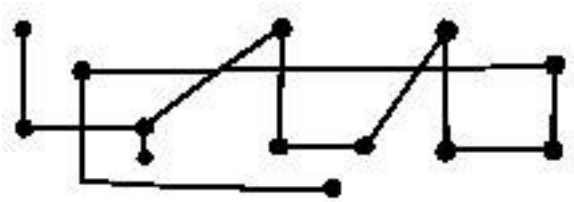
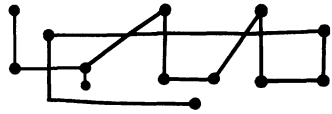


Focusing on Freedom and Movement in Music: Methods of Transcription inside a Continuum of Rhythm and Sound



Julio Estrada

Introduction

Transcription from the sound-rhythm continuum is certainly one of the most revolutionary techniques in new music composition. However, in what follows, this subject will be considered not only from a methodological point of view but also from a more aesthetic one approaching the idea of the imaginary in music. The musical imaginary can be understood as a private inner world, consisting of intuitions,

impulses, free associations, internal representations, memory, fantasies, or reverie-induced aural perceptions. The imaginary can be translated into music through a chrono-graphical recording method that utilizes a precise drawing process similar to a sound recording procedure, in which the musical matter is broken up into numerous chrono-acoustic categories. By so doing, traditional notions of rhythm and sound are enlarged to create a broader reference for graphic recording methods.

This discussion will concentrate mainly on a different understanding of transcribing what is considered a continuum of rhythm and sound. With no specific reference to a pre-existing musical language, this compositional methodology is based upon a chrono-acoustical description of either an imaginary individual universe or of other methodologies that tend towards abstract transformations of musical material.

The application of chrono-graphical recording and transcription methods need not be restricted to the compositional field. This precise musical notation can also serve the fields of musicology and ethnomusicology where a wide variety of chrono-acoustical components could be easily incorporated. Also, its application would be useful to traditional music where vocal and instrumental articulations come from both oral and written practices. In order to elaborate upon these ideas the structure of the continuum will first be described in general terms, an idea already discussed in previous articles (Estrada 1990, 1994a, 1994b).

A Physical Continuity between Rhythm and Sound

Twentieth-century music has contributed to a new understanding of the relationship between sound and rhythm. Musicians such as Julián Carrillo or Alois Hàba researched microtonal systems as can be found in Indian or Byzantine music—or even in the European Renaissance, the sixteenth-century cartographer and musicologist Gerhardus Mercator, who proposed a temperament at 53 tones per octave, being one example (Johnston, in Vinton 1974, 483–4). Carrillo's instruments were capable of achieving about 800 tempered micro-intervals within an octave, a number at which the human ear will perceive pitch transitions as a continuum (Estrada 1988a, 126–7; 1988b, 183–7).

Henry Cowell emphasized the existence of several parallels between sound and rhythm; i.e., by the identification of the harmonic divisions of both domains in which a similarity can be observed between pitch frequency and rhythmic metronomical proportions (Cowell 1930, 100). In 1931 he designed an original instrument constructed by Lev Termen—the Rhythmicon—used in his work *Rhythmicana* to generate low

frequencies according to the harmonic division of a duration of a second as a reference unit (Slonimsky 1988, 151). Some of Cowell's ideas were applied and extended by Conlon Nancarrow, who proposed, starting in the forties, the use of several simultaneous tempi to treat contrapuntal imitations (Fürst-Heidtmann 1986, 54). His works for player piano were radical in that they offered new perceptual experiences of rhythm: a single melodic sequence, played at a tempo of approximately 200 notes per second—already a pitch frequency—became a timbre in which the melodic rhythm—previously understood as a discontinuum—became a continuum to human perception (Estrada 1994c).

In order to have a better understanding of the previous ideas, imagine the global extension of musical material as a huge spectrum integrating an infinity of frequencies, from the lowest ones—which can be physically identified with the notion of rhythm and the sensation of time—to those whose higher speed lead to the notion of sound and the sensation of space. Inside such a global extension, rhythmic and sonic vibrations can be unified as a continuum, where the boundary between both is perceivable. While attempting to discriminate the frequential structure of this *macro-timbre* one can perceive, in the lower register—by kinesthetic rather than auditory sensations—a discontinuity as a result of countless micro-instants, while, due to their higher frequency speed, pitches will be perceived as a continuity.

Approaching this so-called macro-timbre demands an understanding of acoustics. Fourier's method of analysis provides a broad understanding of any auditory matter, as complex as it may be, as the addition of sine waves. His method, generally applied to analyzing the harmonic structure of sounds, contributes in the digital electronic music studio laboratory to observing rhythm as it emerges from its waveform structure at very low frequencies. Using this method, and assuming a constant wave structure, rhythm and sound frequencies are distinguished only by their speed. All of these observations lead to a new physical and musical awareness in which rhythm and sound share a common vibratory link. Such a statement about the physical and psycho-acoustical nature of basic musical material could allow one's musical consciousness and knowledge to expand and have a positive influence on the quality of our perceptions.

Six relationships between what is understood as rhythmic and sonic physical components can be expressed as follows:

A. frequency: in rhythm, duration; in sound, pitch

B. amplitude: in rhythm, global intensity (where attack is perceived as primary); in sound, global intensity (envelope)

C. harmonic content: in rhythm, microstructures of duration (similar to vibrato); in sound, timbre (in the sense of pitch color).

If the parallels of A and B are clear, it is obvious that the notion of a rhythmic timbre—harmonic content inside a fundamental duration—will not be easily integrated into traditional musical concepts.

As with sounds or tones, timbre can be constituted by an ensemble of different partials. Also possible is the consideration of several co-existing durations inside a global duration. For instance, the total duration of a single stroke on a drum could itself be modulated by the presence of small low frequency vibrations produced by the effect, either of a pressure exerted on the skin or through the action of shaking the instrument itself. The microduration resulting from either of those two articulations could constitute essential information about its internal structure. In fact, those articulations could be equivalent to the acoustical terms of frequency modulation (pressure, vibrato) or amplitude modulation (shake, tremolo).

Once an audible object is understood through the above-mentioned six components it is possible to discover the reality of its complex structure. The task of handling such high amounts of information is difficult. But it is justified if the method of unifying rhythm and sound meets the needs of composers or musicologists who desire more precise musical systems for the representation of the materials they use.

It has been traditionally said that one cannot perceive low frequencies. However, one can challenge this idea by pointing to the fact that one cannot even perceive pitch frequencies if they are not sustained through a certain amount of time—in other words, without being carried by a rhythmical duration. This will now be considered from three perspectives:

I. Rhythm: take a single low frequency of 1 second in length—a quarter note where MM = 60: it cannot be perceived unless it is carried by a sound.

II. Sound: the attempt to listen to a single period of 1/440th of a second—an A 4—will be impossible unless it is repeated for at least sixteen periods in order to create a low frequency of about a 1/16th or a 1/20th of a second, a minimum necessary for the perception of short durations.

III. Rhythm-sound: consider rhythm and sound frequencies, when isolated from each other, as single sinusoidal waves. According to the aural mechanism, the only zone in which these will be audible is at the border between rhythm and sound—around 1/16th or 1/20

of a second. Apart from this exception (that could be thought of as a rhythm-sound), both types of frequencies are inaudible unless combined (II). Without this complementary relationship between rhythm and sound human perception cannot function.

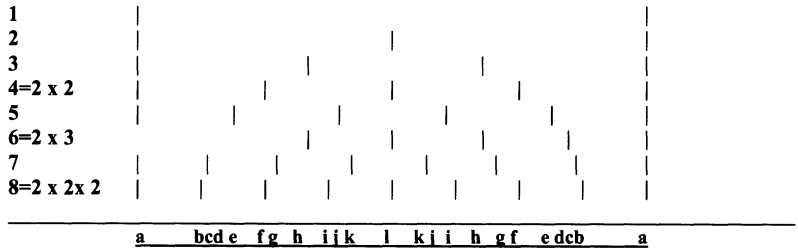
Even if one can conceive and treat rhythm and sound as abstractions out of time, once they become part of a heard reality both need to be integrated as a unity constituted by time (duration) and vibration in space (amplitude vibrations varying through changes in waveform pressure). The conception of a chrono-acoustic field leads to the consideration of rhythm and sound components as a whole: in other words, as a macro-timbre. In it, each physical component should be considered as integral to the whole. A broader conception of this musical material can be used to model the real world of rhythms and sounds, which in turn elaborate abstract transformations. In opposition to the preconceived structures usually employed in musical languages—or even in some technological systems—it is necessary to put more emphasis on the inherent richness of auditory phenomena. In addition to the previous physical components, the presence of a three-dimensional space for musical performance can be considered part of the macro-timbre. Through this enlarged perspective a chrono-acoustic field requires an equally large amount of information in order for a macro-timbre to capture the richness of nature and of the imaginary.

Chrono-Graphical Recording Methods

Within the extension of any one of the dimensions of the macro-timbre, a reference scale can be defined with a high degree of resolution that approaches a continuum. However, even if perception is not yet sufficiently refined to discriminate some of the micro-intervals of those components, upper and lower auditory thresholds still need to be taken into account. The easiest components to define as reference scales are the amplitude of rhythm and sound. But when reference scales are faced in music notation with the complexity of sound timbre—understood as the harmonic content of sound—they need to be reduced simply to pitch color. When rhythmic components such as frequency or harmonic content are pushed to extremely small and rapid durations, they will be experienced no longer as rhythms but as additional lower frequency sounds inside the resulting macro-timbre.

Methods to obtain a resolution of a continuous type differ from those based on a Pythagorean division of a given unit that generates a harmonic

series of durations or pitches. In this case, superimposition of successive harmonic divisions of a given unit—i.e., into 2, 3, 4, . . . *n*—will always favor a discontinuous distribution. This is caused by the constant repetition of sub-multiples of the unit related to the initial prime numbers (Example 1).



EXAMPLE 1: PYTHAGOREAN DIVISION OF A RHYTHMIC UNIT, BETWEEN NUMBERS 2 TO 8. A SINGLE RHYTHMIC UNITY, 1, IS DIVIDED BETWEEN DIFFERENT DIMENSIONS, FROM 2 TO 8, SOME OF WHICH ARE MULTIPLES OF PRIME NUMBERS 2 AND 3. EACH OF THE DIFFERENT POINTS GENERATED BY THE PROCESS OF DIVISION IS INDICATED IN THE LOWER PART OF THE GRAPHIC WITH A LETTER, FROM a TO l. FROM THE CENTER, l, ALL THE POSITIONS REAPPEAR IN RETROGRADE ORDER, A DISTRIBUTION WHICH INDICATES THE SYMMETRY GENERATED BY THE SERIES OF DIVISIONS. THE POINTS ESTABLISHED IN THE LINE a - l - a DENOTE THE LACK OF AN HOMOGENEOUS DISTRIBUTION OF THE PROCESS OF MULTI-DIVISION OF THE RHYTHMIC UNITY. AS CONSECUTIVE DIVISIONS INCREASE THE NUMBER OF COINCIDENCES THAT ARE THE PRODUCT OF MULTIPLES OF PRIME NUMBERS 2, 3, 5, ETC. WILL INCREASE LIKEWISE

In contrast, a small and unique sub-division of a unit will yield a higher resolution and a homogeneous distribution of distances in the creation of the reference scale. This provides a sensation closer to continuity as it tends to erase the perception of intervals. Such a method of obtaining resolution can be applied to any of the above-mentioned components of rhythm and sound, including the actual space of execution. Furthermore, the mapping of a three-dimensional physical space for musical performance can benefit from this method.

Reference scales are only useful in the transcribing process. Its set of points is not to be used for combinatory purposes, but only to determine

Pitch	Intensity	Instrumental color	Pulse	Attack	*Vibrato*
SI	***fffff***	*dietro il pont*	1/10"		*1/10"*
LA $^3/_4$			1/8"		*1/9"*
LA #	***ffff***	*sopra il pont*	1/6"	***sfffz*** *	*1/8"*
LA $^1/_4$			1/4"		*1/7"*
LA	***fff***	*sul pont extremo*	1/3"		*1/6"*
SOL $^3/_4$			1/2"		*1/5"*
SOL #	***ff***	*molto sul pont*	1"	***sffz***	*1/4"*
SOL $^1/_4$			1 1/4"		*1/3"*
SOL	***f***	*sul ponticello*	1 1/3"		*1/2"*
FA $^3/_4$			1 1/2"		*2/3"*
FA #	***mf***	*poco sul pont*	1 2/3"	***sfz***	*3/4"*
FA $^1/_4$			1 3/4"		*1"*
FA	***mp***	*ordinario*	2"		*1 1/4"*
MI $^1/_4$			2 1/4"		*1 1/3"*
MI	***p***	*poco sul tasto*	2 1/3"	***mfz***	*1 1/2"*
RE $^3/_4$			2 1/2"		*1 2/3"*
RE #	***pp***	*sul tasto*	2 2/3"		*1 3/4"*
RE $^1/_4$			2 3/4"		*2"*
RE	***ppp***	*molto sul tasto*	3"	*poco attacco*	*2 1/4"*
DO $^3/_4$			3 1/3"		*2 1/3"*
DO #	***pppp***	*sul tasto extremo*	3 2/3"		*2 1/2"*
DO $^1/_4$			4"		*2 2/3"*
DO	***ppppp***	*al dito*	5"	*senza attacco*	*senza vib*

*Various signs may be used to indicate a scale of rhythmic attacks, although the usefulness of these is that they reinforce the relationship between this component and traditional symbols.

EXAMPLE 2: REFERENCE SCALES IN RELATION TO A MACRO-TIMBRE CONSISTING OF SIX DIFFERENT COMPONENTS. THE PITCH HARMONIC CONTENT SCALE REFERS IN THIS INSTANCE TO TIMBRE COLOR IN STRING INSTRUMENTS. PULSE IS UNDERSTOOD AS THE DURATION PERCEIVED BETWEEN TWO ATTACKS; PULSE IS ATTRIBUTED HERE TO THE CHANGE IN BOWING TECHNIQUE AND ITS GRADATION CAN BE REALIZED ACCORDING TO THE INTENSITY OF THE ATTACK. THE MINIMUM DURATIONS OF PULSE AND *VIBRATO* REFER TO A RELATIVE SPEED LIMIT IN THEIR EXECUTION, WHEREAS THE MAXIMUM DURATION HERE INDICATED IS ONLY AN ARBITRARY REFERENCE

a particular position inside the ambitus of a physical component (Example 2).

Graphic recording methods can have useful compositional and musicological applications if one is seeking an accurate objective representation of:

1. the sonic world around us
2. the inner music of our imaginary

3. musical performance.

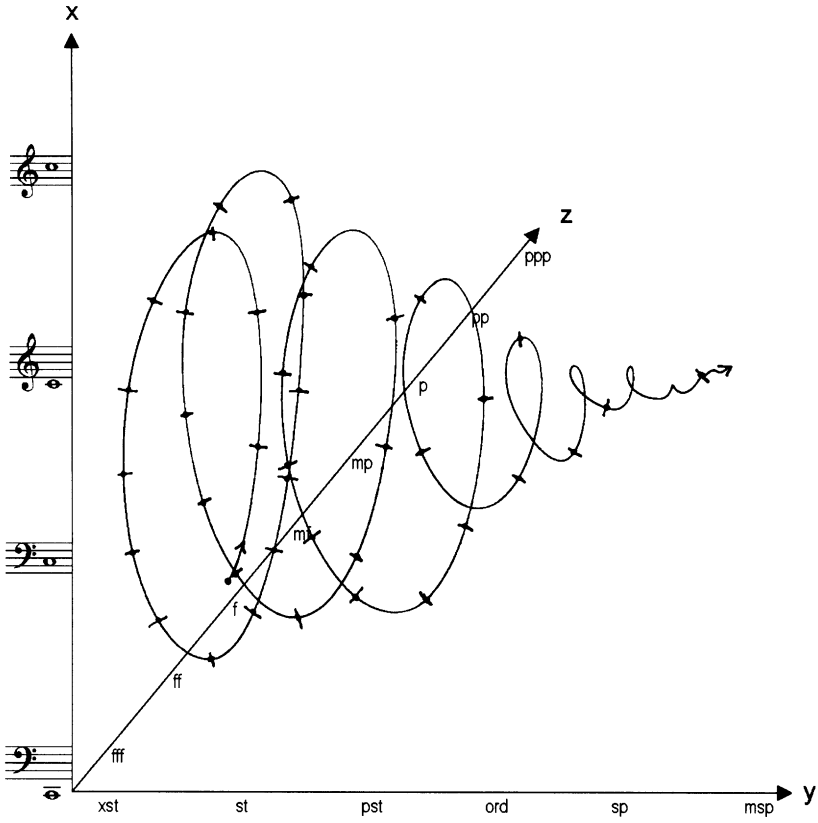
In the case of musical performance it is possible to avoid any ethnocentric musicological style when transcribing traditional music. In musical composition, the process of creating one's own musical materials may require an accurate chrono-graphical recording method. This can be obtained by a meticulous process of drawing the time evolution of each chrono-acoustic component.

The collection of chrono-graphical data represents the basic elements needed to create a score. This can be understood as the main textual material for the composer because it has captured auditory phenomena. A secondary text is the resulting score—the product of transcribing graphical data into self-selected reference scales. The degree of resolution of each reference scale can be determined by many circumstantial factors: perception, traditional practice, performance capacities, instrumental possibilities, compositional goals or, in transcribing musical traditions, fidelity to different styles.

The chrono-graphical recording method needs a high resolution of time flow in order to be able to create or to capture states of instantaneous transformation in any parameter. Most chrono-graphical methods are based on a two-dimensional representation space, one of which is time evolution. Traditional European musical notation is based on such a process, where any note can be found on the x-y axis of pitch versus time. Almost four decades ago Xenakis proposed a new chrono-graphical method that was able to handle continuous pitch transformation. One can cite such works as *Metastaseis* or *Pithoprakta* in which he successfully applied this method (Xenakis 1963). This idea was further refined in the graphical computer music system UPIC—developed at the CEMAMu—which uses the same recording method to determine the envelope, waveform and frequency of the sound (Xenakis 1992).

In order to define six or more macro-timbral components it is necessary to extend Xenakis's method. In other words, instead of using a series of individual two-dimensional chrono-graphical recordings—one for each physical component—one must develop something broader. This consists of a multi-dimensional representation of simultaneous trajectories—a common method used in acoustics (Leipp 1989, 83–4). For instance, on a three dimensional trajectory each individual dimension can be assigned to an individual component, either of rhythm or sound—e.g. x = frequency, y = amplitude, z = harmonic content. In order to include the time evolution or speed of change of each component, the graphical recording must utilize time units—i.e., seconds or fractions of a second—which will function as reference points on each trajectory. This helps

determine the position of each physical component at any moment (Example 3).



EXAMPLE 3: THREE-DIMENSIONAL TRAJECTORY: X = FREQUENCY; Y = HARMONIC CONTENT; Z = AMPLITUDE. THE RATE OF CHANGE IS INDICATED BY THE DISTANCE BETWEEN IDENTICAL TIME UNITS (|) INSIDE THE TRAJECTORY. A CHANGE OF COLOR, OF TEXTURE OR OF THICKNESS OF THE TRAJECTORY LINE COULD COMPLETE A SIMULTANEOUS REPRESENTATION OF ALL SIX MACRO-TIMBRE COMPONENTS

The practice of graphically recording three-dimensional trajectories requires a highly developed ear in order to capture the immense amount of data inherent in musical materials. A multi-dimensional chrono-graphical trajectory can allow one to obtain a variety of inflections simultaneously occurring on several layers. This is important when musical ideas are understood as a living material. Since 1984, I have used three-dimensional chrono-graphical trajectories for compositional purposes. In the beginning this method was put into practice "by hand," fixing pre-designed trajectories with material objects in which time evolution was indicated by small marks. Later on, I designed a computer music tool, the *eua'oolin* system, which will be described below.

The *eua'oolin* system—in the Nahuatl language: "eua" (to fly away) + "oolin" (movement) = flying of movements—was developed at UNAM between 1990 and 1995. The system uses a cubic space, where a single television camera records three-dimensional movements. These are delineated by a stick with a small white ball at the tip where the main object is observed by the camera. The television recordings are then digitally converted into thirty images per second, which are in turn converted into a MIDI-Toolkit file consisting of three lists of information that correspond to three previously defined physical components. According to the principle that rhythm and sound can be treated in a similar fashion, a set of three components can be attributed to each. The main purpose of the *eua'oolin* system is to produce a computer-printed score resulting from the automatic transcription of three-dimensional trajectories (Estrada 1990; 1994a, 23–8).

Musical Transcription

A transcription is here regarded as a conversion of chrono-graphical recordings into musical notation. This understanding is not too far removed from the notion of transcription as an alternative interpretation of signs—as in paleography. The use of transcription applied to the three cases discussed earlier (the sonic world around us, the imaginary and musical performance) are distinct from the traditional notion of transcription, be it a new instrumental score based on a given composition within a similar musical system—such as Ravel's orchestration of Mussorgsky's *Pictures at an Exhibition*—or an ethnomusicological score of music using different systems.

The method behind musical transcription, as described in this essay, consists of the following:

I. A chrono-graphical recording—an accurate copy—of any musical material.

II. The assigning of a series of reference scales to chosen parameters in order to obtain the conversion of chrono-graphical data.

III. A series of alternatives for transcribing data into a multi-dimensional musical score.

IV. A musical performance that is a new version of the original material (I) based on the resulting score.

The transcription method will consist of the precise discretization of each dimension included on a given trajectory. Both in terms of score notation and music performance, high resolution in reference scales can also mean the necessity of dealing with a higher amount of information, an aspect in which the pragmatic choice related to the transcription process will become a fundamental one. The choice of a given resolution will determine the transcription of each component through the conversion of chrono-graphical data into a score.

The final score—as a secondary text—is a different kind of written record from what one might think of as a musical score. It will be here described as:

I. Non-generative as a language: none of the different aspects of the score could be considered as a result of a process of directly writing into traditional musical notation—as is generally employed within a scalar conception. On the contrary, this method is the result of an indirect process—passing from a chrono-graphic analogical recording to a transcription—where signs and symbols or instrumental articulations are generated by the musical process itself. They in turn cannot be used as a point of departure for creating other scores.

II. Hyper-deterministic as a musical notation: the process of creating the final score, even if it uses a free choice of reference scales, is a highly deterministic one in the sense that it demands a precise performance of every single inflection. Since this requires notating an enormous amount of information, the complex score will appear far removed from the musical source that inspired the composer.

III. Related to the reproduction of the chrono-graphicals: even if tools are designed to realistically copy musical sources, the score will always be an attempt to represent auditory phenomena moving in the relativity of time and space. From such a perspective it is impos-

sible for rational, sensorial and imaginary mechanisms to assimilate all the information of the objects taken as models.

IV. Non-definitive as a text: the final score will be one existing among thousands of possible versions. Even if the transcription method represents an exhaustive attempt to concretize the total information of each dimension of a trajectory, it cannot be presumed that any one reproduction of a model could be considered "definitive." This idea can be observed in more detail from three different perspectives:

1. The system of notation chosen for transcribing is useful for transmitting the musical idea to the interpreter; however, it is hampered by the use of approximate signs and symbols—in particular regarding amplitude or harmonic content in both rhythm and sound. Furthermore, musical notation suffers from the habits of performance practices.

2. Each written version could be the product of a particular combination of a series of reference scales. The highest resolution in the combined physical components will never offer a sufficient number of points to permit an exact reproduction of a model. Even in the field of pitches, for example, the process of breaking up a chrono-graphical shape into a high amount of discrete divisions can never be reproduced twice in the same manner. Discrete pitches become negligible and are only useful as links within continuous transitions—e.g. an F♯ linked to another pitch by a glissando has no meaning of its own.

3. A single inflection within a musical dimension may be conveniently transcribed, whereas this same inflection could be unnoticeable when applied to another component. For instance, the micro-variations on a given trajectory could be successfully transcribed as pitch micro-intervals; however, they will be less satisfactory when assigned to timbral color. Each reference scale will differ in its resolution.

The process of transcribing implies a permanent duality between high determinism and relativism, a contradiction that cannot be avoided if one is to obtain a result faithful to the original. In spite of the attempt to reproduce precise musical objects, physical changes of dynamic energy through time are always relative. The information embodied in the transformation of a moving object in any given environment is almost impossible to perceive in one observation. The problem here depends upon the

limits of both psychological and physiological perception. The subjective process is illustrated in experiences concerning performance or listening. More precisely, in the case of an imaginary listening experience, musical ideas tend to be constantly modified by different types of influences: rational thinking, sensorial stimuli or the freedom of action in the imaginary itself. It is possible that one cannot apprehend internal images as a whole, but only as successive attempts at interpreting them.

Alternative Applications of Chrono-Graphics

The representation of macro-timbre has as a goal the synthesis of the general movement of objects. This goal is not easily reached, as a large amount of energy is required in order to perceive, remember and understand each state of a given imaginary, be it an environmental or musical object. The origin of this methodology is based on a compositional conception oriented towards the evolution of musical objects in time. Procedures here described could also be considered the result of a creative listening to movements found within our imaginary or the exterior sonic world.

The dynamic motion of created models is of primary importance to the processes of composing and performing. The varying movements of a given object tend to be perceived as a whole; only through analysis can the specificity of movement at the level of its individual components be understood. For instance, while watching the flight of a bird, the main perception will be that of a dynamic whole. This can be thought of as the product of a multiplicity of relationships: the interweaving of the bird's own body movements—its wings, head and tail—or its environment—the flow of wind, the presence of other beings—or even other visual stimuli included while observing this action—clouds, trees, lights or any other objects surrounding it and the observer. Since the observer is not able to process all this information at once, when generally speaking about music composition, one can try to reproduce it by abstraction or by synthesizing its various rhythm and sound physical components.

The process of chrono-graphical representation itself requires both of these procedures to achieve the whole macro-timbre. This idea, even if on the surface it appears to be "new," is an expansion of traditional European harmony and counterpoint: besides their combinatory or acoustic foundations, both can be understood as procedures designed to aid the composer in representing dynamic musical thinking. In order to obtain a well-balanced relationship between the different components of a macro-timbre, the multi-layered dynamic chrono-graphical process transposes

the notion of voice leading in harmony. Contrapuntal imitation has also served as a model while considering the dynamic shape of a given dimension as a stable structure that can be reproduced in similar fashion as thematic motives.

Chrono-graphical recording and transcription methods can be considered as alternatives for creating music of a more abstract kind. A couple of possibilities that I have developed in the last few years will be examined briefly:

I. PERMUTATIONAL VARIATION

This takes the graphics of one or more musical dimensions and attributes them to others, thereby creating a partial or global permutation of the original data, for instance, varying attributions within a set of components such as:

frequency ➔ amplitude

amplitude ➔ harmonic content

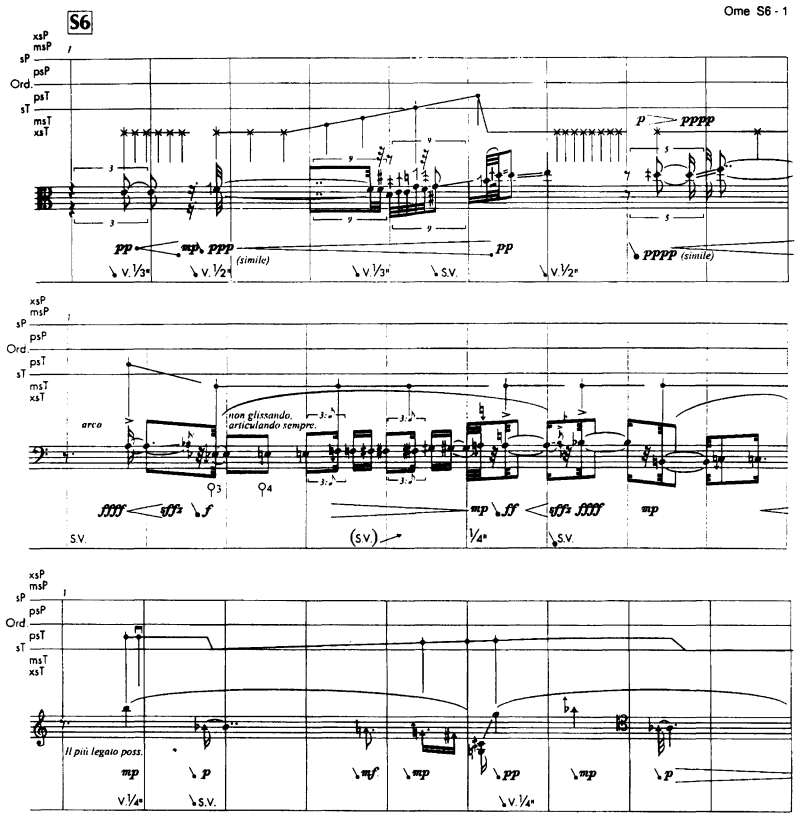
harmonic content ➔ frequency

Each new attribute will maintain a similar global dynamic energy in relation to the original musical object, however it is channeled through a different perception. What is proposed here is a new kind of musical variation, where macro-timbre is modified without changing its inner dynamic tendencies.

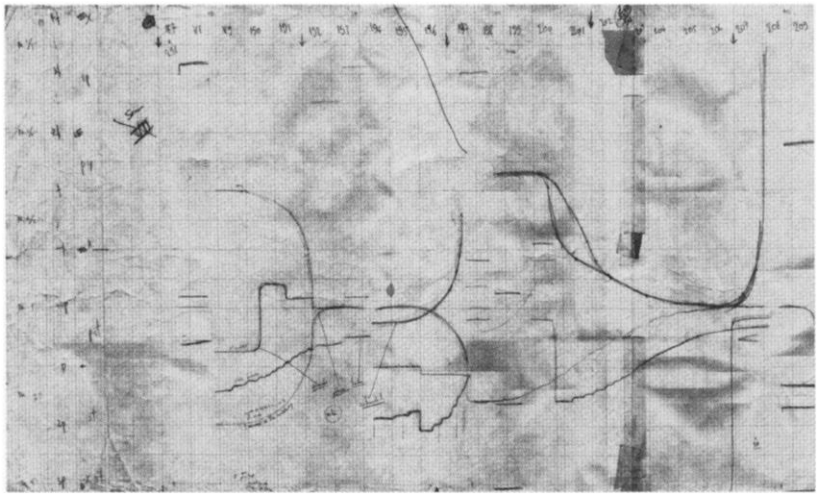
Such permutations of dynamic shapes were used when creating three of the four *yuunohui*, a series of compositions based on *yuunohui'yei* for cello. The four pieces resemble each other in their general appearance but the sonic result contains different macro-timbres. Pitch dynamic shape in the first version can be heard as intensity in the second one, as timbral color in the third and as duration in the fourth. In *ensemble'yuunohui*, a version permitting a performance of the four solos as six duets, four trios and one quartet, the set of physical components of one instrumental version is perceived as being in synchrony with those of other versions (Example 4).

II. TOPOLOGICAL VARIATION

Once a multi-dimensional trajectory is established, it can be considered as topological data manipulated in space. One important reference has



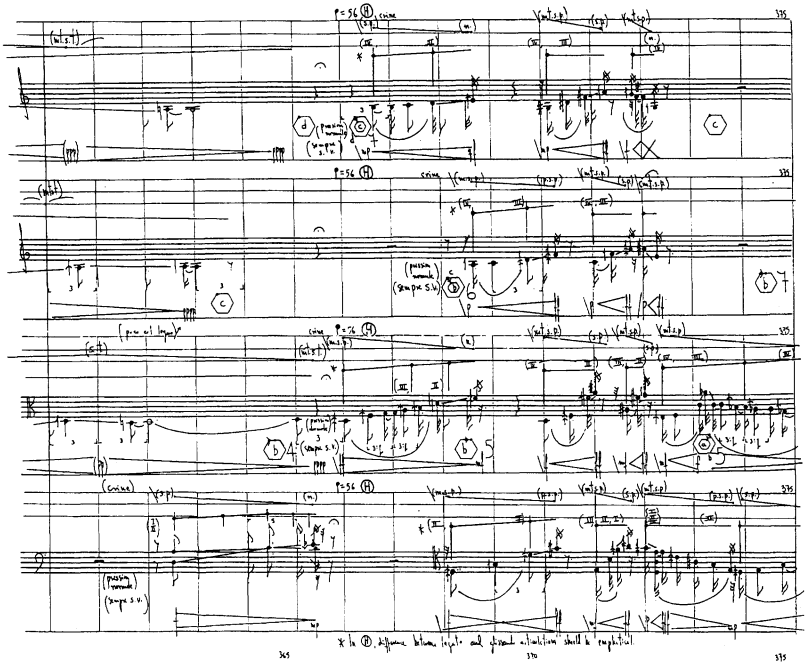
EXAMPLE 4A: DYNAMIC TRANSCRIPTION OF *ENSEMBLE'YUUNOHUI*, INITIAL FRAGMENT OF SECTION 6, IN A SUPERIMPOSITION OF THREE DIFFERENT VERSIONS: *YUUNOHUI'OME*, *YEI* AND *NAHUI*, FOR VIOLA, CELLO AND CONTRABASS, RESPECTIVELY. ALL THREE VERSIONS ARE BASED ON THE SAME CHRONO-GRAPHICAL MATERIAL, FROM RHYTHMIC UNITS 1 TO 9, CONTAINING A TOTAL OF FIVE PHYSICAL COMPONENTS: THREE FOR SOUND—PITCH, INTENSITY AND TIMBRE—AND TWO FOR RHYTHM—DURATION AND VIBRATO. THE SYNCHRONOUS SUPERIMPOSITION OF THE THREE VERSIONS DENOTES THE NON-SYNCHRONOUS TENDENCY OF SPACE-TIME CONTINUOUS RELATIONSHIPS. EXAMPLE 4B SHOWS THE GRAPHIC ORIGINS OF THE THREE SCORES.



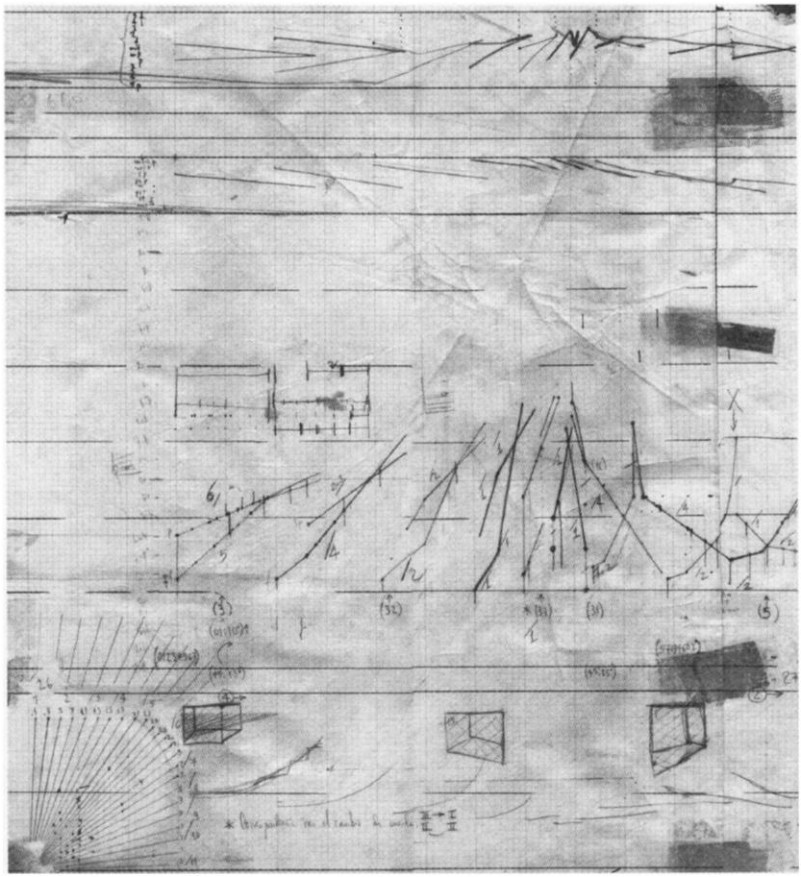
EXAMPLE 4B

been Xenakis's proposals of two-dimensional rotations of a continuous kind, such as those developed in the UPIC system in its 1987 and subsequent versions. Nevertheless, the restrictions of a two-dimensional space render a certain number of manipulations impossible if time is one of the axes. In contrast, a three-dimensional space where trajectories include time allows for any accurate topological manipulation such as a continuous transformation of any given shape. Some methods of topological variation have already been developed using musical scales inside a three dimensional space (Estrada/Gil 1976, 1984). These procedures are also a new kind of musical variation through which the dynamic tendencies of the original dynamic shapes can be freely moved in three dimensions to generate a transformation.

Two main sections of *ishini'ioni* for string quartet (1984–90) use several procedures dealing with topological transformations of three-dimensional trajectories. In the first section there is a constant variation of an initial three- dimensional shape. (Example 5). In the second, a chrono-graphical recording of a section of Schubert's *Ungeduld* consisting of two three dimensional trajectories—one containing three melodic components and the other related to the accompaniment—serves as the basis for simultaneous topological variation.



EXAMPLE 5A: TOPOLOGICAL VARIATION OF A THREE-DIMENSIONAL SHAPE AS USED IN *ISHINI'IONI*, STRING QUARTET. THIS FRAGMENT—SECTION H, RHYTHMIC UNITS 360 TO 375, PAGE 26 OF THE SCORE—IS THE TRANSCRIPTION OF A CHRONO-GRAPHICAL SHAPE INITIALLY APPLIED TO THE CELLO AND ITS SUBSEQUENT TRANSFORMATIONS IN THE OTHER INSTRUMENTAL PARTS AS THE RESULT OF ROTATIONS OF THE ORIGINAL SHAPE, AS SHOWN ON THE CHRONO-GRAPHICAL REGISTER (EXAMPLE 5B). IN UNIT 363 APPEARS THE TWO-VOICE TRAJECTORY OF THE DYNAMIC IDENTITY IN THE CELLO; THE FIRST TOPOLOGICAL VARIATION DISTRIBUTES THE TWO VOICES BETWEEN THE FIRST VIOLIN AND THE VIOLA; THE SECOND VARIATION, BETWEEN THE SECOND VIOLIN AND THE CELLO, AND SO ON. THE EXAMPLE SHOWS THE GRADUAL EVOLUTION OF THE TOPOLOGICAL VARIATIONS IN EACH OF THE MACRO-TIMBRE COMPONENTS.



EXAMPLE 5B

Final Commentary

This essay has described the process of graphically recording and then transcribing into musical notation the imaginary of the composer in order to liberate it from the imposition of any pre-formed musical system. Both the external sonic world and the imaginary are sufficiently rich as models that can generate a wide diversity of new vocal and instrumental possibilities. Through an accurate chrono-graphical recording of such musical materials one can produce a new macro-timbre, whose precise

notation will demand, first, a different performance style, and second, a variety of musical chrono-acoustic inflections approaching the richness of all audible objects within or without the imaginary.

The relation between musical notation and representation is known to depend on the performer—i.e., the interpretation of scores tends to considerably transform them through constant changes of its acoustic components. One of the performer's tasks consists of converting symbols into a living macro-timbre that is interpreted through the knowledge of one's cultural tradition. This illustrates how music is less stable in reality than on paper. A strict chrono-acoustical analysis of a performance will show the gulf between what is notated and what is heard. This can be noted in sonic or rhythmic components such as pitch portamenti, amplitude crescendi and decrescendi, frequency and amplitude vibrati, breathing, bowing or percussive accents, or even through multiple non-written stylistic inflections belonging to each performer and epoch.

Technology's influence on composition has radically changed performing styles, practically imposing a larger acoustic awareness on them. One of today's modern musical styles embodies the search for a high precision of interpretation of inflections and expression previously left to the performer. Once precise performance indications become a compositional goal, any acoustical change takes place within a rich sonic field. One's perception and the methods used to represent it answer such a new artistic challenge. If the imaginary is understood to be an authentic chrono-acoustic inner reality comparable in richness to the sonic world of an external reality, attempts to transcribe it will not benefit from any existing musical system—however complex or elaborate it may be. The character of musical systems is that fixed rules are applied to the interpretation of the imaginary. These rigid systems are detrimental to an individualistic, free and spontaneous musical thinking.

Transcribing graphical recordings has become a central issue of the methodology here described, both as an attempt to record data with precision and as a new process for creating a score. From an aesthetic perspective, transcription as conversion maintains an identity closer to the original object in which the resulting score becomes a realistic, figurative version. In turn, transcription as a compositional choice leads to a dialectic between the original object and the score, or even between it and its permutational or topological variations. This results in the creation of an abstractly transformed new version. While conserving the dynamic character of an original object, the alternative applications of chronographicals transcend mere operational processes. They are, in a sense, the multi-dynamic memory of the original movements.

Movement itself is one of the fundamental qualities of any living thing and is considered, as well, one of the main attributes of art. The goal I wish to achieve in transcribing is a realistic reproduction of my inner and outer auditory experiences that then become one portrait of our musical universe.

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