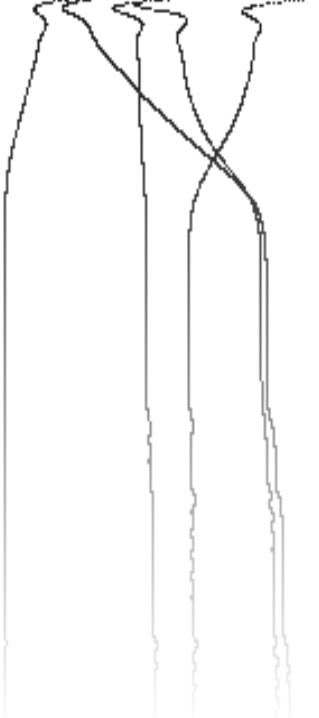
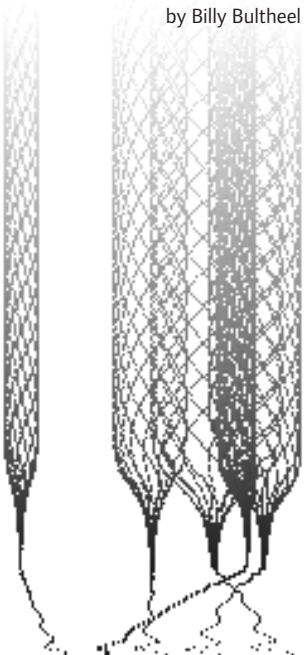


POLYPHONY - TIME - DENSITY

A research on polyphony in contemporary music composition

Bachelor Thesis,
Instituite of Sonology 2009
by Billy Bultheel



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Acknowledgement

The subjects presented in this text were inquired and developed between 2007 and 2009 at the institue of Sonology, The Hague. The narrative of the thesis can be divided in two parts: a theoretical investigation on time, density and polyphony in Medieval and 20th century music; and a reflective inspection on own musical works.

I would like to express my appreciation to Paul Berg for his delightful yet supportive and intelligent guidance and custody during the development of this thesis. I would also like to thank Kees Tazelaar, Joel Ryan, Raviv Ganchrow, Johan van Kreij and Peter Pabon for their encouragement and knowledge during my stay at Sonology. Also recognition goes to Wim Boogman, Sasha Zamler-Carhart and Konrad Boehmer for their help and advise on Medieval music theory.
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And last but not least I make free to wish Nika Neelova my love for her Russian affection and warmth which made my life unbearably joyful.

Billy Bultheel
The Hague, May 2009

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Introduction

This thesis deals with the idea of polyphony outside its conventional scope. Instead it investigates the idea of multiple interacting voices in a nonhierarchical amalgamation. The term ‘polyphony’ should not be misunderstood by the classical concept of harmonic counterpoint, but instead be seen as a broader technique to congruously combine several equivalent voices.

An aesthetical and technical appreciation for 14th, 15th and 16th century polyphony motivated the writing of this thesis. The search for similarities between Medieval and contemporary music theory establish the main subject. Consequently this text describes the treatment of time and density in a compositional environment and tries to find an overall musical strategy to construct a valid polyphonic edifice.

The first chapter describes how time creates musical structures.

The second chapter describes how density is needed to concretize time structures.

The third chapter combines the two former chapters into a strategy to create a polyphonic edifice.

And a fourth chapter highlights and evaluates the application of this strategy in the composition ‘Forty-part Motet’ which I created in January-May 2009.

chapter one: Time

introduction.

Music is an ephemeral art, manifested and experienced in time. When music is performed the details of its existence pass quickly by the relatively small window that we call 'now'. This present is framed by the span of our awareness and enhanced by memories of previous moments and conditions established by them in the music. When music concludes or when a particular moment is past, we are left only with the memory of its unfolding and, of course, the possibility of re-creating other manifestations of it in time.

Consequently we can state that a discrepancy exists between absolute time and the human perception of time. Moreover, time as an absolute fact, discretely passing us by, is becoming an obsolete idea. Time is rather a way of describing relations between a person and an experienced event.

> *"The words "past", "present", "future", express relationships between objects or events, and people. [...] These are all distinct but related experiences of time. Time has no grip on events. It is events, as lived through by people, which define time."*
>
> Thomas Clifton (Quoted from Kramer 1988, p. 5)

The idea that time merely describes a relation between an event and the person who perceives it opens up the possibility for time to be shaped. By suggesting temporal relationships the artist has the power to construct upon time. Above all in music, due to its abstract language and formal approach, composers take advantage of its artistic implications.

The passing of time is no longer independent from the control of the composer; instead it becomes an object that he designs, develops or reorganizes. The timeframe is constructible and by all means gives rise to being deconstructed and analyzed.

Concurrently, due to memory and cognition the listener is also capable of reshaping their perception of time by relating temporal processes to sounding material. The listener recreates a musical architecture by discovering connections between sound events, motives, phrases and their relevance inside the musical framework of a composition.

The frequently used quote by Jonathan D. Kramer: Does music exist in time or does time exist in music? (Kramer, 1988, p. 5) reflects the importance of this trait. If music would exist in time, we consider time to be an absolute entity, external

to music. Yet if we consider time to be shaped by music, we can imagine the possibility of music to adjust, distort or even re-articulate time. Music is not merely a sequence of events that contain time, but a sequence that has the power to shape time itself.

This chapter will focus on some strategies that composers have developed in order to construct with time. It starts with Medieval music by Johannes Ockeghem, a composer from the 15th century, and ends with Horacio Vaggione in the 21st century.

Music from the 14th and 15th century will be continuously present in this chapter, since early music and contemporary music deal with similar time compositional problems. To be specific, tonality is not present in both periods. Tonality has for long functioned as a succesful vehicle for time composition, since it ensures a lucid harmonic development and a comprehensible closure. Tonal composers work with closed statements which advance over preconditioned harmonic grids that are known to the audience. The listener is constantly guided and therefore understands their position in the musical process. Harmony provides them with a backdrop and a prospect to the development of the composition.

Since pre and post tonal composer do not deal with conventional tonal composers, the harmony does not necessarily imply direction. These composers look at other methods to invite their audience to apprehend their musical goals. As a result we see that form becomes important and develops strongly over the centuries.

Here, a few terms are important to describe specific time concepts. These terms will be highlighted more thoroughly throughout the thesis, but it is convenient to label them briefly beforehand since they will be used frequently during analytical descriptions.

A distinction will be made between 'absolute' and 'musical' time. These are terms adopted from Jonathan Kramer's 'The time of Music'. Absolute time is the time that is given by the clock, describing the absolute duration of an event. This is in opposition with musical time which describes the duration of an event as experienced through music. Musical time is the time that music evokes.

A second distinction is made between 'linear' and 'nonlinear' time. Also these terms are adopted from Jonathan Kramer. The linearity of time describes the process of a certain musical development. Chunks of music, in which a development is articulated, can be taken out of their context and be placed in a different order. The reorganisation of a given linear development is called a nonlinear development. A simple example of a nonlinear development is Beethoven's first Symphony which opens with a dominant and then solves to the tonic, instead of the expected symphonic opening that starts solely with the tonic. Nonlinear can thus be seen as a sequence which is taken out of its conventional order and develops against the expectations of the listener.

A last addition to this terminology derives from Xenakis and is the opposition between 'inside-time' or 'in-time' and 'outside-time'. Outside-time is the place where decision are taken on large scale formal procedures. These decisions are abstract concepts that describe musical constraints but which do not imply small scale dynamic processes. Rather, they form a compositional framework for the composer. In-time focusses on the dynamic structures inside the outside-time framework.

This chapter is divided in four subchapters. I will start with a subchapter on Ockeghem and his early time-compositional strategies, followed by a description of Webern's fascination with early music, then Xenakis and his outside-time techniques, and ending with Vaggione's idea of the multilayered time network.

Medieval temporal composition methods.

Johannes Ockeghem is a polyphonist from the second generation of the Flanders school. He is born in 1410 in Saint-Ghislain, Flanders, but worked most of his life for the French court, succesively under Charles VII, Louis XI and eventually Charles VIII. He was highly respected and known for being an extraordinary singer and composer. As a teacher, he created a fruitful and experimental compositional environment at the Chapel de Tours de Loire. Here he lived most of his life and died in 1497.

Ockeghem's prominence as a composer stems from his exceptionally cerebral approach to creating music. He designs his time structures by combining complex processes which abolish all relics of narural imitation and conform fully to a formalistic philosophy.

Although Ockeghem is accused for being a 'pure cerebralist', his music contains a highly poetical language. This is promoted by its relentless continuity and an overall sensation of consonance and freedom. Ockeghem's formal procedures are not meant as a tour de force or a childish challenge but are applied with the aim of making beautiful music.

In order to understand Ockeghems innovative formal approaches, it is important to understand some of the existing musical techniques from the 15th century. Some Medieval compositional systems for time modifications will be illustrated. These systems were used by Ockeghem but at the same time also influenced his approaches to composition.

The first important system is the mensural system, literally the measured system.
The gradual development of polyphony prevailed out of adding extra voices onto an existing cantus firmus (a default religious melody). The added voice was sung faster in order to ornament the sustained notes of the cantus firmus. Later on, another voice was added that sung even faster than the previous one so that it could ornament onto both voices. Composers found a consensus with three differently speeded voices, in which the slowest was called modus, the middle one tempus and the fastest prolatio. A mensural composition exists of musical material that is distributed and modified over these three voice groups, which sing at different speeds.

> *'It's like three platforms revolving around the same axis at different speeds'.*
>
> Ernst Krenek (Krenek 1962, p. 46-47)

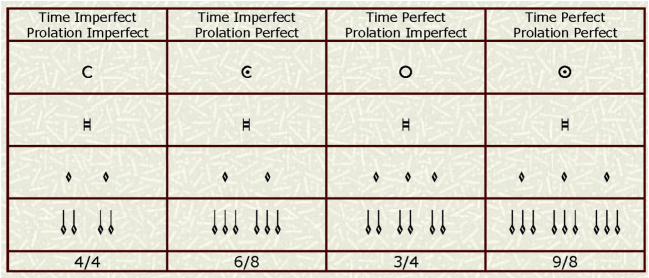


Figure 1.1: Four prolations, developed in the 14th century

A second important technique is the proportional system, a system in which time is expressed through proportions. Since the mensural system proposed three temporal orientation points, the proportional system was used for more complex and subtle time modifications. By using fractions, composers were able to suggest slight changes in speed and rhythm. They notated this as a fraction on a certain place in the score which signified that from that point on the speed modulates. The duration it takes to sing a certain amount of notes is - from that point - the duration it takes to sing another amount of notes. For example, 4/3 means that four notes in the next passage will take the same amount of time as three notes in the previous passage. The voices sing thus slightly faster than before (Krenek 1962, p. 48-49). In contemporary music this technique is still used and is called 'metric modulation'.

Later on, the mensural and proportional system developed into a very specific time control mechanism, called prolations. A prolation is comparable with a classical time signature that indicates the division of the measures. In the 15th century four prolations derived from a combination of 2 subdivisions called 'time' and 'prolation'. These can both be imperfect, meaning that the measure is devided by two and grouped in measures of two. They can also be perfect, meaning they are divided by and grouped together in the 'holy' number three. [see figure 1.1]

By using these signatures, composers were able to give speed and division indications to their performers. Accordingly the performers were so well trained on these specific time-signatures that they were able to keep the right speed and articulation while another sang a separate prolation simultaneously. Because of this remarkably strongly trained technique composers were able to create complex time relations between the voices in a polyphonic composition. Philipe de Vitry is the first composer who developed this idea, and who used this technique to create a new astonishingly rhythmical music in the 14th century (Condon 1992, p. 3).

Phillipe de Vitry also set the basis for another exceptional medieval compositional technique called isorhythm. In this technique, sequences of rhythm and pitch are composed independently, both containing a different amount of events. When superimposing these sequences, thus assigning the pitch values to the rhythm values and keeping their order in regard, the sequences run out of phase (Hoppin 1978,

p. 362-363). A score and recording of the isorhythmic motet In nova fert by Phillipe de Vitry in appendix III and on the CD in appendix II, track 01. This motet is one of the most peculiar in its kind and shows clearly the rhythmical potential of prolations and isorhythm.

It is interesting to note that the phasing of pitch to rhythm in isorhythm is expressed through fractions, a notation system which is also present in the proportional system. Contrary to the proportional system, where fractions describe the relation between two voices inside a polyphonic structure, isorhythmical fractions describe the relation between two musical parameters inside one voice. The action of contrasting timings of multiple events is a reoccurring technique in the Middle Ages, and is applied onto different levels of the compositional process.

An obvious yet very important medieval time concept is the canon. Despite its loss of complexity, it is probably the foremost surviving compositional technique from this early time. Nowadays a canon is a composition based on one melody that is successively repeated in other voices with a certain time offset, with the result that the melody harmonizes itself. In the Middle Ages the repetition of that melody would undergo a larger amount of modifications, resulting in a compostion where it is transformed succesively by each voice and still harmonizes itself. The most used modification was transposition in length, meaning that the melody was stretched or shortened in the different voices. When layering the results in a polyphonic composition, an intricate network of time relations takes place, articulating the melody on a multitude of temporal levels. The mensuration canon is very popular throughout the Middle Ages and the early Renaissance, it also revived strongly in the beginning of the 20th century in the music of Anton Webern.

Looking at the aforementioned techniques, we can conclude that Medieval and early Renaissance composers dealt with the idea of outside time composition. Many of the techniques describe processes which are not yet executed in time but merely propose a systematic development of musical material. Hence these composers had the power to conceptualize music by condensing it into these algoritmic devices.

In polyphony, time is represented by a simultaneity of temporal-processes that are developing asynchronically. The linearity of time is broken by a constant change in proportions between the voices and their temporal processes. One can state that

polyphony enhances a non-linear perception of time. One can best illustrate this with the example of a 'horse race'. All horses are going from start to finish yet the distance between the horses will constantly change. The overall movement of the race is not synchronous to the movement between the horses.

A milestone Renaisssance work in the development of time proportional techniques is the Missa Prolationum by Johannes Ockeghem. The name of the mass literally means 'The mass of the prolations' or time-proportions. It is so scholarly written that some specialists think it is purely created for didactical reasons. However Ockeghem knew to keep his musical language aesthetically high, which shows his talented insight to complex counterpoint and harmony.

The mass is written for four voices and throughout most of the work, especially where the four voices sing together, the four prolations are used simultaneously. Each prolation is assigned to a voice and transforms the same melody. As we see in figure 1.2, only two melody lines are written down for four voices. Yet if we look in the beginning of the score, two prolation signatures are given. The singers thus had to stretch or modify the melody line according to the signature or algorithmic transformation given to them. Towards the end of the melody line, a flagpoint is given, illustrated with three dots arranged in a triangle. These flagpoints indicate where the voices fall together and prepare themselves for the ending cadence. The melody written after the flagpoint is a cadence that the faster voice uses to fill up the timeinterval he is ahead to the slower voice.

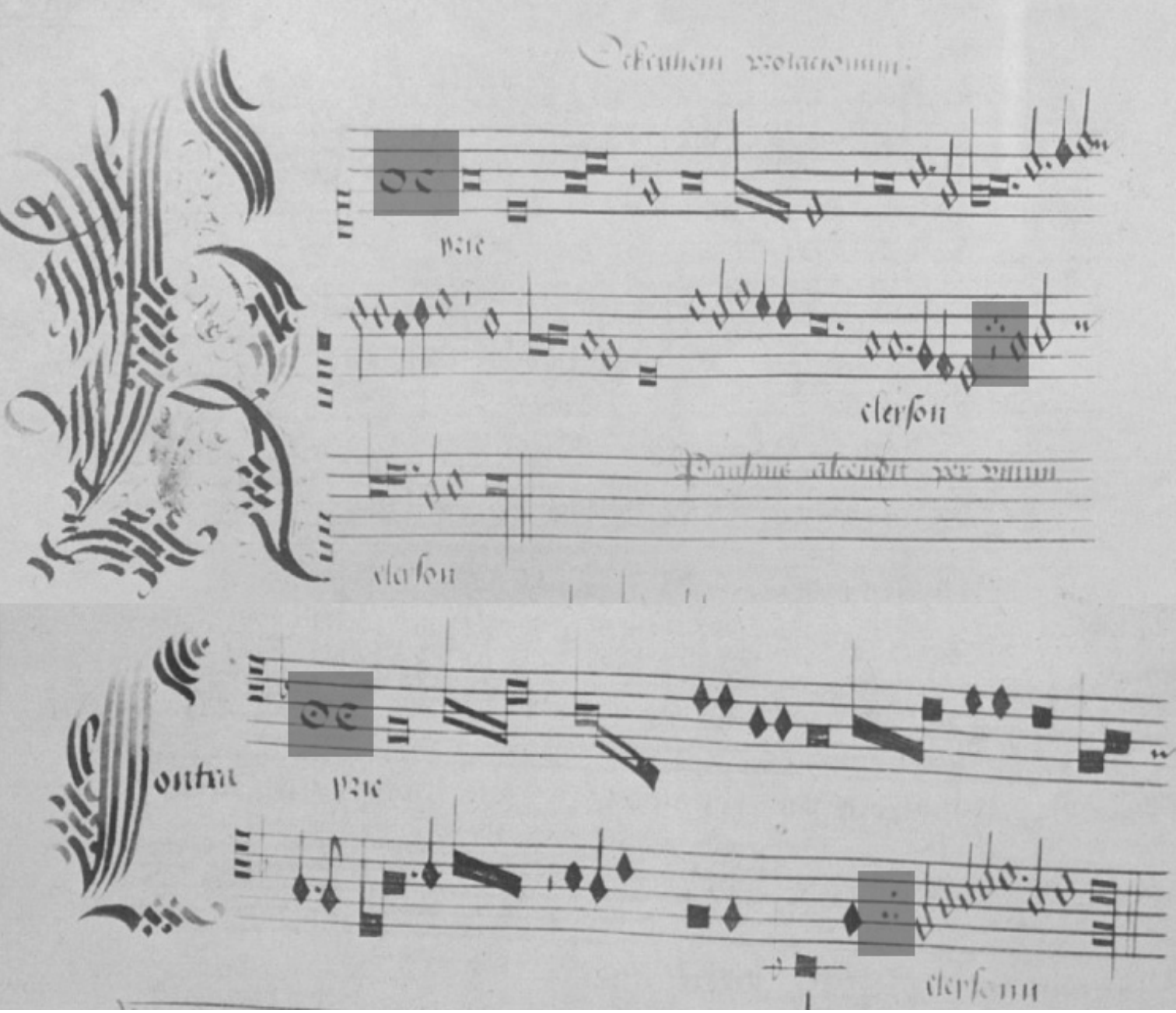


Figure 1.2: Original manuscript from Chigi Codex of Kyrie I, Missa Prolationum by Johannes Ockeghem.

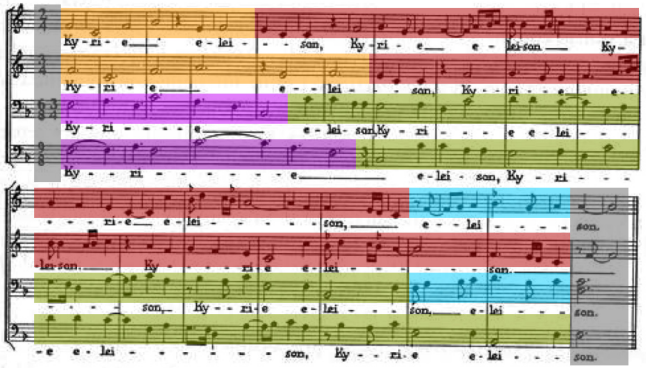


Figure 1.3: Transcrption to contemporary notation of Kyrie I, Missa Prolationum by Johannes Ockeghem.

Each section of the mass exists out of a double canon, meaning that two canons are sung at the same time. Each double canon starts as a mensural canon, due to the different prolations, and ends as a normal canon. Regarding harmony, every time a new section in the mass starts Ockeghem jumps one diatonic interval in his canons. This way he utilizes all harmonic possibilities.

When one looks at the transcription of the Kyrie [fig. 1.3], he can see that the two canons are written down at the unison. Furthermore it becomes obvious how the melody transposes and creates time offsets between the voices [orange and purple]. After several measures the voices simulate the same prolation mode which simplifies and stabilizes the canonic process [red and green]. Eventually, when the faster voices have fully sung the melody and reached the flagpoint, it continues with the cadense and works its way to a synchronized closure [blue].

As a final conclusion we can state that the exposition of the musical material embodies many compositional criteria. Moreover it is mostly the exposition that generates the form and not the musical material. Ockeghem constrains himself so strongly to preconceived compositional ideas that the material becomes but a vessel to translate the form (Boehmer 1988, p. 30). The large scale procedures are so important for him that they influence the musical material itself. Ockeghem composes outside-time. His compositional structure reprocesses material by assigning it to distinct temporal processes. These do not occur in sequence but instead appear simultaneously. They refer to each other and to the structure, but not to a natural musical development. They show non-linear.

Webern & Isaac.

At the end of the Renaissance Humanism develops and culture turns away from the Medieval scholasticism. Art's credo becomes centered around the promotion of human needs and moralities. The Medieval musical doctrine dilutes and makes place for tonality in Classicism and eventually Romanticism. Nevertheless shreds of Medieval cerebralism survive in music of Bach and Beethoven and find a thorough revival in the beginning of the 20th century.

In 1908 the emergence of the twelve-tone technique, developed by Schönberg, founded a new prospective for abstract aesthetics. It triggered a chain reaction of new approaches towards the composition of time.

The twelve-tone technique breaks radically with tonal harmony and simultaneously creates a new all-containing musical system. When applying the twelve-tone technique a composition can only emerge from one fixed row of the twelve chromatic notes and its modifications. The logical guidelines - that the harmonic development in tonality ensures - disappear due to an over-chromatism. Musical direction has to be created elsewhere apart from tonal harmony. And since the twelve-tone technique ensures unity due to its reprocess principles, a total freedom of abstract thought is possible between the borders of its own constraints.

> *"The twelve-tone row is, as a rule not a "theme". But I can also work without thematicism, that's to say much more freely, because of the unity that's now been achieved in another way: the row ensures unity.*
> *[...]*
> *"Now I can invent more freely; everything has a deeper unity. Only now it is possible to compose in free fantasy, adhering to nothing except the row. To put it quite paradoxically, only through these unprecedented fetters has complete freedom become possible!"*
>
> Anton Webern (Webern 1960, p. 55)

From all composers of the second Viennese school, Webern differs most from his German predecessors. In contrary to the late Romantic strategies of Schönberg and Berg, Webern approaches composition with a different, more abstract style. His new style is partly but crucially inspired on medieval compositional techniques. In Medieval music Webern found similar ambitions to create a music which is totally self-referential and fully faithful to its preconceived constraints.

These issues are of utmost importance to Webern, since he believes that they are necessary to achieve a complete freedom and yet a musical congruity. He struggles with ingenious compositional designs that strive for perfect structural unity.

In his book 'The path to the new music' Webern describes his approach to the compositional process. The first step is the 'intelligability' of the material. The second step is the 'comprehensibility' of the musical structure and the last is the 'differentiation' of these steps over the distinct compositional layers and scales (Webern 1960, p. 17-18). This approach is important to create clear thoughts on material and large scale structures. Subsequently he applies these thoughts on the different musical layers in a composition. Hence because of such an economical use of the musical material and a constant recycling of the same structural ideas, a unity is ensured. Accordingly Webern concludes that unity serves best as the comprehensibility for communicating abstract musical ideas.

The credo behind these compositional steps is clearly that of communicating abstract musical thought. It is not unusual that Webern finds support in Medieval and Renaissance music. Moreover it can be proven that his strive for unity and order is highly influenced by the technical methods of Early music.

In 1906 Webern finished his Musicology doctoral dissertation study on the Renaissance composer Heinrich Isaac. Isaac is a polyphonist from the third generation and a student of Ockeghem. Webern's knowledge of this Renaissance composer influenced him strongly and made him develop a style which is rather different from his contemporaries.

The significance of Webern's study on Isaac's music lies mostly in the technical and compositional possibilities it suggested to him. 'The profuse employement of canonic devices, of close or distant imitation, the subtle interplay of parts' (Mason 2005, p. 3-4) and the peculiar characterization of the musical layers shaped Webern's musical techniques.

> *" I 've gone in a certain direction, and now we find this process, this remarkable course of events – that what we saw in polyphony, the greatest possible unity, that 's to say the so-called Netherland technique that this tendency is again gradually taking possession of these things, and that a new polyphony is developing."*
>
> Anton Webern (Webern 1960, p. 27)

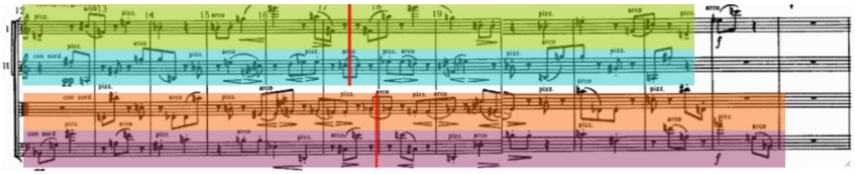


Figure 1.4: Symphonie Opus 21, Second Movement, first variation by Anton Webern.

When we look at Webern's oeuvre we see the 'Netherlandish' techniques almost literally re-occur. E.g. Fünf Kanons, Opus 16 is a collection of small pieces that make use of canonic techniques. Later on Webern develops this thought further and applies it to all levels of the compositional process. His much revered work Symphonie, Opus 21 is a result of his resolute believe in these techniques. We will go deeper into Opus 21 since an analysis of the piece will open up clear tangents between Medieval music and Weberns determined working method. Following we will primarily focus on the second movement Variationen since it highlights best Weberns aims.

The key-concept of Opus 21 is the palindrome (Bailey 1991, p. 197). Briefly, a palindrome is a sequence which reads the same backward as forward (e.g. RADAR or 12321). The second movement of Opus 21 can be seen as a succession or exposition of variations on the idea of the palindrome.

On the first step of this twelve-tone composition a row occurs that is set up as a palindrome regarding interval relations. All its modifications are consequently variations on this palindrome. Furthermore, looking one level up, each variation in the second movement can be read as a palindrome, since they are constructed out of a vast variety of canons by inversion, crabcanons or symmetrical canons. A crabcanon is a melody of which its inversion is sung simultaneously in another voice, reading such a canon backwards thus delivers the same result. Similarly the symmetrical canon can be understood as a canon which reads the same backwards as forward, since in this canon a melody is mirrored around a central axis. This canon occurs very obviously in the first variation of Opus 21. [Fig. 1.4]

Additionally Variationen exists out of nine variations. Originally the structure of the variation-form implies an initial theme over which each variation elaborates and grows more complex toward the end of a composition. Webern, however, rearranges his variations after having them composed linearly. Through changing the second variation with the last, and fourth with the eight and so on, he rearranges his variation around a symmetrical axis. The macro form itself becomes a palindrome.

Webern's method of 'differentiating' the palindrome concept takes its effect on the whole composition. From the micro to the macro level, all steps of the compositional process are obedient to Webern's determined strategy.

Consequently by rearranging the natural development of time, time it is taken out of the conventional context. Time is victimized by the musical idea of the palindrome, and does not addresses its conventional function of enlarging or articulating a musical gesture. Weberns aim for greater unity is postulated since he forces his abstract thought, aside from pitch, duration, dynamics and timbre, also onto time. Time and development become palindromes and are hence no longer linear, but just as complexly designed as the other musical parameters. Time and form are treated like the other compositional parameters. They are treated like the other compositional parameters and become obedient to Weberns 'sculpted' composition.

Besides the abstract constructive reasoning, Webern is also highly influenced by the idea of polyphony, in which he discovered a third musical dimension.

Webern believes he can enhance unity by representing a musical idea in several parts simultaneously. When different results on the same musical process sound at the same time, the differences between the voices create inner connections within a composition. They take distinct positions within the time development of the musical process and make time multilayered, enhancing a dimension of depth.

" It was soon found necessary not to limit the presentation of a musical idea to one part; they [the Flemish polyphonists] tried to make more room. When several parts sound at once the result is a dimension of depth; the idea isn't expressed by one part alone, and that 's the nature of polyphonic presentation of a musical idea."

Anton Webern (Webern 1960, p. 19)

Xenakis & Tinctoris.

Another intriguing connection can be made between Iannis Xenakis and Johannes Tinctoris. Tinctoris is a collegue of Isaac and a student of Ockeghem. Regarding Xenakis' attempt at developing a new all-containing musical system, it is rather intruiging how he refers to Tinctoris in his focal literary work, Formalized Music. It becomes even more appealing to this thesis since he mentions him in relation to time.

> *" [...] I propose to make a distinction in musical architectures or categories between outside-time, in-time and temporal. [...] I have dealt with this distinction already, but here I shall show how ancient Byzantine music can be analyzed with the aid of these categories. [...] The rapid evolution of the music of Western Europe after the ninth century simplified and smoothed out the plainchant, and theory was left behind practice. But shreds of the ancient theory can still be found in secular music of the fifteenth and sixteenth centuries, witness the Terminorum Musicae diffinitorium of Johannes Tinctoris."*
>
> Iannis Xenakis (Xenakis 1992, p. 183)

The Terminorium Musicae diffinitorium, or Dictionairy of Musical Terms is a catalogue of 15th century musical terms which describe the main music theory and concepts of Medieval music. Nevertheless, it conserved shreds of ancient theory that reveal interesting associations between Flemish polyphony, Ancient Byzantine Music and Xenakis' music theory. Xenakis surveys how these composers deal with time and he recognizes a strong similarity with his personal aims. He explains this by distinguishing three time categories in the compositional process: outside-time, in-time and temporal.

The outside-time category is the process of deciding over large scale musical constraints. These are decisions that have no immediate effect on time but rather propose the development or consistency of a musical parameter during a composition. E.g. a modal scale can be seen as an outside-time constraint since it is consistent during a composition and yet does not impose an effect on temporal modifications.

The second category, the 'temporal', decides over the inner-movement of a composition. It suggest a development on the metrical axis and thus proposes dynamic movements within a composition. It bears an immediate effect on the temporal

development of the music. The temporal category decides on the placing of events in the musical development.

The in-time category is the result of mapping the outside-time over the temporal category, resulting in the dynamic processes that form a composition (Flint 1993, p. 221). As an example to explain the in-time category he illustrates with the concept of a melody or a chord. Such an event clearly derives from mapping an outside-time constructed scale over a temporal sequence of events.

Xenakis proposes an abstract algebra for each seperate category. He conditions that these are to be treated abstractly insofar that the integrity of one is not dependent upon the other. Consequently a musical work derives from the imposition of these temporal processes.

> *"We have noted in the above three kinds of algebras:*
> *1. The algebra of the component of a sonic event, with its vector language, independent of the procession of time, therefore an algebra outside-time.*
> *2. A temporal algebra, which the sonic events create on the axis of metric time, and which is independent from the vector space.*
> *3. An algebra in-time, issuing from the correspondance and functional relations between the elements of the set of vectors X and of the set of metric time, T, independent of the set of X.*
> *All that has been said about sonic events themselves, their components, and about time can be generalized for a set of sonic events X and for sets T."*
>
> Iannis Xenakis (Xenakis 1992, p. 170)

His associations with Flemish polyphony are most visible in his description of the outside-time, since he believes that Medieval composers deal with outside-time constraints.

> *"Music participates both in space outside and in the temporal flux. Thus, the scales of pitch; the scales of the church modes; the morphologies of higher levels; structures, fugal architectures, mathematical formulae engendering sounds or pieces of music, these are outside time, whether on paper or in our memory. The necessity to cling against the current of the river of time is so strong that certain aspects of time are even hauled out of it, such as the durations which become commutable. One could say that every temporal schema, pre-conceived or*

post-conceived, is a representation outside of time of the temporal flux in which the phenomena, the enteties, are inscribed."

Iannis Xenakis (Xenakis 1992, p. 264)

The scales of the church modes, fugal architectures and eventually mathematical formulae engendering sounds or pieces of music, show a clear reference to Medieval music. The Terminorium Musicae diffinitorium of Johannes Tinctoris witness the outside-time stratetgy. Here his description of a canon:

"A canon is a rule showing the purpose of the composer behind a certain obscurity."

Johannes Tinctoris (Tinctoris 1963, p. 13)

What Xenakis meant by 'mathematical formulae engendering pieces of music' is strongly present in the canon-description of Tinctoris. In the 15th century a canon functioned as a complex musical guideline. It was used to condense large pieces of music into an algorithmic description. By using an almost mathematical language, performers were able to unfold the composer's composition, unravelling his 'obscure' structure. Ockeghem's Kyrie can be seen as an immediate influence on Tinctoris' terminology.

Xenakis applies this strategy strongly in Herma, a composition he wrote for solo piano in 1960. Instead of using canonic devices, Xenakis elevates the mathematical formulae to a handful of complex flowcharts that are each assigned to a specific temporal category. His preselected material, here groups of pitches on the piano, submit to a network of modifictions that are governed by stochastic decisions. The composer remains free by setting the weighted choice that guides overall compositional gestures.

When one looks at such a flowchart, it is certainly not farfetched to compare it with a canonic device from the 15th century. Despite the fact that medieval composers only managed this abstraction of composition on the outside-time, or macro-structure, it nonetheless appeals to Xenakis's three folded temporal theory. The temporal and in-time category were after all set by devices such as churchscales and counterpoint rules that made it unnecessary for composers to restate them within each composition.

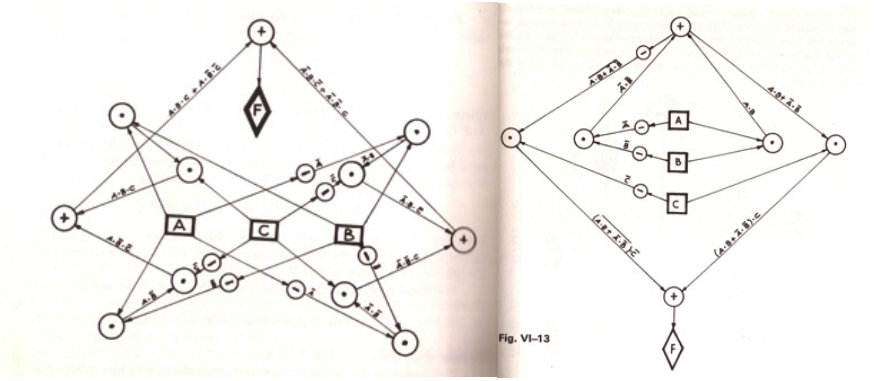


Figure 1.5: Two flowcharts from the score of Herma by Iannis Xenakis.

Reflecting on time, we see that the outside-time escapes absolute time. Time is composed as an object that suggests temporal relations but is not obedient to time itself. The time evoked by the music is a result from the interaction of the temporal levels dealt with in the construction the piece. Musical time is deconstructed and highly nonlinear, but instead an immediate result of an outside-time design.

> *"The role of time is again defined in a new way. It serves primarily as a crucible, mold, or space in which are inscribed the classes whose relations one must decipher. Time is in some ways equivalent to the area of a sheet of paper or a black-board."*
>
> Iannis Xenakis (Xenakis 1992, p 173)

Vaggione.

The formal approach by which compositions are designed in the previous chapters give proof of musical architectures and their possibility to be constructed outside-time. Horacio Vaggione elevates the concept of the musical architecture to the idea of 'network', and not just any network, but a musically interactive network.

In Vaggione's articles before 1983, he uses the word polyphony to describe his music-compositional theories. He understands polyphony as an interaction between different temporal levels, creating a complex musical system. But since the term polyphony refers back to its classical concept, which musicians often misunderstand as being composed linearly, he substituted polyphony with the term 'network'.

Vaggione has a very peculiar approach to building outside-time constructions. Instead of creating systems that are absolute and imposingly controlling the sound-material as is the case with Xenakis, he sees the outside-time structure as a network, existing out of transparent objects of transformation. These objects are modular and can thus be connected in different configurations. Furthermore he does not define temporal borders to his objects, meaning that every object is able to address the micro as macro timescale and all 'temporalities' that lie in between.

Consequently Vaggione defined a specific compositional thought, that he calls: Object oriented composition. (Solomos 2005, p. 321) Similar to object oriented programming, he uses a methodology that enables his compositions to be modeled as a set of objects that can be controlled and manipulated in a modular manner. His compositions are thus reconstructable, highlighting different configurations, resulting in various musical perspectives on the combination of compositional objects.

He often compares one such object with the idea of the 'figure' (or sometimes even the 'motive') in conventional composition. A figure, being a salient buildingblock of a musical composition, circulates within an outside-time network in order to produce multiple morphologies. Furthermore a figure articulates a specific musical feature that individualizes itself. Because of its cognitive quality, the figure is able to put the transformations in perspective and thus articulate aspects of the transformations by generating variation on itself.

"We are considering an approach that consists in generating ensembles of figures regrouped into objects, the figures being defined as the product of articulations showing particular pregnant musical features, and the object as constituting an operational category allowing it to include the figures in a network of compositional operations. A figure can be considered as bearing particular morphological properties, on which we can realise diverse types of operations."

Horacio Vaggione (Sedes 2005, p. 330)

Having this view on the object, we can see a similar methodology in Ockeghem's Missa Prolationum and Webern's Variationen. Here, a motive or figure undergoes transformations by different temporal modifications that augment, diminish or shift in time. These different temporal transformations are combined and put in perspective so that the eventual composition articulates the figure on different temporalities.

Vaggione calls for this articulation as being one of the most important aspects of his music. By articulating different temporalities in an interactive network, he puts importance and relevance on all time scales. There is no 'grading' between the temporalities.

Consequently one could say that Vaggione breaks the hierarchy of the temporal scales. Macro and micro time are no longer treated differently. By constructing a network in which "objects" are interchangeable between all temporalities, the music results in a complex amalgamation of figures articulating time, interacting between micro and macro-time.

"Time "taken", that is, "external", occupied, filled with something. And, on the other side, time evoked, "internal" (to musical form), created, syntactical time. In order to avoid any reductionism by the way of a dialectical synthesis, we can consider them as poles that appear in the building of the idea of music, as we look to understand it as a complex phenomenon. Once this is assumed, we can consider the "internal meaning" of musical time as belonging to music itself (as it is expressed in music), that is, belonging to the "syntactical" nature of music, which can be equated with form. Now, if we hold – as I do – the idea that, in music, form and content are indivisible, then we

can consider all temporalities present in music in a non-contradictory, pluralistic manner, and still retain syntactical time in order to articulate them all – because any articulation (any articulated thinking) is expressed in form, and form is precisely the result of a multi-level interactive articulation."

Horacio Vaggione (Vaggione in Kramer 1980, p. 94)

Another important aspect of Vaggione's networks is 'interaction'. Not only does he create networks constructed out of interacting objects, but he places himself as an interactive object inside his network. Thus besides creating a network, he also actively cooperates within.

Vaggione sees this as the coexistence of the global and the local level of composition. He creates a system and subsequently interacts with it. He is thus the creator of a network and yet he is submissive to his own creation. He controls on a global level and yet can locally interact with his system. This gives him the possibility for extremely detailed compositions. Furthermore it is an excuse for him to keep on using his compositional handicraft, without completely depending on the results of his algorithmic network. Vaggione calls this 'operative composition'. It is a way of combining his conceptualization with his musical intuition.

"The concept of composing with networks of objects is above all operative, its main purpose being to allow working at several simultaneous time scales, hence linking micro-time features, which are not always directly perceived, with 'surface' activity, where these features can clearly show their incidence on larger time scales."

Horacio Vaggione (Vaggione in Solomos 2005, p. 322)

The discrepancy between inside and outside-time composition is blurred. Vaggione moves himself on both fields at the same time, by superimposing a system on musical material and simultaneously manipulating the system from the inside. Equalizing these two levels, one can state that the hierarchy is broken between inside and outside time composition. Instead vaggione creates a vague hybrid compositional strategy.

Subsequently the idea of time takes a new form, addressing more to what Xenakis calls 'the temporal level'. Nevertheless Vaggione increases this level with another dimension, namely that of different temporalities. In my belief this derives from a polyphonic thinking.

The result is a morphological modular construction in which the composer has the possibility to interact on a local as global time level, with 'objects' that address to local as to global time structures. The results are amazingly 'complex'. Here Vaggione found reinforcement in the philosphy of Lévy-Leblond.

> *"...Will be called "complex", a system where mutual interactions between different levels are manifested..."*
>
> Lévy-Leblond (Solomos 2005)

Vaggione's methodology combines temporal transformations and large scale time procedures. Following, one cannot state that Vaggione controls time composition in an absolute manner. Instead the resulting and obviously constructing parameter becomes mass. The most important musical guidelines become the speed and occurence of events and the amount of object in a time frame. The treatment of time becomes so complex that it applies more to the musical parameter we call density.

chapter two: Density

introduction.

In the previous chapter we have seen how a compositional structure can be built and what role time plays within such a process. Nevertheless, time was labelled as a static structure which was not yet executed. Time was kept outside-time. Since outside time structures merely describe timeblocks and processes in which a musical composition is about to enfold, it does not fill the in-time. In order to fill in and articulate the constructed time formation and highlight its inner relations, another parameter is used, namely, a parameter which fills up the outside-time edifice and enlightens its structural methods, one which creates musical direction throughout a time block and makes its time interval perceptible. This parameter is density. Density concretizes outside-time structures by filling them up with sound-material [see fig 2.1].

We have seen that time as an absolute fact becomes obsolete. 'Time expresses the relationships between events and people. *[...] It is events as lived through by people which define time...'* (Thomas Clifton quoted by Kramer 1988, p. 5) Just like time, density inside a musical framework does not represent an absolute quantification. Instead density is measured by contrasting characteristics of events and their occurences to surrounding events. By comparing the characteristics of events and subsequently relating them to one another, density structures are formed. A density structure postulates a specific musical coherence inside a timeblock between events.

Consequently the notions of high and low density become relative. Furthermore, declaring a quantitative limit that seperates them would be nonsensical. Instead other extremes have to be sought to describe the behavior of density, extremes which enable the listener to reflect every musical event onto a density structure.

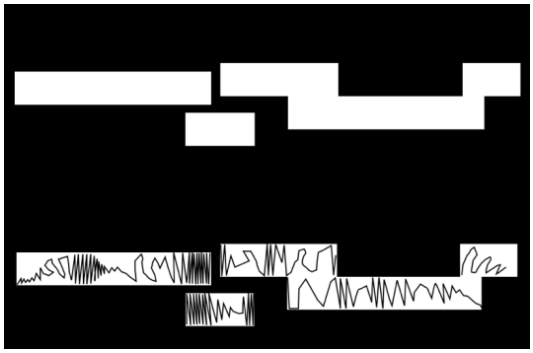


Figure 2.1: I. A time structure – II. A time structure filled with density

Hypothetically one can state that low density occurs when events with a specific musical quality are perceptibly isolated from each other inside their musical network. Yet they are accurate in as much as that they can be linked back to each other. One can introduce here the idea of articulation. Since one such event is isolated and thus distinct compared to its immediate surrounding, it stands out. The event articulates itself due to its specific characteristics and the lack of those in its surrounding events. Such a density structure creates contrast by articulating the events it encompasses. Extending this line of thought one could say that specific characteristics which occurs only once in a musical framework are part of a very low density structure.

On the other side, another structure takes place when events with similar quality occur regularly throughout a given time span. Such density dilutes the articulation of one event and instead highlights the constellation the event is placed in. It enhances the events to group together and form a texture. The shared characteristic of these events is promoted throughout the musical framework. This texture can be static or movable, meaning that the sound quality stays steady or changes gradually over the given time-span respectively. One can introduce here, opposed to articulation, the idea of morphology. Morphology happens when events with similar characteristics are so closely spaced that they are perceived as a coherent mass. Since these events form a mass, they are capable of sustaining their presence over a longer time span. Morphology in this case means 'shape'. It is a musical shape that has the possibility to change form over time.

The terms articulation and morphology are applicable on all time levels and do not necessarily impose their presence onto other simultaneous time scales. This means that a morphology on the micro level does not demand a morphological approach on the meso or macro level. The effect of density on one temporal level is independent and does not bear consequences on other time levels.

However, we can understand that the perceptible effect of density treatment is different according to the temporal level it functions on. On the micro level we can differentiate articulation and morphology by differences in a soundquality of a meso level event. Furthermore we can create textures or rhythmical structures by treating density on the meso-level. Eventually the macro-level creates large-scale gestures and

textures by the aid of it.

Looking at how density is capable of filling in pre-established time blocks one can note that it gives direction to an outside-time structure. By the aid of articulating or creating morphologies inside a time structure, density elucidates the time proportions and enhances their inner connections. It shapes the inner space of time by concretizing it with sound constellations. Here density means more than the quantity of events over a given timespan. Instead it is the factor which creates sonic edifices inside a given timeblock, it creates the pillars on which the outside-time structure is communicated.

Hence density is a key concept for an understanding of music, both for creative as for analytical purposes. This thesis will look at examples of density treatment of three main composers. Opposed to the first chapter, this chapter will start with contemporary music and work its way back to the Middle Ages. Vaggione's understanding of density will highlight some of the most contemporary concepts regarding density. After that Iannis Xenakis will be discussed. Eventually an analysis of the style of Medieval composer Guillaume de Machaut will conclude this chapter.

Vaggione.

The aforementionend chapter described how Vaggione constructs musical networks. One can say that these networks break the hierarchy between the different temporal levels since objects are able to interchange between 'all temporalities'. Furthermore the network breaks the hierarchy between local and global composition since the composer can interchange his position between them. This reflects back on breaking the opposition between in-time and outside-time. The network is not an imposing structure, it only suggests modular interactions between objects. In other words: the network is a variable form, it potentializes musical structures and outputs one when interaction takes place.

Since no timeblocks have been radically set, one would assume that this strategy makes the idea of filling up time-structures ambiguous. However, instead it becomes of utmost importance for Vaggione. Morphology and articulation are postulated throughout his musical theory. In fact, because of these terms Vaggione is able to suggest the outside-time structure he creates while interacting with his system. Hence he is able to derive a musical structure from a variable potential by utilizing the concepts of morphology and articulation.

The notion of morphology is present throughout Vaggione's musical theory. In fact, he believes that on all timescales morphological phenomena can be understood as 'figures' that evolve within the timescale pertaining specifically to them (Solomos 2005, p. 317). For Vaggione morphology is not an incident which is only perceptible on the surface, but a method that deepens itself unto the micro-composition of music.

His assertion on morphology starts with the 'morphological salience', a microscale construction that appears first in his description of Jean-Claude Risset's survey on the inner-movement of brassy sounds (Sedes 2005, p. 328). A morphological salience can be understood as a chunk of multi layered events covering many simultaneous temporal levels. Since micro scale morphologies stipulate a micro temporal development its effect is that of a changing soundquality. Vaggione's 'morphological salience' is a development in soundquality that strives for outstanding characteristics. He illustrates this with Jean-Claude Rissets paradigm; the salient point of briliance in a brassy sound. It is the point where a sound attains a characteristic by which it succinctly differentiates itself from its surrounding.

On the meso scale a morphology converts itself into a figure. Here a morphology reveals a certain shape, it indicates a sense of direction and formalizes a specific figure. On the macro level such a morphology translates into a large scale transformation. This can be the content of a whole section or just a formalistic guideline.

> *"The morphological approach allows sonic forms to be thought of as dynamic movements, as processes. This appoach is 'transformational', which implies that evolutions of charecteristics or parts of sonic morphology are envisaged with regards to their context."*
>
> Solomos on Horacio Vaggione (Solomos 2005, p. 318)

Morphology enables a sonic form to be thought of as a dynamic process. It generates a pertinent adherence between the events which are comprised in the process. They are inevitably placed with regards to their context and to each other. These events form a shape, a morphology that takes place within the musical structure. This shape encompasses a time-block which is seen within an outside-time structure. It is a dynamic process that elucidates a time-interval and articulates it with developing soundmaterial.

Articulation is hence the opposite of morphology. Articulation does not group an event into in a shape, but isolates it. It forms a distinct difference in quality. The event differentiates itself from its surrounding and articulates its place inside a dynamic process. Whether an event, a figure or a whole phrase is articulated, they are all musical forms which stand out from their surroundings.

> *"[...] it seems to me, a content that is relevant for us today: after having accomplished a profound questioning of traditional thematicism during the 20th century, we can now envision new perspectives to develop with regards to the issues raised time and again by the need to articulate the material."*
>
> Horacio Vaggione (Solomos 2005, p. 318)

The parallel drawn to traditional thematicism is likely the best example of Vaggione's high esteem for articulated material. In traditional thematicism the constructing element regarding sound-material is the theme and its transformations. A theme can here be seen as an articulated figure which - when placed in a composition - emphasizes a specific location in the compositional framework. By recalling itself in different

orchestration settings or in different variations in length or pitch dispositions, the theme surveys the limits of a musical setting and its compositional constraints. Articulated material emphasizes the borders of an outside-time structure and forms perceptible pillars of a musical edifice.

Vaggione's network is thus fully shaped and pronounced by using morphological and articulation principles. He constructs complex compositions in which the hierarchy of density and time is broken. The network creates a musical structure while interacting with these principles. Density creates time structures and concomitantly time creates density structures. The music expresses itself fully mastered but nevertheless derives from a method where a hierarchy is absent.

> *"Only music that is fully mastered can itself be free from all constraint, including its own....The task of informal music would be to positively surpass those now counterfeit aspects of rationality. Only a completely articulated work of art provides the image of a non-mutilated reality, and at the same time of liberty."*
>
> Theodore Adorno (Solomos 2005, p. 320)

Xenakis.

The idea of filling up time with density structures attains a more lucid hierarchy in the compositional methods of Iannis Xenakis. In 1954 he introduced stochastic theory which is a compositional theory based on generating density structures. Stochastic theory uses probability to distribute an amount of events over a time interval. The distribution determines events to follow a mostly logical progression. Xenakis made a collection of pieces using this technique, we will discuss a couple of them.

> *"These sonic events [mass sound events] are made out of thousand of isolated sounds; this multitude of sounds, seen as a totality, is a new sonic event. This mass event is articulated and forms a plastic mold of time, [...]"*
>
> Iannis Xenakis on Stochastics (Xenakis 1992, p. 9)

Metastasis (or "transformations"), composed in 1954, is the first work in which stochastic techniques are used as a predominant structural element. In this piece Xenakis uses stochastics to create mass sound events within a preconceived macroscopic form.

Figure 2.2: Metastasis by Iannis Xenakis. Mass events within a pre-conceived form

Metastasis is Xenakis' first attempt at creating 'living sounds'. His desire was to create compound sounds like rain, hail or the song of cicadas in a summer field which were dynamic and yet inherently beautiful. These sounds are not static, they rather grow, swell or transform (Xenakis 1992, p. 9). He wanted to inject his music with that organic sense of plasticity. A 'living sound' is one that is constantly evolving and morphing. Xenakis saw density treatment as one of the most important tactics in creating such sounds. Nevertheless he understood that to control density he had 'to control so many parameters that only probability could help' (Varga 1996, p. 73).

Next, in 1956 Xenakis composed Pitoprakta (or "actions by probabilities") for string ensemble trombones and woodblock. In Pitoprakta he wanted 'to process the problem of mass more thoroughly' (Varga 1996, p. 75). He drove stochastics even further by using specified calculations for probabilities. For

example, in measure 53-60 Xenakis uses Boltzmann kinetic gas theory to calculate the probability of pitch and occurence of pizzicato notes in the string ensemble. Stochastics guide the 'atoms of music', without absolute precision, but for artful moulding of an aggregate. Importance was not given to the individual event, but instead to its frequency of occurence, intensity and duration in comparison with what else was happening around it (Zimmerman, p. 8). The formal construction of Pitoprakta is a juxtaposition of sound mass events imbedded in a macroscopic time-structure.

A year later Xenakis composed Achorripsis. He created this piece after having answered his mind boggling artistic question, "What is the minimum of logical constraints necessary for the construction of a musical process?" Through his stochastic approach he was able to answer this question by conceptualizing form as a relationship between time and density.

> *"In our desire to create sonic complexes from the temporary accepted primary matter of sound, [...] and to create sonic complexes as rich as but more extraordinary than natural sounds [...], we have implicitly recognized the importance of three basic factors which seem to be able to dominate both the theoretical construction of a sonic process and its sensory effectiveness: 1. the density of the elementary elements, 2. the topographic situation of events on the screen, and 3. the order or disorder of events."*
>
> Iannis Xenakis (Xenakis 1992, p. 58)

The first factor obviously reflects the density or amount of events, the second on their distribution inside a time interval, and the third on morphological or articulated characteristics. While composing Achorripsis, Xenakis applied the law of Poisson, which predicts the probability for multiple occurences of an event over a given time interval. In opposition to his former stochastic approaches, the Poisson formula allowed him to look at probability macroscopically (Zimmerman, p. 8). Consequently he was able to establish relationships between simultaneously occurring relative density. He had achieved a formal construction, using density as an organizing concept that created temporal relations between events.

" During successive rehearsings the relation between the events of the sample ordained by "chance" will form a network, which will take on a definitive meaning in the mind of the listener, and will initiate a special "logic", a new cohesion capable of satisfying his intellect as well as his aesthetic sense; that is, if the composer has a certain flair."

Iannis Xenakis (Xenakis 1992, p. 18)

Later on, Xenakis extended his stochastic density theory into the digital domain. First he programmed the stochastic music program which computes distribution probabilities for scores or eventually electronic sounds. Afterwards he programmed GENDY, which stochastically synthesizes a sound file that stands alone as a piece of electronic music.

Guillaume de Machaut.

Going back to the Middle Ages and enclosing the thesis' narrative of thought, a last view on the ballade Dame, de qui toute ma joie vient of composer Guillaume de Machaut will be discussed. Machaut is a contemporary of Phillipe de Vitry and lived about a century before Ockeghem. His usage of the Medieval techniques show some pivotal concepts pertaining to density. Two Medieval composition procedures will be discussed because they are important to understand the treatment of density: text-setting and of course, polyphony.

The text-setting in Medieval music was profoundly important. In contemporary music text-setting is not constrained with such high esteem, but in medieval music it was a key to access the different temporal levels.

Medieval music evolved from a chant composed for the purpose to transfer liturgical texts. We call this chant Gregorian chant. Initially these early hymns were composed in order to transfer the liturgical text as comprehensibly as possible. However due to a growing musical complexity, the musical priority shifted from text to melody. Music became more than just a vessel for liturgical texts and gained an individual importance. Nevertheless text was still to be set on this complex music and so likewise gained a creative exploration.

The setting of syllables of a text on a melody is called tessitura. A distinction can be made between syllables that are placed upon one note and syllables that sustain over a sequence of notes. If we compare the syllable to the contemporary music's 'event' we observe an important difference between writing a melody inside a syllable and writing a melody onto syllables. In fact medieval composers entered the micro- and mesoscale by taking the syllable as the line that seperates these temporal levels.

Writing a melody inside a syllable is mainly known as melismatic writing and can be understood as writing onto the micro-level. When the composer fills up a syllable with a melody, he fills in density on the microlevel. A very obvious medieval implication of this technique is troping. A trope sustains a given piece of music in order to fill its syllables up with other smaller pieces of music. It is an iterative process where a liturgical text is filled up with other liturgical texts in order to decorate or amplify the grace given to a deity. The text is used on different temporal layers in the musical architecture; it can be seen as a density structure which fills preconceived structural timeblocks.

In opposition to melismatic writing stands syllabic writing. Just as the name describes, syllabic writing means that each syllable gets assigned to only one pitch. There are no melodies inside a syllable. All writing happens on the meso level.

In contrast to tessitura, density on the macro level is simply controlled by the amount of voices. In Flemish polyphony, density on the macro scale is often managed by muting or activating certain voices. By reducing or enlarging a vocal group a refreshing disposition of energy is proposed which gives a new impulse to the music. (Arranz 2007, p. 47)

Another technique of enhancing musical presence without changing the amount of voices is counterpoint. When a number of voices perform together, it is possible to thin or thicken a density formation by means of counterpoint techniques. A strong counterpoint individualizes the voices and creates a sense of more density, while a weak counterpoint, (e.g. voices running in parallel) groupes voices together and reduces their musical presence. Counterpoint is thus not only a harmonic technique, it also controls the direction of movement between voices and in how these movements enhance or dilute their musical presence. Counterpoint is a technique for controlling density.

A technique which stands opposite to this macroscopic morphology, is a side-branch of tessitura. This technique articulates density structures. While setting text onto a polyphonic network, the rhythm of the text is different in the seperate voices. When the same text is used in all voices, it is often not read in a synchronous way, rather each voice reads the text at its own pace, adapted to the melody that it performs. Hence the offset of every syllable in each voice is different and creates a density to the articulated syllable unit.

Listening to Machaut's Dame, de qui toute ma joie vient remarkably clarifies the concretization of these techniques. This motet shows how morphology and articulated density structures layer onto each other and create musical directions inside a musical edifice. The ballade is incuded on the attached cd, track 03.

Dame, de qui toute ma joie vient was composed between 1342 and 1349 in the musical style of Ars Nova. It is noteworthy that the term 'Ars Nova' (Hoppin ..., p. 240) appear first in 1320 in the form of a treatise of the same name by Phillipe

de Vitry. The revolutionary innovation of this treatise is almost identical to Webern's book 'The path to the new music' which is published in the beginning of the 20th century and which refers back to Medieval Ars Nova techniques.

The ballade is in four part polyphony. [Fig. 2.3] The Triplum and the Cantus are the two upper voices and the Contratenor and Tenor the lower. Regarding density we can see that the upper and lower voices are divided in two density groups. The mean amount of eight-notes is larger in the upper voices, giving them a higher density while in the lower voices second and fourth notes are abundant.

More remarkable, the timestructure of the piece seems to be an alternation of segments of morphological and articulated density structures. A morphological segment is created by sustained flowing melismatic melodies which cause little dissonance between each other. [orange]

In opposition to that, the articulated sections are formed by jumping syllabic notation. The articulated voices do not correlate, instead they are interspersed by hocket techniques. When the tessitura articulates them it causes in the melodies a spasmodic or interrupted effect. [green]

These sections are seperated by blocks of sustained consonant intervals (mostly fifths). Such sustained chords are musical orientation points in which all voices synchronize. They articulate the borders between density structure and prepare the listener for the next to come. They set the time-intervals of the preconceived macroscopic structure. [yellow]

In the next chapter a hypothetical summary of the advantages concerning polyphony will be given. It shows how polyphony is capable of creating density and time structures which function as a comprehensible vessel for artistic poetics imposed by the composer.

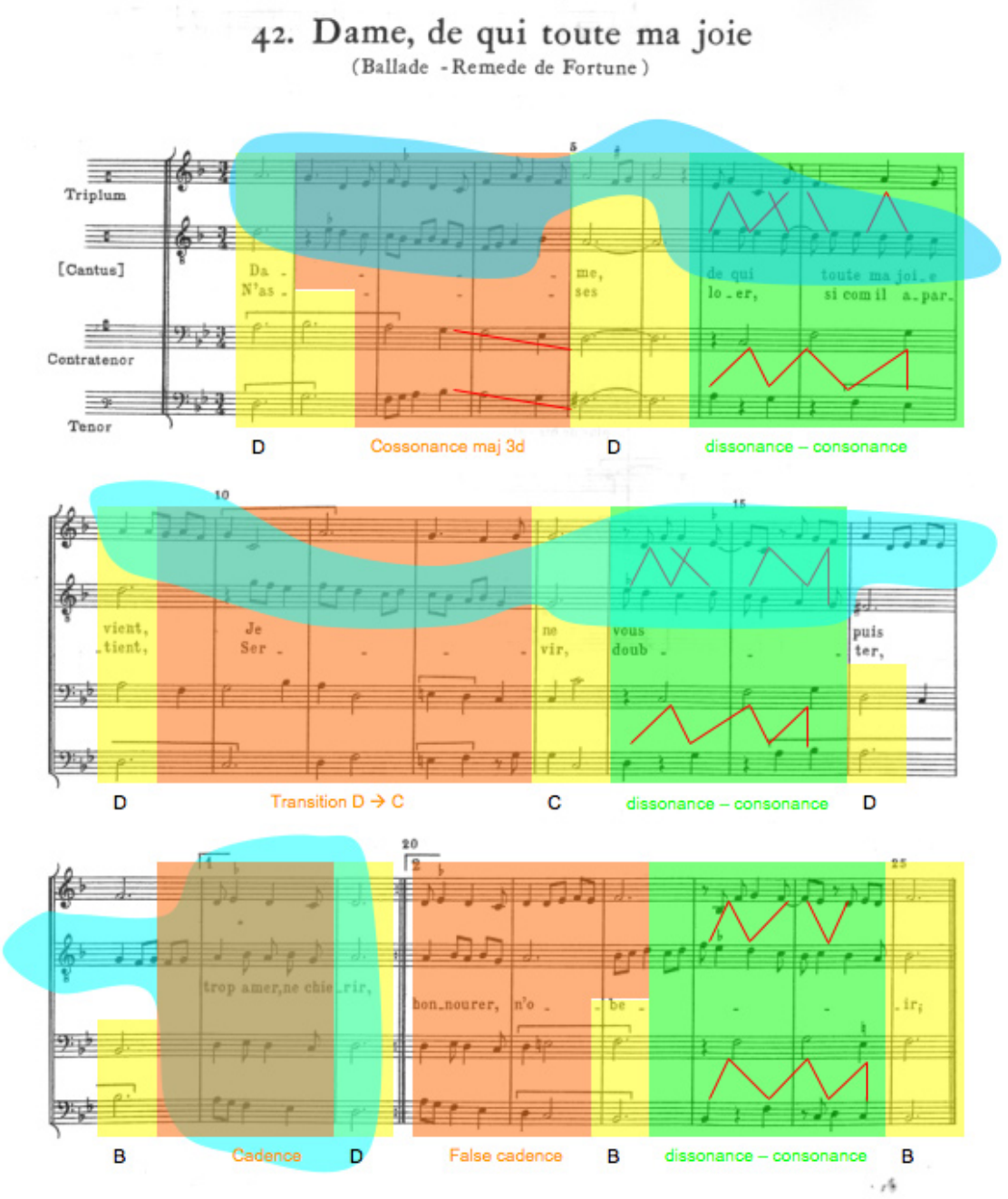


Figure 2.3: Transcription and analysis of Machaut's Dame, de qui toute ma joie vient [included on CD, track 3]

chapter three: Conclusions on polyphony

a hypothetical summary.

The first chapter elucidated strategies of building outside-time compositional structures, then the second chapter explained the concretization of such structures by the use of density. This last theoretical chapter will focus on the concept of polyphony and its advantages in a compositional setting.

Firstly a connection is to be drawn between Medieval polyphony and stochastic music composition. Both compositional strategies are made to conduct a congruity between multiple sound sources in order to create specific masses of sound. Furthermore they both conduct sound sources in a nonhierarchical manner. This means that all soundsources are regarded as equal; there are no submissive functions between them. Regarding this refusal to inner functionality we see how Medieval polyphony and stochastic music differentiate themselves from 17th to 19th century music philosophy. Baroque, classicism and romanticism focus on harmonizing a single melody line, they are built on a clear hierarchical strategy. Instead, Medieval polyphony and stochastic music focus on composing form in which they can guide a multitude of equally important sound sources.

Also an opposition can be made to show the relevance of polyphony in contemporary music aside from stochastic theory. Stochastic theory works with probability. It sets a time interval and specifies with algorithms how an amount of soundsources is distributed inside it. The congruity between the sources derives from the collective direction that the distribution specifies. The mass is seen as a rudimentary mould by which the overall shape bears most importance. Xenakis states that 'microsounds and elementary grains have no importance on the scale which we have chosen' (Xenakis 1992, p. 50). Opposed to this, polyphony creates articulated interactions between the sound sources in a mass. Polyphony considers the mass as a place where articulated material (motives, figures, articulated events) transfer and relocate between sources. Polyphony articulates the inner space of a macroscopic shape.

Each voice inside a polyphonic structure owns a separate time and density structure. Although derived from one 'subject' (e.g. a Gregorian chant) all voices attain an individual procedure. Polyphony layers these procedures by which the themes and their modifications are drawn in perspective to one another. Since time does not evolve in only one line, but in a simultaneity of asynchronous lines, the metrical axis is nonlinear. Instead a new parameter grows, a dimension which

draws connections between the procedures of the voices. Webern called it a dimension of depth (Webern 1960, p. 19).

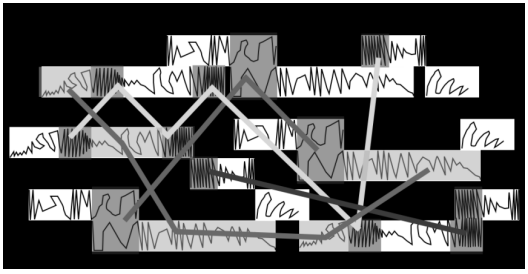


Figure 3.1: A polyphonic network creating a dimension of depth

Due to a multitude of simultaneous representations, the subject of a composition does not conform to a single voice, it decentralizes. The hierarchy between the voices is broken and consequently there is no hierarchy between the different procedure. Music does not focus on the subject, but on the management of voices and hence on mass and its interaction. Composition brings a structure into being and does not need narrative connotations to communicate. The structure already means by itself.

The interaction of time and density give ground for a continuous coherence in a musical work. They construct musical edifices upon which music can be projected. Nevertheless these terms resolve structural decisions and do not yet imply poetical art. A poetical presence is yet to be superimposed by the composer. Nonetheless, the construction of a coherent musical structure suggests a communicative language towards the audience. This has effect on the comprehensibility of the composer's poetical language. Briefly, a coherent structure proposes comprehensible poetics.

> *"In addition to these two modes of activity – inferential and experimental – art lives in a third, that of immidiate revelation that is neither inferential nor experimental. The revelation of beauty is made at once, directly, to the person ignorant of art just as to the conoisseur. Revelation makes the force of art and, it seems its superiority over the sciences because, living in the two dimensions of the inferential and experimental, art posseses the third possibility, the most mysterious of all, the one that makes the object of art escape any aesthetic science, all the while indulging in the caresses of the inferential and experimental."*
>
> Iannis Xenakis (...., p. 173)

chapter four: Reflections on ‘Forty-part Motet’

introduction.

This chapter gives a description of my applications of the techniques described above. I illustrate them with a piece called ‘Forty-part Motet’ which I have composed in January/ March 2009 for the NoWFS concert.

Forty-part motet is a composition which is inspired on the forty-part motet Spem in Alium written in the late 16th century by Thomas Tallis. In this motet Tallis creates a polyphonic structure of forty voices. In order to attain control over such a large quantity of voices, he designs a strategy which divides the forty voices into smaller workable units. Consequently Tallis is able to compose conveniently on the smaller units without losing an overall musical congruity.

In an attempt to translate this concept into electronic music, I approached this construction with a similar strategy. I combined forty soundsources by deviding them in eight groups of five. Each group forms an individual entity and simultaneously a supportive base for the other groups. A bilateral conditioning of time and density offered me a system in which I was able to compose macroscopic tendencies without losing detail on the microlevel. By setting up a strategical flowchart, five voices undergo a sequence of modifications by which they blend into a five-part polyphonic structure.

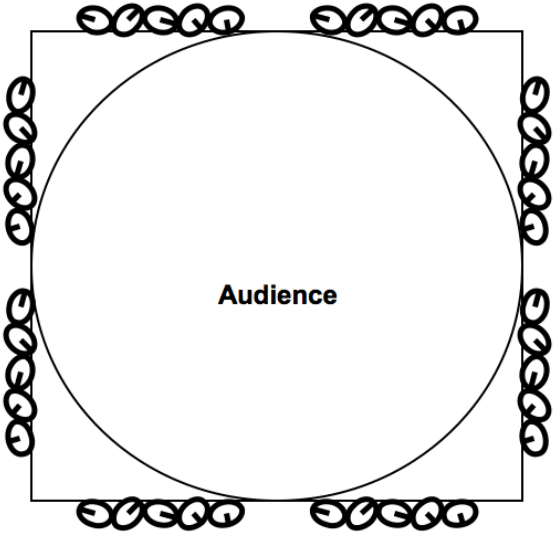


Figure 4.1: Forty voices organized in eight groups of five around the audience.

creating a polyphony.

Before going through the steps that create the polyphonic interactions, I want to go through a brief recapitulation of the important musical tenets that define polyphony. It will explain some of the decisions I made while construction the system for Forty-part Motet.

An obvious aspect to recapitulate is the individuality of each voice in a polyphonic structure. Each voice needs to perform a process that is separate from the other voices. This means that each process is not only different from the others, but it also develops in a way that is unique to itself.

Another important aspect is the congruity between the voices. The voices need to interconnect and yet be independent. They need to form a collective musical base on which they can freely move as well as comfortably recline. They build a musical structure together in which they coexist but still state their independence. Unison is not of order, instead the idea of a system or network is applicable. Such a system can in my opinion be built using two methods. I call these two methods 'pre-polyphony' and 'post-polyphony'.

Pre-polyphony is established before the voices sound. The polyphony is partly created by preconceived guidelines that move the voices in a similar fashion. The voices obey the same algorithms and stochastic decisions separately, and thus show similar tendencies. By creating coherent individual behaviors, a certain polyphonic support is established. Nevertheless while running these algorithmic routes in parallel, the voices can interact before translating their data into sound-control. By keeping each other in regard, the algorithms adjust weighted choices within the preconceived guidelines in order to direct them towards a congruent coexistence. The polyphonic interaction takes place before the voice sound.

Post-polyphony is established after the voices sound. The voices analyze each other and consequently readjust their musical state towards a congruent coexistence. They adapt themselves in order to correlate with each other. The voices need to sound before the polyphony can take place. For a successful programming of this method a strong analytical device and intricate mapping to synthesis are needed.

My composition combines the two methods described above.

In the programming domain I work mostly with pre-polyphony.

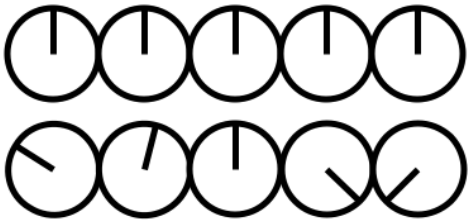
Since I do not need to worry about a complex analysis device, pre-polyphony is technically more appealing. It keeps the thought of composition on an abstract level. The voices do not need to sound prior to their interaction, compositional thought takes place prior to the music being generated. This opens up the realm for experimentation on musically suggestive algorithms that accomplish a satisfying polyphonic interaction.

After generating such interaction with MAX/MSP I enhanced the polyphonic interaction by manually articulating specific aspects inside the sound files. This is thus a non-live post-polyphonic action that – regardless from its complex name and yet simple action – adds extra eloquence and comprehensibility to the polyphony. This was done by sequencing and readjusting quantity, amplitude and occasionally filter settings of the voices.

composition.

As mentioned above, I divided the forty voices into eight units of five voices. Consequently two types of polyphony established themselves. A micro-polyphony controlled the voices inside one unit and a macro-polyphony managed the interaction in between the eight groups.

micro-polyphony.



'It's like various platforms revolving around the same axis at different speeds'.

Ernst Krenek (Krenek, 1962, p. 46-47)

Five voices construct a polyphonic unit. A system is created in which five parallel processes support one another by readjusting themselves to a congruent coexistence. Each process undergoes a sequence of steps. The steps interconnect the separate processes and promote coherent behaviors.

I designed the following steps that each voice in a unit undertakes.

1. Each voice has a voice-buffer from which it acquires sound material. All voices reassemble that buffer from four other precomposed buffers. By use of weighted choice the material in each buffer is distributed differently. [Fig. 4.2]

2. The second step decides on how each voice reads through its buffer. Two important elements are the location of the read-interval and the speed which the voice reads through that interval.

   a. The speed is the most obvious perceptive element since it controls the pitch and timbre of the resulting sound. The speed results from two decisions. First I use Markov-chains to create a coherent sequence of speed intervals. By running parallel Markov-processes over the same initial list, the information from the initial list is recycled and reorganized

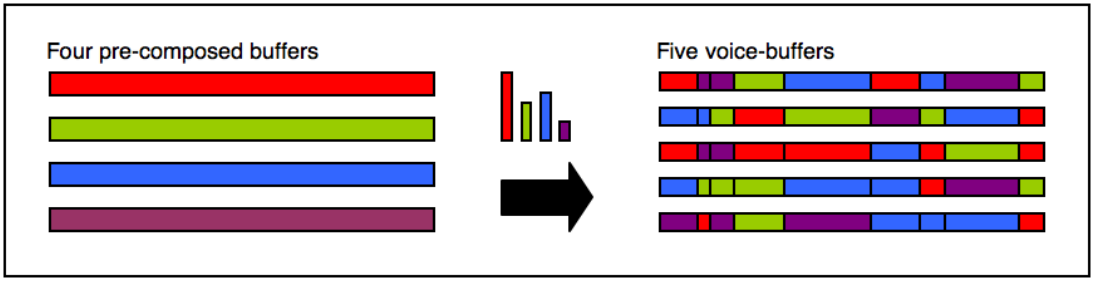


Figure 4.2: Creation of voice-buffers

in five different processes. A deceptive imitation structure arises in between the voices. The orders of the Markov-chains are variable over time by which the amount of imitation in between the voices is controllable. The resulting information is mapped over a series of preselected speed-values translating the chain into speed (or pitch) sequences.

b. Furthermore every voice functions in a specific speed mode. It can operate in prolatio, tempus or modus mode; fast, medium or slow speed respectively. This is an immediate translation from the Medieval mensural system which gives access to different temporal developments in a voice group. The speed interval between these modes can be controlled and ranges from the unison (same speed) to the octave (twice faster or slower).

c. Second step is choosing the read-interval. The startpoint of the read-interval is set by the location where the voice arrived after its former read action. The destination point however is determined according to settled location points. One series of location points is chosen by the composer, another is recorded when distributing sound material over the voice-buffers. The composer sets tendencies between the two series and the point inside them by controlling the weight of choices.

Each voice has a carefully chosen speed-value and destination-point. Guided by varying weighted choices the voices undergo an abundance of temporal modifications such as augmentation, transposition, diminution, reversal and combinations thereof. The density inside each temporal sequence is decided on at the first step when creating the precomposed buffers. These can vary in length and obviously sound material. Each voice can adjust a different setting in reassembling its buffer by which an individual density behavior can be enhanced. Furthermore each voice can be muted or activated each moment of the process.

3. The last step decides the postproduction of each voice which is mostly done manually. This includes modifications such as amplification and occasionally filtering.

Although every step seems rather simple, the combination of all delivers a highly interconnected structure. By recycling the same sound material the voices attain a coherence. They connect on moments where they share the same initial buffer. The sound material shifts over the voices by which they connect to each other.
Furthermore by interconnecting the Markov processes a coherence in movement and speed-sequences establishes. The voices transfer musical figure that modify over time. One unit-fragment is included on the attached CD. Track 5, 6, 7 and 8 are four separate voices, and track 9 is the result of the total unit.

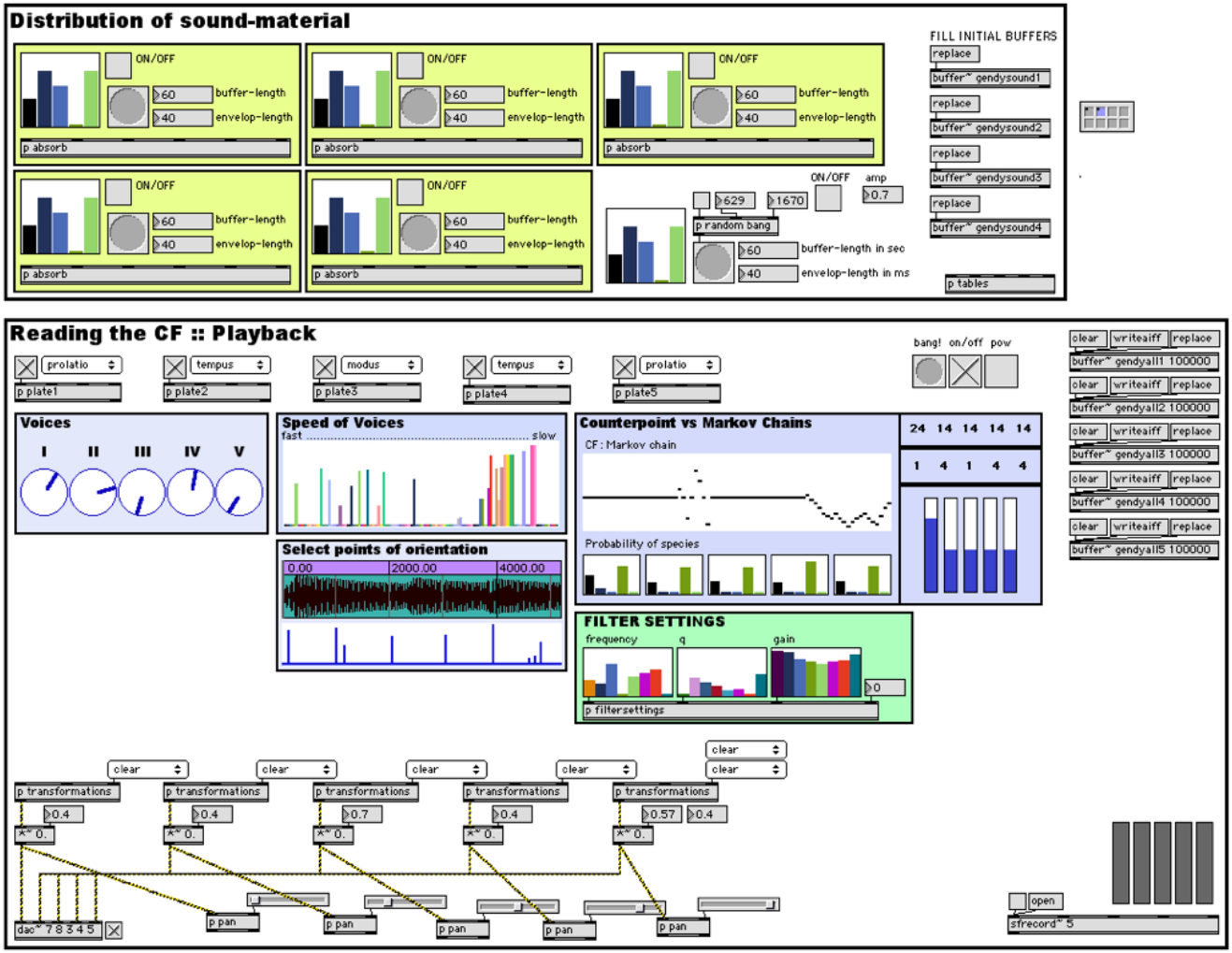


Figure 4.3: Main patch to create a unit

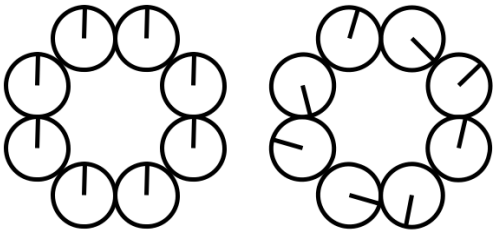
macro-polyphony

The macro-polyphony takes place in between the eight units that are located around the audience. This polyphony was composed after a variety of material inside the units was created. While composing I approached the micro-polyphonic material from a macro-scopic level. I was free to compose the density and time by creating sound-masses and collective gestures that contrast one another.

I analyzed Thomas Tallis' Spem in Alium and reinterpreted his composition into an abstract score that I used to guide my motet. By simplifying the rather large composition I discovered how musical sections are sequenced in an ambiguous sonata structure.

1. Opening (A)
2. Repetition of opening (A')
3. Development (B)
4. Reprise (A'')
5. Coda (C)

The sections do not respond to any kind of melodic development Tallis shows no tendency towards this classical conception, instead density and behavioral aspects govern his composition. The sections define their character by creating tendencies in quantity and correlation between the voices. Furthermore each section moves over a distinct spatial path. The opening section rotates over the full circle, the development jumps in between the choirs, and the coda uses all voices together.
Each section is enclosed by a moment of unison between the forty voices. These points of total synchronization clarify the sections and set compositional pillars.



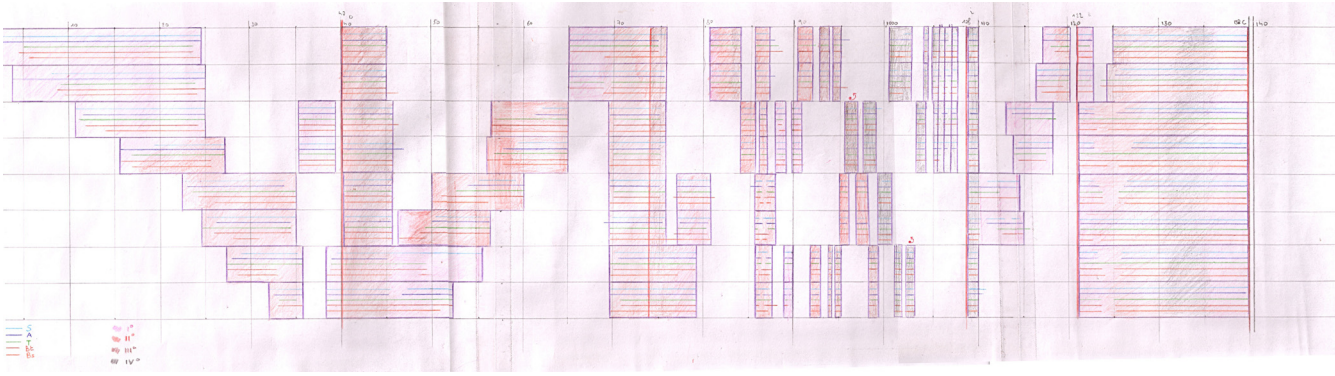


Figure 4.4: Interpreted translation of Tallis' Spem in Alium. The 8 choirs are spaced underneath each other.

APPENDICES

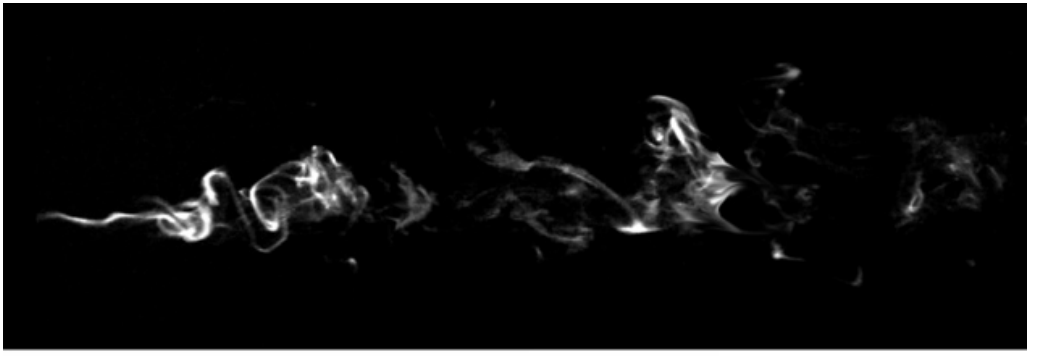
Appendix I

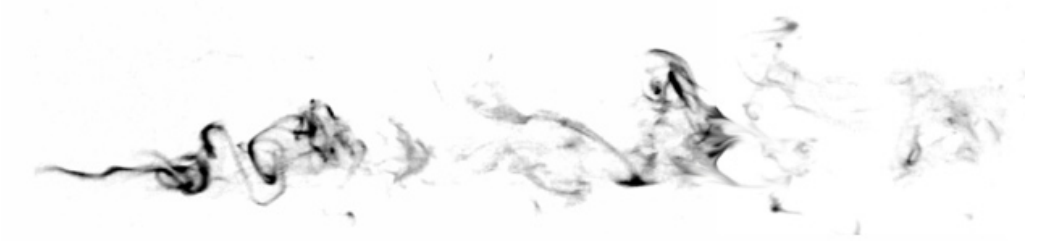
A collection of my most prominent works created during my study at Sonology.
[2005 – 2009]
I ensure that I produced the works in the portfolio unless when a collaboration is mentioned.

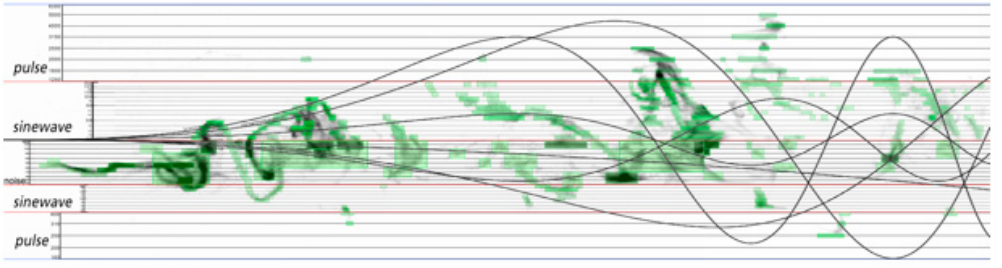
Inside Sonology

Smokesounds

Smokesounds is a composition made in the analog studio. The piece translates a picture of smoke into an electronic music composition. The aim is to recreate the volatile behavior of smoke and translate this into music.

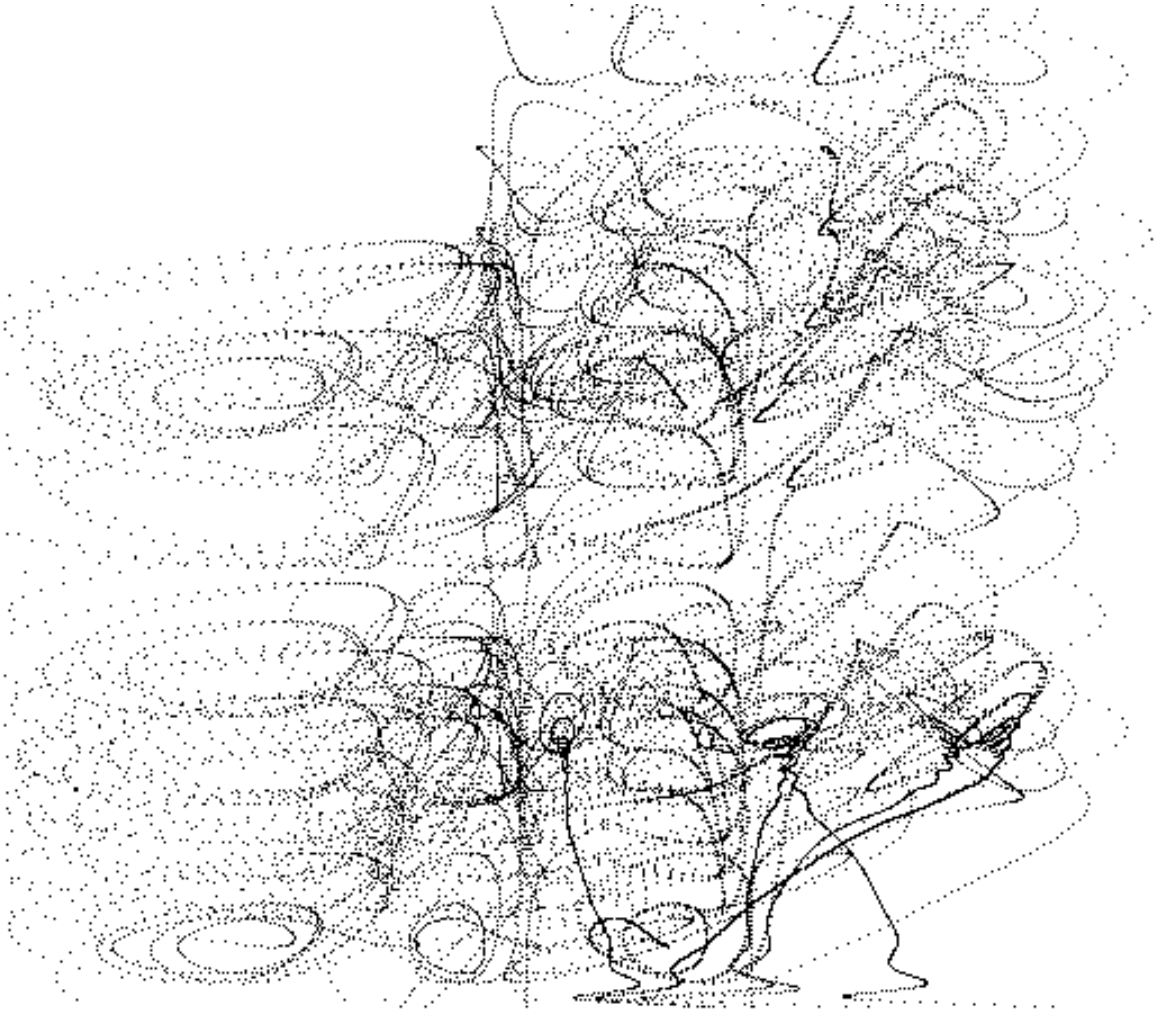






Smoke-patch

This work was a continuation on the idea of smoke-movement. I wrote a soundsynthesis program in MAX/MSP based on the Navier-Stokes vortex algorithm. It provided me from a smoke-movent inherent to sounds created.



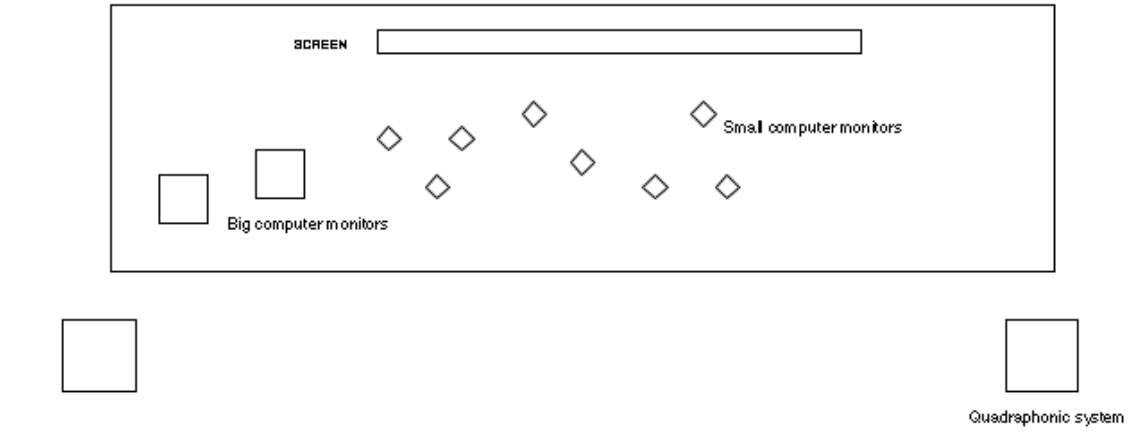
Interlude 28Oct. Music and film.

[included on DVD]
Using 8 small computer speakers and 2 active monitors on stage
+ the quadraphonic system in hall.
Film of flocking birds over the city of Brussels

Stage setup Interlude 28okt.

The small sound-events in the beginning of the piece are distributed over the small computer speakers, creating a herd of little clicks and noises.
The tones start in the active speakers on stage and are gradually taken over by the quadraphonic surround sound-installation. The Audience gets absorbed in the soundscape and mediates in a counterpoint between the music and the flock of birds.

Setup:

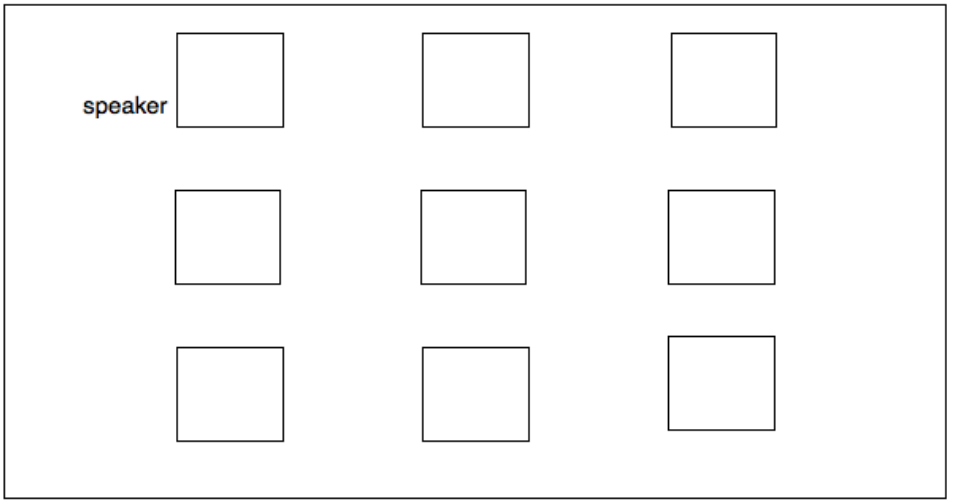


9SPP. Music for 9 speakers

Stage setup of 9SSP, 9 Speaker Piece

The speakers are set-up on a stage like a choir. The audience is sitting very close to them. The set-up makes place for a peculiar movement of the sound in space. Each speaker obtains its individual character at the start, but this situation is broken during the development of the piece. The speakers start sharing sounds and break their personal profiles. Through ambiguous distribution of sound-material, the borders between the individual speakers are broken. By creating false soundsources, music elevates to an unrealistic level in which the polyphonic interaction steps outside of its given sources.

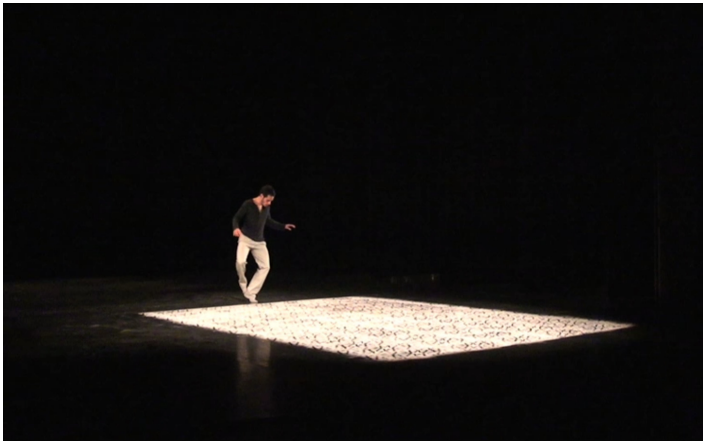
Setup:



Dancepiece: Carpet III.

Music, dance and sculpture in collaboration with Nika Neelova and Nitay Lehrer.

[included on DVD]
The decomposition and recomposition of a sculpture by means of dance and music.

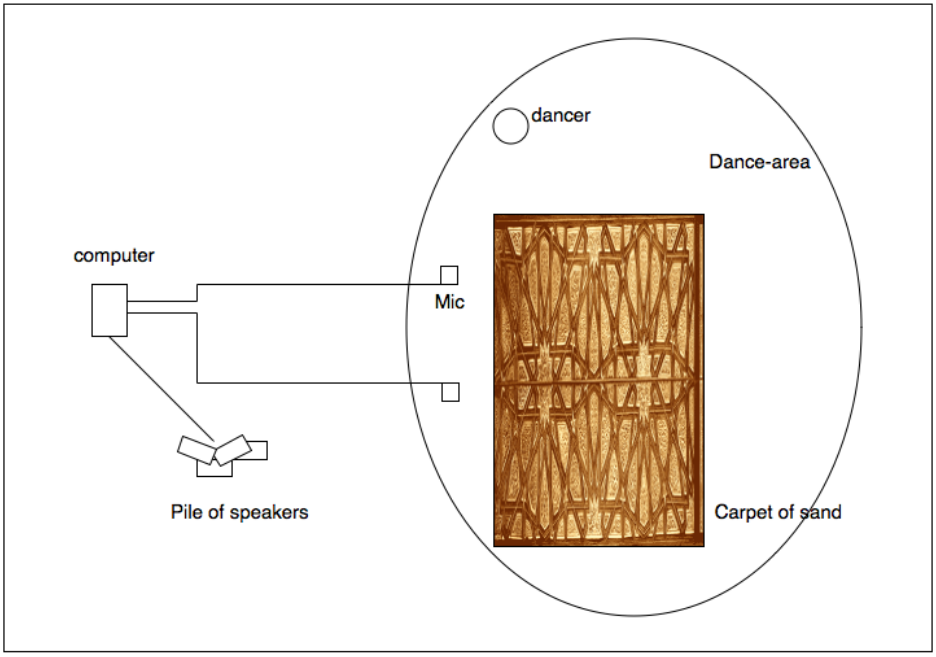


Stage Setup of Dancepiece:Carpet III.

The dance piece is governed by a few principles.

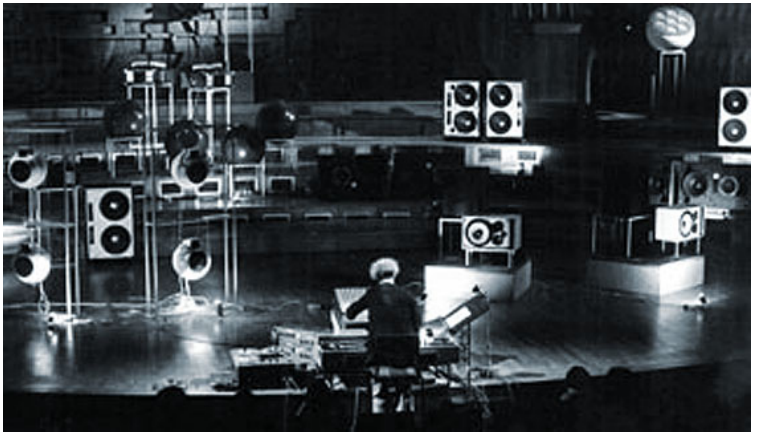
1. The choreography is an attempt at creating polyphony inside a dancer. Based on Laban's theory of tendencies, the dancer operates several specific characteristics simultaneously in different points of his body. These characters are able to travel over limbs and eventually over space inside and outside the body of the dancer.
2. The carpet exists out of sand that is organized by a geometric ornamentation of an ancient Arabic floor-pattern. The dancer destroy the detailed sandsculpture by dancing over it, leaving its traces of destruction.
3. The music derives from the sound that is created by the friction of the dancer and the sand-carpet. It is processed and played back over a pile of speakers. The speakers are set up next to the carpet, forming a second personality on stage.

setup:



AUDIENCE

6SPP. Music for the acousmonium

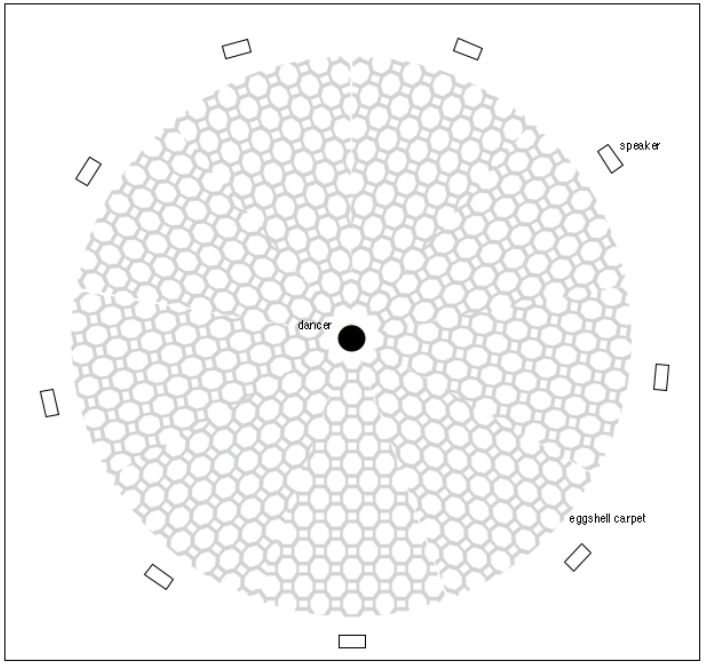


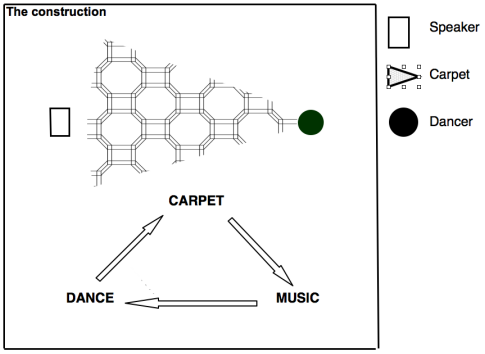
Forty-part Motet. Music for the NoWFS system

Dance-piece: Carpet IV.
Music, dance, sculpture in collaboration with Nika Neelova and Pedro Goucha.

Stage Setup of Dancepiece:Carpet IV.

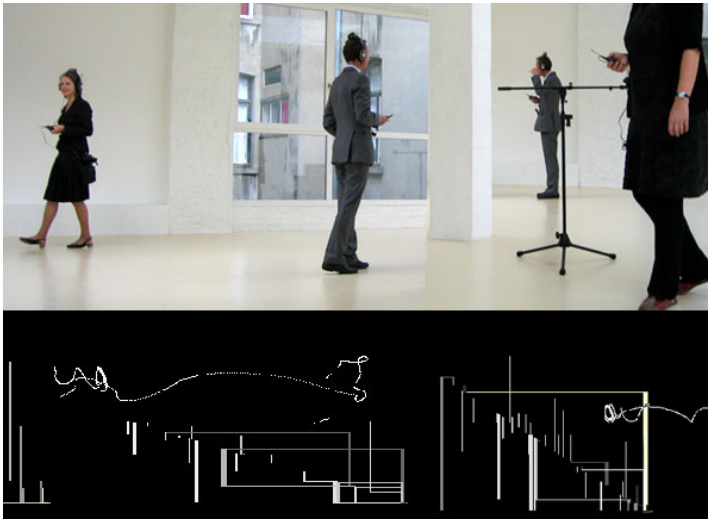
The three disciplines (dance, music and sculpture) move towards selfdestruction by influencing each other in a feedback loop. The dancer destroys the carpet by dancing on it. The sound of the carpet is recorded and destroys the music by digital means. And likewise does the music alter the dance. They are inter-connected and create an inter-disciplinairy counterpoint.



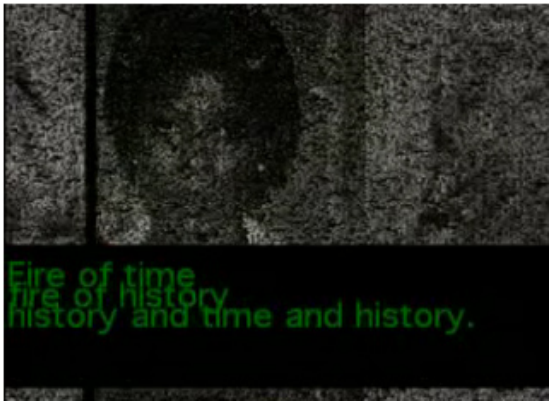


Outside Sonology

NoToVo. Interactive installation in collaboration with SO-ON vzw



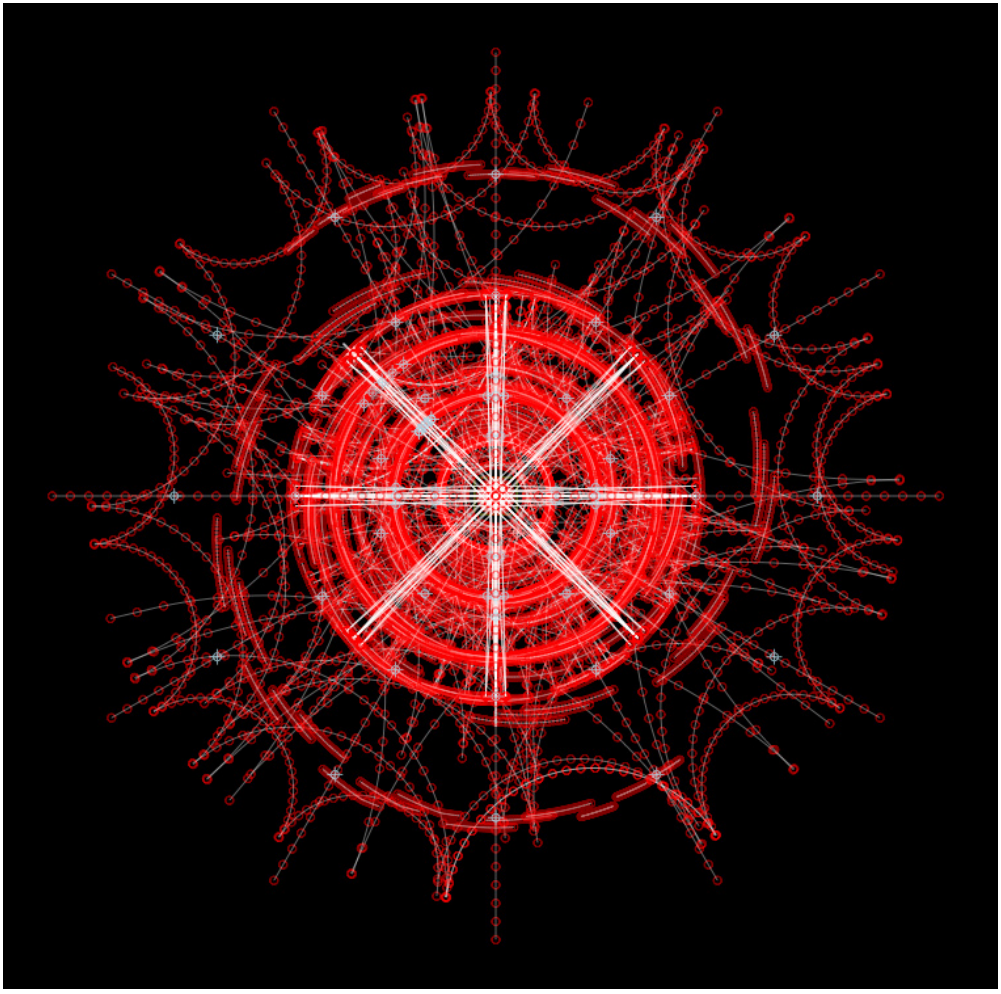
Peopledatabase slowscan transmission mode.
Interactive movie with So-on vzw
So-on.be, media arts collective, Brussels.



Sternenrest.

A musical work based on astronomical research by Wim Boogman.

Electronics for the Wave Field Synthesis system.
Sound system consisting of 192 speakers.
www.sternenrest.nl



Tin Mahila.
An experimental documentary on women empowerment in India by So-on.

Creating an electronic soundtrack based on the sounding environment of Barefood collage, where the documentary takes place.

www.so-on.be

Appendix II

Content of the included CD and DVD

CD.

1. Phillipe de Vitry - In Nova Fert
2. Johannes Ockeghem – Missa Prolationum Kyrie I
3. Guilleaume de Machaut – Dame, de qui toute ma joie vient
4. Thomas Tallis – Spem in Alium
5. 40-part motet – fragment: voice I
6. 40-part motet – fragment: voice II
7. 40-part motet – fragment: voice III
8. 40-part motet – fragment: voice IV
9. 40-part motet – fragment: all voices.

DVD. portfolio

Movies:

1. Dancepiece: Carpet III
2. Dancepiece: Carpet IV
3. Interlude 28Oct.

Music:

1. 9 SSP
2. 6 SPP
3. 40-part Motet recording
4. 40-part Motet stereo

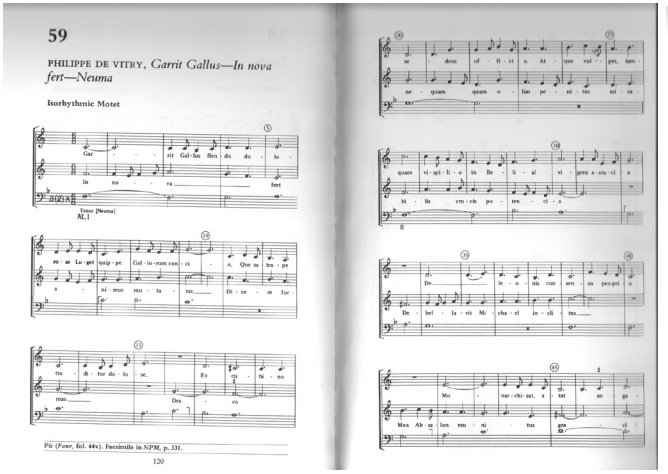
Pictures

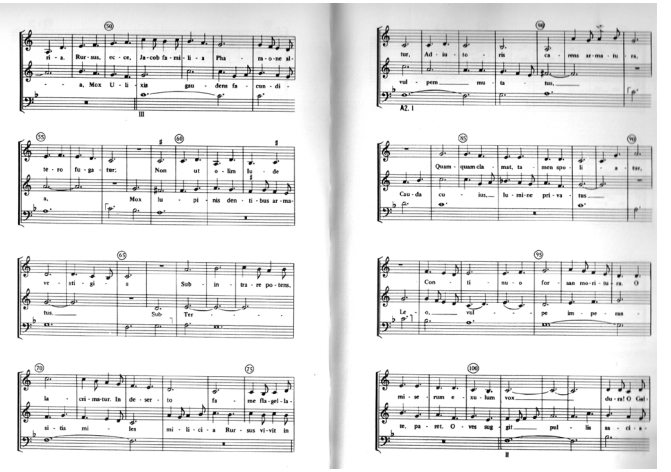
1. Dancepiece: Carpet III
2. Dancepiece: Carpet IV
3. Interlude 28Oct.
4. 9SSP

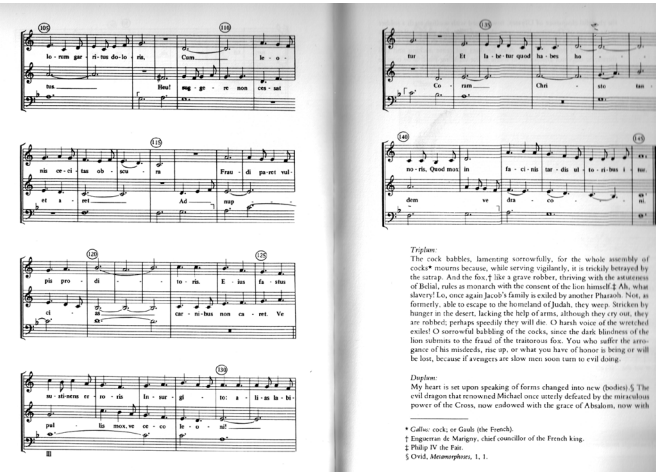
Appendix III

Phillipe de Vitry, Garrit Gallus - In nova fert – Neuma

An isorhythmic Motet from the 14th century. Rhythm generated with the techniques disussed in Chapter I. Motet is included on CD, track 1.







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