the reiteration of Greek feet. The repetitive use of Greek feet in *Numen* belongs to a much earlier compositional moment in which there was a great interest in periodicity. This interest came back in different forms with *Marriage of Heaven and Earth*. However, with *"…nature loves to hide…"* aperiodicity rules. The fundamental time structure of this piece is a single sequence of different Greek meters that is repeated over and over to form a rhythmic continuum designed to be an irregular succession of long and short syllables, and whose total length is variable. I call this kind of sequence a "time cycle". Time cyles were also used in *Mojave* and *Archipelago*.

The time cycle in *"…nature loves to hide…"* has twelve syllables, seven of which are long and five short, in the following order: __ U U __ __ U __ __ U __ U __, which corresponds to the following Greek feet:

__ U	| U __ __ |	U __ |	__ U __ |	U __
trochaios	báckeios	íambos	kretikós	íambos

The time cycle is a more or less background structure. Sometimes it is evident in the foreground, sometimes it is hidden in the background, depending on other formative codes taking place at the same time of its exposition. Specifically, in *"…nature loves to hide…"*, the very idea of the piece has to do with whether or not it is clearly perceptible by ear. This title is a fragment of 6th-century Greek philosopher Heraclitus; in it, "nature" is understood as the real constitution of things. The fragment may suggest that it is possible to know this nature since it only mentions that nature likes to hide itself. However, it would be necessary for the mind or the senses to make an effort to apprehend more deeply the nature of things. The composition reflects this idea in that the time cycle appears in continuous repetitions and yet one cannot recognize it by ear, but only through analysis.

Several techniques are used to "hide" the time cycle in this piece. They are not as much a consequence from a "need" to hide it, but really a matter of creating variation and multiplicity from unity, different repetition (as opposed to identical repetition), and an interest in complexity, leaving identical repetition to a much deeper structural level. The first technique is the creation of a rhythmic heterophony. The texture is a 3-voice polyphony in which the instruments play a rhythmic-melodic line with the time cycle providing the succession of durations in each line. Considering rhythm isolated from pitches, texture is heterophonic because it is made of the superimposition of three versions of the time cycle, one for each instrument. Each line is assigned a different cp stream and this assignment is valid for long sections, creating, for each line, its own basic continuum of impulses. In the first section, they are the sextuplet for the oboe, the quintuplet for the trumpet, and the quadruplet for the cello as shown by Example 5. The third section rearranges this to the quintuplet for the oboe, quadruplet for the trumpet and sextuplet for the cello. In the middle section, all instruments play in a rhythmic unison using the sextuplet as cp.

Example 5. *"…nature loves to hide…"* mm. 46-49

The time cycle is also hidden by replacing positive syllables (sounds) by negative syllables (rests). In the first section of *"…nature loves to hide…"* the cycles in each instrument have a fixed configuration of positive and negative syllables (+/- configuration of the time cycle). In the middle section, rests occur freely, while in the third, each instrument starts with its own +/- configuration different from those in the first section, and then, gradually and systematically, the positive syllables are replaced by negative syllables, leading the piece to an extremely rarefied texture of isolated sounds and long silences.

Since the time cycle appears in a continuum, like a repetitive structure throughout a same layer in the texture, it lends itself to accumulative processes that clearly create a sense of directionality. The circularity of the cycle's continuum becomes here like a spiral. The uncoiling of this spiral is created by the gradual extinction of sound in the third section of the piece just mentioned above combined with a gradual process of deceleration generated by the progressive augmentation of the syllables. At each repetition of the cycle, a constant reason is added to the value x in the chronos protos formula (an arithmetic progression): +3 for the oboe and cello, and +2 for the trumpet. A more abrupt ritardando occurs at a certain point where the value 1 is added at each syllable of the cycle (and not at each repetition of the cycle).

Conversely, the first section is characterized by a gradual process of acceleration generated by the arithmetic progression of "x" in the chronos protos of each instrument, producing the progressive diminution of the syllables, like the coiling inwards of the spiral. The reason is -4 for the oboe and trumpet, and -2 for the cello. When x = n, the reason becomes -1, producing the subtraction of one sixteenth note at each repetition of the cycle, until the cp becomes equal to one sixteenth note. This is the cp in all instruments in the next, middle section.

The occultation of the time cycle is further carried out by the metric accentuation code. As mentioned before, the Greek meters without specific words assigned to them do not provide any code of accentuation. Syllables are accented not because they would be the first in a Greek foot, but according to the recurrence of a particular pitch in the melodies of each instrument. This pitch is the primary note, the center of the pitch collection that makes up a structure that I call "circle". In Example 5, these pitches are the D in the oboe, the D# in the trumpet, and the C in the cello. This procedure results in a polymetric texture with each line with its own alternate meters every time the sequence is repeated.

Last but not least, the pitch distribution along the syllables of the cycle does not contribute to clarify the rhythmic structure. Pitches form phrases (circles) that do not follow or re-affirm the beginnings and endings of the cycles. They only use the continuum of time cycles as a provider of durations, in the same way that phrases in serial music are not equivalent to statements of the pitch series.

Rhythmic heterophony, variations in the +/- configuration of the time cycle, spiral processes ruled by arithmetic progression of the chronos protos, the metric re-interpretation of the cycle through the accentuation code, and the pitch distribution of notes in the cycle are techniques by means of which the cycle is varied and transformed in *"…nature loves to hide…"* with the goal of expressing the content of the title or of yet another of Heraclitus' fragments: "...the hidden harmony is better than the obvious harmony...", also translated as "...a non-apparent connection is stronger than the apparent connection...".

I have developed other treatments of the time cycle in the following pieces as different means of avoiding the occurrence of identical repetitions of the time cycle, as if stretching the capabilities and limits of circularity, using periodicity without creating periodicity. In *Mojave*, the time cycle is no longer a fixed sequence of Greek feet, but appears in two different permutations. In *Archipelago*, every time the time cycle is repeated it appears in a different permutation of its constituting feet.

Conclusion

It might be argued that expanded modal rhythm does not use rhythmic modes, if one understands rhythmic modes to be the reiteration of a syllabic meter. Time cycles were reiterative structures that would come closest to the repeated syllabic meters of *Numen* or the 12th-century. However, what defines a rhythmic mode in expanded modal rhythm is simply the association of syllabic meters to syllabic ratios. There are too many ways one can produce this association, and I do not believe in the usefulness of generating a list of the possible associations and call each of them a "mode", for fear of creating a stiffer straitjacket. Used with flexibility, the principles of expanded modal rhythm take care of a comprehensive variety of types of motion and textures, from pulsating to cross-rhythms, from monody to multi-layered polyphonies. They also unify in procedure that which might be seen aesthetically as antithetical, for they allow the composer to move comfortably from periodicity to aperiodicity, from simplicity to complexity.

Bibliography

BENT, Ian. "Rhythmic Modes". *New Grove Dictionary of Music and Musicians, vol. 15.* Oxford University Press, 1980.

CLAYTON, Martin. *Time in Indian Music – rhythm, metre, and form in North Indian R□g Performance.* Oxford: Oxford University Press, 2000

COOPER, Grosvenor and Leonard B. Meyer. *The rhythmic structure of music.* Chicago: University of Chicago Press, 1963.

DÜRR, Walther and Walther Gerstenberg. "Rhythm: II, 4: 13th-century polyphony: modal rhythm". *New Grove Dictionary of Music and Musicians*, Ed. Stanley Sadie, London: Macmillan Publishers Limited,Vol. 15, 1980.

HOPPIN, Richard H. *Medieval Music.* New York: W. W. Norton & Company, 1978.

IRLANDINI, Luigi Antonio. "Cosmologia da composição e suas interações com a teoria e análise musicais". In: IV Encontro de Musicologia de Ribeirão Prêto, 2012, Ribeirão Preto, SP. *Anais do IV Encontro de Musicologia de Ribeirão Prêto,* 2012, ISBN 9788577470396, pp. 239-245, 2012.

___________. *Numen*. Florianópolis: L.A.I. Editio Princeps, 1986

___________. *"...a natureza ama esconder-se..."*. Florianópolis: L.A.I. Editio Princeps, 1989.

___________. *Mojave*. Florianópolis: L.A.I Editio Princeps, 1989.

___________. *Archipelago*. Florianópolis: L.A.I. Editio Princeps, 1989

Messiaen, Olivier. (1949) *Mode des valeurs et d'intensités*. Paris: Editions Durand & Cie.

REIMERT, Erich. *Johannes de Garlandia: De mensurabili musica*. Wiesbaden: Franz Steiner Werlag GMBH, 1972.

ROESNER, Edward H. (2007-2017) "Rhythmic modes". *Grove Music Online*. Oxford University Press, 2007-2017.

ROWELL, Lewis. "Aristoxenus on rhythm". *Journal of Music Theory,* vol. 23, no. 1 (Spring 1979), pp.63-79, 1979.

SACHS, Curt. *Rhythm and Tempo – a study in music history*. New York: Columbia University Press, 1953.

SCLIAR, Esther *Elementos de Teoria Musical.* 2nd edition. São Paulo: Novas Metas, 1986.