INSTRUMENTAL COMPOSITION WITHIN THE FRAMEWORK OF SINUSOIDAL DECONSTRUCTION: AN OVERVIEW

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ABSTRACT

The sinusoidal deconstruction provides a number of possibilities for the composer about conducting, merging, recombining, adding or removing a limited number of instrumental dispensable parts through parametrical stochastic self-referentiality and generative procedures. Such a compositional environment has also the capability of standing itself without necessity of any vertical pitch control system, as for instance harmony is. Psycho-acoustically coherent, this system also allows a wide dynamic palette, a pre-compositional articulatory/gestural field without restrictions, and a rather big amount of efficient instrumental recombinations in regard to the integrity of the macrostructure. For its ideation and subsequent developments, some historical issues were considered, as for example the obsolescence of temporality as the only time conception in detriment of an emancipation of spatiality, some insights around diverse aesthetic deconstructive influences, the idea of *sequenza* or the exploration of the musical discourse as an issue that starts from the analogy sound/time from a more tactile experience. A subsequent block will discuss some practical explanations and realizations within some compositional strategies on the Paul Berg's AC Toolbox program.

INTRODUCTION

From 2006 to 2008, some theories about modular/assembled composition crystallized in DK<sin>, a multi-instrumental ensemble for nine musicians and/or a live electronics environment. The sinusoidal deconstruction allows the composer to hybridize effectively two opposed realms, the acoustical instruments and the electronic means, in which seeds are the basis. Thanks to the seed, the minimum compositional element, the composer finds a neutral environment where it is possible to express equally the musical ideas and to put in close relationship these two distinct worlds: the instrumental realm, as well called macroform, and the electronic-processed sound realm, or microform. This paper exclusively revolves around the upper part of the system, the instrumental realm or macroform, dealing with some historical, aesthetical and technical issues.

1. THEORY

1.1. Emancipation of spatiality

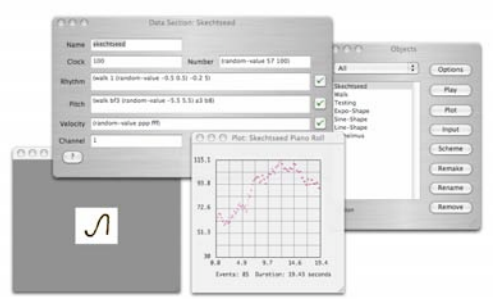
With the aim of considering what has been the role of time as a compositional concept and as a tool, some historical models were analyzed from the past (1). Nowadays, a deep revaluation on seeing music as time occurs, comparable to what occurred one hundred years before about seeing music based on the consonant/dissonant phenomena (2). Thanks to the popularization of computer, algorithmic composition techniques and other digital 'graphical/timeline-based' resources have found a natural expression in current composition. Through these means, mental space finds its own way of manifestation by manipulating time and making it flexible within the composition. This emancipation of spatiality has expression in at least two aspects:

a) Macro-spatiality, which concerns with the general (dis)order of a composition, as a manifestation of deconstructive actions on the macrostructure, seen as an entire dynamic object.

b) Micro-spatiality, which concerns with the writing, the realm of the graphical representation of music and their notational flexibility.

Along the history of notation, from the very beginnings of the Gregorian *neuma*, pitch and rhythm were gradually disassociated as independent parameters. As while as pitch found soon its place as a non-relative quantifiable phenomena in representational terms, rhythm started to find something analogue tardily. This disassociation provoked the establishment of the metrical system in music on a firstly quasi-logical operational field (3), and then on a geometrical

grid of values and proportions. This sort of metrical tyranny was permanent until the second half of twentieth century. Varèse was the pioneer in exploring another rhythmic flexible possibilities –contours- through invisible grids on this pre-existent metrical system (4).



Analogy 'torculus-seed' in AC Toolbox [Arranz]

'Poème Symphonique for 100 metronomes' by György Ligeti can be considered the most paradigmatic composition on expressing such a metrical tyranny, as a hyperbole of the reticular accumulation and decomposition of different constant beats. The work tries successfully to explore the entire rhythmic spectrum, from the most complex/textural configurations, passing through all kinds of complex massive patterns and polyrhythmic cells, to the most natural proportional simple manifestation of some 'survivor' metronomes (5). Another thing concluded is the illusory rhythmic displacements that occur with the simultaneous execution of two or more grids [regular beat patterns], creating a new dynamic imaginary rhythm. It could by called 'synthesized rhythm'.

1.2. Tactility of time

With the aim of exploring the possibilities of a timeline according with a flexible approach, some initial reflections were taken into account. For its conception, time was considered as the only ground to achieve it, without implying the support of external resources, as for instance musical parameters are. Thanks to these temporal approaches, space reaches a new time-emancipated dimension.

Two different kinds of musical tactility can be established in sinusoidal deconstruction:

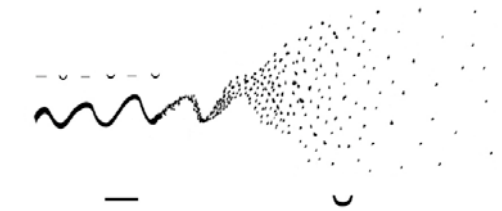
a) Sequenced tactility, which concerns with the structural domain of the composition, based on a discontinuous use of time as a means of achieving contrast and generating a whole discourse. This way of thinking is linked with the idea of exploitation of a single or multiple lines, split in several parts and later deconstructed, as for example the 'Etude II' by Karlheinz Stockhausen or in the 'Sequenzas' by Luciano Berio.

b) Continuous tactility, which is related to the tiniest rhythmic elements that conforms the illusion of a temporal flexible display within each passage and their continuous/discontinuous nature. These minima elements are sized in terms of accelerations and decelerations, from smoother to more abrupt ones, and they are not only organized, but also rather generated through the utilization of seeds, which are their graphical primitive expressions.

Regarding the time-space relationship in music, a more palpable state of equilibrium occurs. An intermingled situation was established between the synthetic Stockhausen's absolute temporal approach and the natural Ligeti's relative spatial approach. The Stockhausen's approach claims that pitches and durations are embraced by the same general concept, frequency [time], discriminated only as a matter of scale (6). The opposite Ligeti's relative viewpoint considers the psycho-acoustical level as the last one where musical thoughts are depicted; therefore it concedes a much more independent and far relationship of pitches and durations. Such an individualization of parameters contributes to understand the musical phenomena as a state of (de)composition [space], in which parameters express their singularities into a web of multiple performative layers. Time is relegated to a self-folded conception marked principally by its spatial qualities. Evaluating both and merging them as a new reconcilable situation, sinusoidal deconstruction transgresses this union of absolute/relative [time-space] elements as the best imaginable efficient way.

The consolidation of an hybrid temporal/spatial compositional approach establishes at least three things: first of them, an interesting organic expansion around what we understand about rhythm, which feeds as the tiniest details of the composition as bigger massive sections. This concept was denominated seed/anti-rhythm. Secondly, a natural bridge between parameters, creating an interchangeable situation of roles overwhelming all the conventional parametrical boundaries in a revalued landscape. Basically, rhythm is created through 'melodic' up-and-down spatial gestures, and at the same time, pitches play an important role about constructing and conditioning the most intimate essence of rhythm. Third, until this moment, whatever vertical pitch control is totally discarded and therefore has not any functionality. Summarizing, sinusoidal deconstruction claims the complete interchangeableness of parameters because their 'absolute' diffuse synthetic condition –time-, but

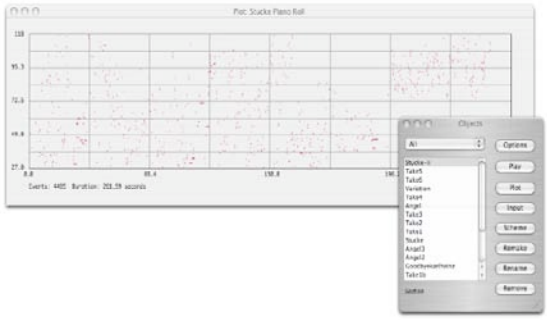
simultaneously respects the psycho-acoustical 'relative' neat autonomy of each of them –space-.



Imaginary diagram of seed/anti-rhythm in sinusoidal deconstruction

1.3. Preliminary experiences

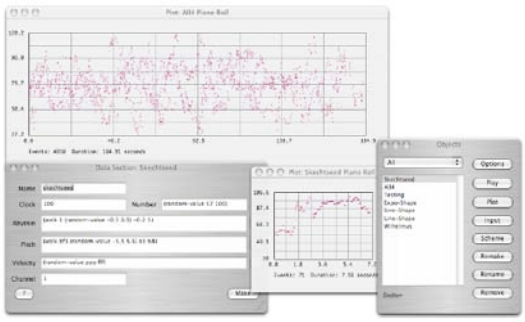
Previous sketches and experiments were realized in the AC Toolbox program. First of all, some proofs using random generators were made with the only aim of observing the degree of coherence between the parts. For this task, some thresholds were specified within three different generators, later modified and finally put together. It resulted into a quasi-coherent discourse based purely on spread gestures, in total absence of any vertical control system.



A fragmented texture achieved by random generators in AC Toolbox

Subsequently, more satisfactory experiences in terms of cohesion were realized. For that, walk generators were implemented over more than one parameter, fundamentally durations and pitches. In terms of capability for creating a discourse themselves, some autonomous monodic lines were obtained. One of the main reasons for such an autonomous capability is the recursive logical outputting of the walk generators. A walk generator basically consists in achieving a new value from the last remained value by simply adding a new generated number. That creates a sort of consequent situation that delineates a random pre-controlled itinerary, and at the same time it offers as well a complete logical correspondence of gestures. As soon as walk generators were translated to another parameters simultaneously, the conjunction between those parameters seemed more compact. Therefore, in the moment that achieving coherence with the other parts, with other parameters and with itself is entirely made by computer through some minimal instructions, we can state that this system is self-regulated, self-organized.

We tried to scrutinize what was the essence of such an hypothetical self-organized system of autonomous parts, and we considered to study two aspects: its historical musical roots attending to Renaissance counterpoint techniques, and on the other hand what should be beforehand the possibilities of emancipation of a given material in regard to the grammar that includes it. So, two observations were sustained: first of them, the historical confrontation of Renaissance approach versus Baroque approach on polyphony matters, considering that the way of writing separately the parts in the Renaissance, implying the lack of functionality or roles of importance among these parts, propitiated a more autonomous an interesting system of independent parts, unlike the Baroque techniques, in which the autonomy of the parts was completely buried by the acceptance of hierarchical roles between the musical parts via harmony and basso continuo. These concerns on autonomy are related to referentiality and to a neutral treatment of the voices: the bigger the referentiality and neutrality are, the deeper the possibility of living in solitude each voice. The second observation is the Koenig's statement on the notion 'self-sufficient composition', saying that composition is the grammar that generates the structures of a piece. Therefore, composition refers to elements that do not need be the subject of composition (7). In other words, grammar rules material, but material does not rule grammar. So, it indicates that this kind of autonomy should be pursued from a system that determines the behavior of the material, and not from the material itself.



Example of a whole section created by means of walk generators in AC Toolbox

1.4. Dispensability

Dispensability is the property that some musical systems have, by means of which you can remove or add the participation of whatever part in a given staff, and music always sounds in good

terms. Therefore, it implies that each part of the ensemble is not indispensable. In the specific case of sinusoidal deconstruction, it is made by means of conventional parameters –duration and pitch mainly- in the absolute absence of harmony or another vertical pitch control systems.

Three conditions are necessary to establish a system of dispensable parts: first, a receptacle, that is, a virtual space dominated by certain thresholds in which is possible to put some musical flux; secondly, neutrality between the parts –in principle none part is more than the others in terms of activity or representativeness, because every one is the variation of unique primitive one; finally, a compositional environment that responds to a tactile approach, according to both, sequenced and continuous tactility.

Dispensability increases broadly the possibilities of instrumental combinatoriality in music. In the specific case of 'DK<sin>', composed for nine musicians, it is realizable in 511 different instrumental possibilities. Attending to the binomial coefficient,

$$C_k^n = \frac{n!}{(n-k)! \cdot k!}$$

in which *n* is the number of elements in a set, and *k* the number of elements of each subset, the result would be the next:

C 9 1= 9 different versions for instrument a solo
C 9 2= 36 versions for duos
C 9 3= 84 trios
C 9 4= 126 quartets
C 9 5= 126 quintets
C 9 6= 84 sextets
C 9 7= 36 septets
C 9 8= 9 octets
C 9 9= 1 ensemble

Within the creative process, dispensability situates the concept 'instrumentation' at the very beginning of the composition: the level of condition. Unlike other kinds of instrumentation, in which this issue is arranged freely in a pure level of execution –conventional instrumentation- or maybe it is calculated in a level of instruction –as for instance, serialism, spectralism or concrete instrumental music-, the composer allocates beforehand dispensable instrumentation within a state of movable condition. It has a direct effect on the performers' role, who can pre-arrange their own 'à la carte' instrumental configuration before to play the piece, ranging 511 possible combinations from 9 versions a solo, passing through several variable chamber organizations to a whole ensemble of 9 instrumentalists.

The success of dispensability consists in the implementation of the idea of Berio's *sequenza*, but instead of being implemented on a single line, it is made on several lines at the same time. As in whatever sequenza, this implementation has the potentiality of reorganizing the macrostructure in new sequenzas –therefore, with full capability of self-articulation. Particularly, this is made within a general context of a variable stochastically deconstructed timeline, which rules all the discursive operation.
Simultaneously to this structural deconstruction, it is used other smaller stochastic painstaking treatment, which operates all the parts equally. This careful stochastic procedure was not only necessary to manage an interesting orography in the discourse, but also to establish a minimum sense of auto-referentiality that coheres all the compositional levels, from the minimum scale, the microstructure, to the biggest domain, the macrostructure.
Regarding stochastic from these two different macro and micro scales, the simultaneous implementation of both insights – the randomly reorganizable macrostructural timeline and the stochastic writing of the parts- originated indefectiblely a state of optimal conduction of the instrumental parts, understanding conduction as a property that some musical systems have to organize in a logical way structures able to carry sounds inside themselves. It concludes in that the whole instrumental ensemble could be reduced to one of its single lines, as in a sequence occurs, and it would continue working fine in the listening level.

In order to exemplify the efficiency of sinusoidal deconstruction on creating instrumental wholes, it possesses analogous conductive characteristics than other models of the past, as for instance, harmony is. The harmonic system was used as an element to conduct the musical parts in order to create a common discourse. This was a system based above all on an inner logic, in which sounds gravitated around some principal basements: the tonal functions. Chords basically were conductive structures, handled as vehicles that carry certain harmonic sounds.
This new conduction based on this kind of instrumental dispensability is able to plan a solution to carry sounds in a logical way without the necessity of gravitational environment –as harmony traditionally does- nor a vertical control using pitch as reference –as the vertical/discursive pitch control post-serialist techniques do-. This conduction based on stochastic does not compromise a parametrical writing of notes based on energetic/articulated gestures. It is basically achieved by means of a treatment of time as a mould that carries certain sound within it. Instead of using vertical sound structures that modulates a grammar in it, it uses autonomous parts deeply related each other because they

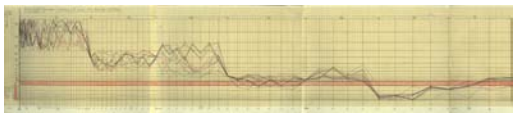
come from the same generative sources and because they share the same tactile temporal strategy within the macrostructure.

Conduction is comprehended as an optimal situation in the middle of the concepts organization and articulation. If we understand to articulate is to take a whole and split it in some smaller parts, and to organize is to take some parts and make a bigger whole, then conduction could be understood as the establishment of a logical path among these, both articulated and organized parts. Thanks to conduction, the composer manages a state of equilibrium between organized and articulated parts as while as the compositional process is happening.

2. PRAXIS

2.1. Generating the matrix

The first thing that was made to start to compose 'DK<sin>' was to create a matrix; this matrix was as a sort of scaffold in which to put in later all the rhythmic distributions of the piece. A descendant behavior was selected for two reasons: one of them, to distribute the values in a non-romantic way, conforming an anti-climax situation, that is, the most intense point at the beginning; secondly, to create an environment where the quick events had an opportunity of manifestation briefly and the slow ones more largely, as later it will be explained.
Seven regions were distributed horizontally inside three longer divisions with the aim of splitting seven different rhythmic behaviors along the musical stream. Three zones were considered to establish a natural contrast between rapid movements (1 and 2), more neutral and paused movements in the middle (3, 4 and 5) and slow movements at the end (6 and 7).



Matrix for rhythmic distribution in DK<sin>

Meanwhile the horizontal plan represents the time arrow, the partition of these mood areas and the distribution of the quantity of events in each area –the shorter the duration of events, the bigger the amount of them-, the vertical axe is in charge of deciding what are the specific ranges within each region. These ranges were sized in pulses per second (pps).

A double logarithmic environment was prepared: in the horizontal axis, the time arrow, it was required a setting of time durations where all portions had a kind of numerical relationship between them. On the vertical axis, the logarithmic drawing concerned directly with a perceptual question. An increasing 'bottom-to-up' scale was prepared to normalize the natural differences that occur in our listening. For definition, our listening is logarithmic, so the natural tendency is feeling more rhythmic differences in the lower regions than in the upper ones.

Some instructions were implemented through walk generators in the AC Toolbox, taking into account some tendencies with which to create an itinerary divided by zones.

2.2. The deconstruction of the matrix

The subsequent idea was to generate a discourse continuous/discontinuous at the same time, that is, a structure where it was possible to observe a principal itinerary of the original setting of the matrix and around it some disordered portions of this structure. This plan consisted in letting some portions of time in their places and moving the remained portions.
A 'double-step' algorithm was used to do that. Inside this split matrix, a positive number means that the selected portion/s remains in its/their placement/s, and a negative number means that it/they must be moved. The second step consisted in solving what to do with the ousted elements. Meanwhile the positives resultant values were in their placements, the negative results were picked up and put in another separate algorithm that mixed them randomly. These two principles were implemented along the 80 portions of the matrix, obtaining a new order:

1 2 9 4 5 6 34 35 36 10 11 12 74 63 54 16 23 24 33 20 21 22
28 71 25 26 27 41 29 30 31 32 59 60 17 18 37 38 19 40 45 42
43 44 53 46 47 66 49 50 48 68 69 76 55 56 79 78 39 3 61
62 75 64 65 51 67 52 70 13 14 72 73 15 80 57 58 77 7 8

From the implementation of this new order to the actual drawing of the matrix, it was obtained the following:

Deconstruction of the matrix after a 'double-step' algorithm

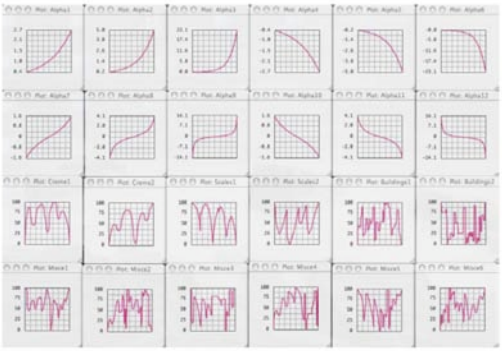
AC Toolbox understands basically temporal unities sized in seconds or milliseconds, so in order to can introduce some instructions into a 'Data Section' was necessary to convert each pps value to milliseconds (ms). Once the values were converted to ms, it was created an abstract mechanism to attend the new order of the

matrix. This mechanism encapsulated in a minimum expression the position inside the matrix environment, the starting point value and the ending point value of each single and independent event. That was very useful to start to specify some thresholds with which to implement curves.

2.3. Making curves

An entire grammar was fully raised on the macrostructure using different kinds of shapes. The aim of that was to establish some mechanisms of regulation that modulates rhythmic chaos inside the matrix. Basically, the idea was to fix an abstract path where was possible to represent some processes in the field of rhythmic behavior.

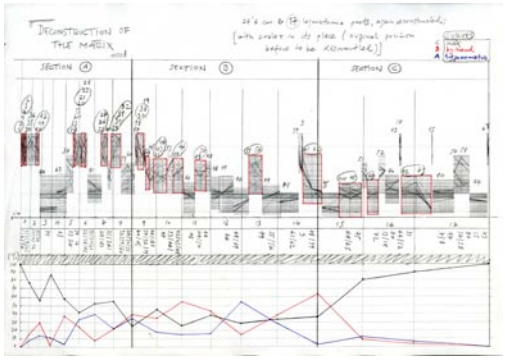
In order to formalize that, the seeds were divided in three different categories: trigonometric curves, by-hand curves and walk generators. Thanks to that rhythmic behavioral process, from something slightly linear, without accidents and trigonometrically expressed, passing through an environment by-hand made, defined in a 'non-Pythagorean' way, more irregular and non linear, to something totally chaotic, randomly generated and without a direct possibility of reproduction, the composer could achieve to control some gradations inside the macrostructure that later allowed the music to express some massive differences.



12 trigonometric seeds and 12 by-hand seeds used in 'DK<sin>' respectively. The third elements, the 'walk-generated' seeds are not represented in this picture.

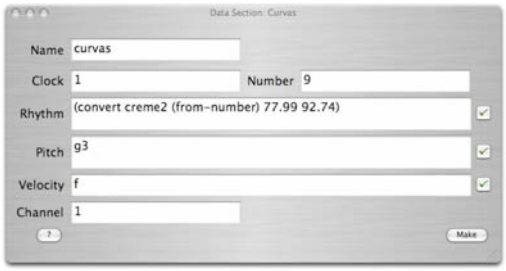
2.4. Thinking in distributions

All the species of seeds seen were distributing along the timeline. It was followed the anti-natural tendency toward complexity, tending to a much more neat environment, inverting the order in some moments, even tending toward some degrees of simplicity.
The matrix was divided logarithmically again, in this occasion in three new bigger sections, which included seventeen logarithmic parts in turn. Some different distributions of the species of seeds were imagined for each one: in the first part, the hegemony was established by the walk seeds, in the second an alternation of different primacies of walk, by hand and trigonometric seeds occurred, and lastly in the third one the tendency was conducted towards the gradual re-establishment of walk seeds. So, it was stochastically constructed a kind of inverted bow: at the both sizes, the most random rhythmic states, and in the middle music goes into a deeper, more simple state and plenty of nuances. The whole procedure was described as external proportionality.



Schema to control the distribution of shapes inside the deconstructed matrix.

Because each one of the segments along the matrix carries a certain number of smaller chunks, an internal proportionality was necessary to distribute them. This kind of proportionality was managed through Markov chains. The next necessary step was to decide the distributions of the 24 shapes of both palettes, trigonometric and by-hand, with 12 elements each one. That was very realizable using *'random-choice'*. After that, some sections could be made.



9.22 were the chosen numbers of points to cover a section of 1.27 seconds with a specific kind of seed. A couple of boundaries were specified as starting and ending points of the section.

2.5. Translating rhythmic values to millimeters

A table was created in order to link some species of bars of different durations with the length data in milliseconds from the matrix chunks. For that,

the 1/4 measure was taken as a reference, marking the metronome the next indication: ♩= 60 [1 pulse per second = 1000 milliseconds].

In order to prevent some mistakes and to make sure the music always would fit well inside the score, seven different scales were defined, one for each section of the work.

Molto Agitato ---------- 1.42 times smaller
Agitato ---------- 2.5 times smaller
Animando ---------- 2 times smaller
Calmo ---------- 5 times smaller
Tranquillo ---------- 3.3 times smaller
Molto Lento-Lontano ---------- 10 times smaller
Lento ---------- 8.3 times smaller

Finally, a list of data in millimeters was obtained from each single curve using converters, ready to be download into the score:

0.0 6.3 11.4800005 16.24 22.89 27.79 31.92 39.41 44.31 50.19 55.58 60.760003 66.64 72.73 80.01 87.36 92.47 99.12 104.020005 109.9 116.62 123.06 130.55 135.73

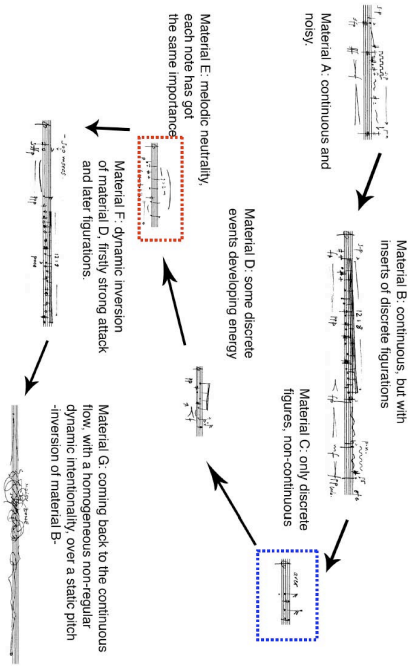
2.6. The level of the craftsman:
rests, pitches and last practical considerations

After the data level and once all calculuses were realized, the level of the composer's hand was considered. At least, three principal levels could be detected in the composition: the most primary state, the level of data, where an abstract shape is formalized by means of proportions, numbers, algorithms and lists, comparable to the Koenig's state of condition. Secondly, an intermediate level of formalization between total abstraction and conventional musical parameters was accomplished, dealing with durations (figures and rests) and pitches. Lastly, a third level, the level of the craftsman, where new processes want to cover an area totally intuitive, as a pure execution. This level corresponds to the use of dynamics, attacks and behavioral designs for instruments.

The process through rests was in charge of achieving a structural independent process along the horizontal matrix design, as a kind of digging or degradation of the musical matter. A couple of the trigonometric descendant curved shapes from the palette were used to create a tendency mask that agglutinates this process.

Pitch was involved in a more complex process. In general terms, several layers were set, which interplay each other within a multidimensional field. The principal layer of pitches was the unisons, which draws a bigger alternate sinusoid along the matrix. Another layers interfered in the process; they were in charge of producing different cohesive and expansive fields of pitches by means of tendencies, according to the idea of seed/anti-rhythm described in the theoretical part of this paper.

About the third level, some decisions about dynamics, attacks and designs of figurations were taken. About the process on materials, a sort of circularity exists, starting from a continuous flow, passing through a more fragmented and neutral treatment of time, and reaching again the continuity, but in a very static manner.



Itinerary of materials in 'DK<sin>', which in turn corresponds with the seven behavioral regions of the matrix

CONCLUSIONS

Sinusoidal deconstruction constitutes the suitable vehicle to imagine a compositional system, comparable to harmony, in which the composer can conduct, join or remove musical parts in an efficient way, given a group of instrumentalists. This versatility, which fits perfectly with the exigencies of practicing music today, as well shares an understanding of space as a kind of mental reflection, which is directly depicted on the score at various levels of the composition. It is thanks to this flexibility that the instrumentalist apprehends, through a sort of intuitive and rational graphical environment, these space-emancipated features in the most direct feasible manner. The system proposes an emancipation of spatiality in all the written levels, using a deeper self-consciousness about time as a means of making space palpable [tactile]. Spatiality is not a parameter more, or a quality, but rather it

represents a strategy that mixes perfectly the graphical idea of creating music with a coherent treatment of time, with discontinuities that dismantle, jeopardize and burn the narrative surface all the time, but without gaps, in an entire manner.

Furthermore, sinusoidal deconstruction allows the composer to download a series of gestures and pre-compositional strategies through a conventional parametrical environment, which, unlike other modular compositional systems, are not compromised by assemblage concerns. The system, rooted in several historical observations and close aesthetically to deconstructivism, proposes an entire revaluation of rhythm according to a total flexible realm, where grid-based rhythmic metrical paradigms of the past are not admissible anymore, nor the antithesis articulation/organization is impregnable.

The most crucial feature extended by sinusoidal deconstruction is the dispensability of the parts. It has originated a new situation in which instrumentation is thought at the level of condition, enhancing other aspects that contribute to assimilate music in a different way. The system also proposes reversibility of parameters in total absence of vertical control systems. This fact makes composition a perfectly supportable place in which new ways of expression were originated via computer.

The system was deeply and successfully tested the 26th of June 2008 by members of the Ensemble Modelo 62 at the Schoenbergzaal of the Royal Conservatory of The Hague. In that recital three different versions of 'DK<sin>' were played: first of all, a sextet for flute, B flat clarinet, guitar, piano, violin and cello; later a trio for clarinet, guitar and cello; and finally, a violin solo version. The performances were able to stand the structure of the entire recital in a very compact way. Each new version listened was generally understood by the audience as a distinct viewpoint respecting the same work. In that aspect memory played an important role. Although memory while listening was an aspect not taken into account during the composition of DK<sin>, however new interesting nuances appeared quasi-spontaneously. It contributed to renew each new performance.

The entire description of the system, MA Thesis '*Dismantling the time: a theoretical and practical basis for sinusoidal deconstruction*' and additional information can be found at the personal website of the composer *www.angelarranz.com*.

References

(1) In his essay '*La figure della musica da Beethoven a oggi*' (Ricordi Publishers), the composer Salvatore Sciarrino analyzes what were all the possible models of timelines in the last two centuries. He summarizes all possible temporal linear structures in a bunch of five categories: windows, accumulative processes, multiplicative processes, genetic transformations and Little Bangs.

(2) The idea of emancipation of dissonance was deeply examined by Arnold Schoenberg in his '*Harmonieliehre'* in 1911.

(3) To this respect, around 1250 Franco de Colonia developed an interesting logical measurement system quasi-geometrical, which was the bridge towards our present rhythmic metrical system

(4) Elizabeth West Marvin has studied this approach in her paper '*The Perception of Rhythm in Non-Tonal Music: Rhythmic Contours in the Music of Edgard Varèse'.*

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(6) STOCKHAUSEN, Karlheinz (1957): '… How Time Passes…'. Die Reihe #3, English translation by Cornelius Cardew 1959.

(7) KOENIG, Gottfried Michael (1978): 'Composition Processes'. Texte zur Musik, Band 3, 1968-1991, PFAU Verlag, 1993, pp. 191-210, as "Kompositionsprozesse".