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An Algorithmic Approach to the Generation of Non-Developing Musical Structures

Submission for a Ph.D. in Music Composition

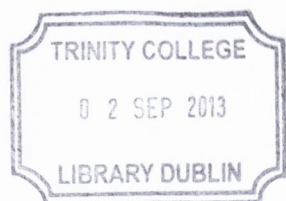
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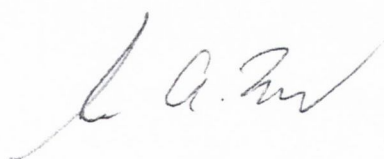
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Summary

Problem statement: It has been the goal of the author to develop an individual style of musical composition that reflects the personal tastes and convictions of the composer while maintaining relevance to contemporary, recent historical, and traditional issues surrounding not only music and art but also areas such as technology and philosophy.

Objectives: The aim has been to achieve such an individual style by developing an approach to structure, motive, and repetition which lies between *narrative* and *moment* form. The style to be developed would be characterized by repeating melodic gestures that are to be conceived as a non-developing series of moments, a rejection of subjective expression while preserving more general emotive qualities, and an underlying, linear harmonic sequence founded in voice-based, step-wise motion within expanding and contracting degrees of polyphonic density.

Solution: An algorithm has been written in the Lisp programming language using the Common Music programming environment by Rick Taube. This program generates empty structures, a harmonic sequence, indications for varying polyphonic density, and directions for motivic repetition. The program takes as its basis a number of probability tables derived from the analysis of techniques by other artists. In the case of instrumental works, the empty structures have then been filled in intuitively. In the most recent form of the algorithm, the structural aspects

of works for fixed-media electroacoustic compositions have become highly automated. The algorithm can be used for tape pieces, instrumental pieces, live-electronics, or compositions combining all three of these components.

Possible future work: The work undertaken has resulted in several very successful compositions, primarily of no greater length than 11 minutes. Next steps will include in-depth consideration and development of approaches orchestration and macro-structures. Other next steps will include a refinement of the algorithm through restricting the lower ranges of the harmonic progression created by the algorithm to greater intervals, especially for instrumental works (more effective orchestration). Programming code will be written to allow the definition of rhythmic motives in conjunction with automatic pitch selection for these rhythms based on the harmonies generated (MIDI output). Ultimately, the goal is to strive for a more intuitive implementation of this approach, perhaps doing away entirely with the automatic generation of structure and pursuing the same approach intuitively.

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1

Introduction

Every composer strives for original approaches to structure, form, material and method in his or her music¹. These are influenced by a fifth aspect of music, namely its intended function. Composers will value a music which is relevant to, among other things, the sociological, technological, philosophical, and political aspects of their time while expressing their own interests and tastes and broadening the perceptions of the composer, other artists, and the general public. Any artist will also endeavor to consciously create work that opens doors for further work within his or her own compositional undertakings as well as that of future artists from the same or other fields.

Being immersed in our own traditions and contemporary standards, it is often helpful to intentionally instigate the Unknown, the Unfamiliar, and perhaps even the Uncanny, through non-intuitive means for the sake of broadening the palette of structures, techniques, and sounds, as well as for the sake of stumbling upon crevices and crannies which may lead to larger paths that can be forged or followed. The use of technology can be of great assistance in such endeavors, in particular the use of computer algorithms.

In this light, the research undertaken for this dissertation has had as its

primary goal the creation of individual approaches to musical structure and various implementations of musical repetition within a function founded in Western European concert tradition. Secondary goals have included embracing various aspects of modern and postmodern thought, such as discontinuity, pluralism, juxtaposition of old and new, and appropriation.

Following years of composing with no motivic repetition, the author of this dissertation has made an intentional return to the integration of such repetition in his music. This return has been undertaken with the explicit goal of expanding the function of structure and repetition in the author's own compositions to transcend traditional motivic-thematic development and variation.

The underlying aesthetic framework for this approach to repetition and structure involves a basis on melodic, phrase-oriented gestures, an emphasis on a series of gestural fragments that are intended to be conceived and perceived more as a collection of consecutive moments than the fulfillment of a grand narrative, an avoidance of subjective expression without departing from general emotive qualities², and the use of a large number of motives that are to be multiply layered and repeated in a non-developing manner. Many aspects of the composer's previous work were to be preserved, such as a preference for simultaneous melodic components (polyphony) with precisely notated near-exactness (which he refers to as *precise imprecision*), and rhythmic figures that obfuscate any sense of meter. In short, the goal was to create a highly repetitive music, whose repetitive quality is obscured by the large number of elements being repeated, and which hovers somewhere between traditional, linear approaches to structure and what has come to be known as *moment form*³.

The stages of the composer's endeavors progress from the use of improvised fragments to an algorithmic generation of structure. The works composed within this progression have moved from those of non-repeating, freely composed gestures, to modular structures, to repetitive structures with a traditional harmonic basis, to repetitive structures with a polyphonically constructed harmonic basis, and to an incorporation of this equal-tempered, polyphonic, harmonic motion into works for *fixed media*⁴, either as the electroacoustic part of works for instruments and fixed media or as

works for electroacoustic, fixed media playback alone.

One very important aspect of the artist's work has been the *quasi-* or *semi-*appropriation of the techniques of other artists, performed by analyzing their techniques to find the principles that govern them and implementing the essence of these techniques into his own work by using a self-programmed computer algorithm based on probability tables. One source of governing principles for his approach to structure and repetition, for example, has been the *Texts for Nothing* by Samuel Beckett (1906–1989). These texts exist within a structure that is located somewhere between prose and verse. They consist of long sequences of fragments of thoughts, rather than whole sentences, loosely held together and simultaneously semi-separated by commas rather than line breaks or periods. Their content is highly repetitive, but in a varied form; Beckett rewords the same basic phrase in many different ways. The texts also contain a large number of what could be considered *motives* if viewed from a musical perspective—words or phrases that refer to the same idea or concept, though they are different in themselves (the use of simple synonyms and antonyms being one example).

Beckett's texts provided a practical point of departure for the majority of the work undertaken in the scope of this research. This work was further conceptually supported by the influence of philosophers Jacques Derrida (1930–2004) and Gilles Deleuze (1925–1995), visual artist Robert Darroll (1946–), and the music and texts of composers Bernhard Lang (1957–), Anton von Webern (1833–1945), Luciano Berio (1925–2003), Steve Reich (1936–) and John Cage (1912–1992). Building on the work of Ferdinand de Saussure (1857–1913), Derrida contemplated the meaning of a sign within a system of signs as defined not by any inherent meaning, but rather by its *difference* from the other signs of the system (not by what it *is*, but by what it *is not*) and its *deferment* to an unattainable concept. Deleuze wrote a dissertation on the definitions of difference and repetition, in which he postulates that repetition can be viewed as something which takes place not only horizontally (i.e., the second of two consecutive signs being a repetition of the first) but rather also on the z-axis (i.e., both signs are the repetition of a non-material concept). Composer Bernhard Lang takes a radical approach to exact and differentiated repetition in his compositions, as influenced by

these two philosophers.

Webern addressed the necessity of repetition for comprehensibility in music. Steve Reich and John Cage inspire with their courage to pursue repetition and empty structure to consequential extremes. The work of visual artist Robert Darroll has given the author the opportunity to explore definitions and functions of structure and repetition in music by closely examining them in the context of time-based visual art (digital animation). He has also enabled the author to realize his techniques in the framework of collaborative audio-visual projects.

The author's use of algorithms to stimulate an expansion of his compositional approaches relates more to the domain of structure and less to that of content. In this context, the author distinguishes between two primary objects or concepts when the word *content* is used in reference to music. The first includes the *material* which fills the structures, such as pitch, rhythm and instrumentation. This can be referred to as *musical content*. At a second level, the word *content* is often used to refer to *extra-musical* meaning or interpretations which are often ascribed to musical passages, such as subjective emotion, atmospheres of piety or sobriety, patriotism, the embodiment of political views or concepts, or the communication or illustration of intellectual, theoretical or philosophical concepts. It is this second level to which the author is mostly referring when discussing *content* in this text.

In this light, the content of the author's musical compositions can be found to some extent *via negativa*, through his partial rejection of the concept that music on its own possesses the capacity to carry extra-musical content at all. This view is reflected in the author's practical implementation of positions concerning structure, subjective expression, authorial control, and interpretation. His preservation of emotive (rather than *emotional*, i.e. *subjective expression*) gestures enables an intuitive approach to pitch, rhythm and melodic shape, allowing him to fill in empty structures linked to meandering polyphonic harmonies by using compositional techniques from his previous work, new techniques he has developed in the course of the exploration, and the appropriation of techniques from other artists.

For the exploration of new (for the author) structures and their dependence on (differentiatedly) repeating motives, the Lisp programming

language, the *Common Lisp Music* programming package and Rick Taube's *Common Music* programming environment were used. The author has devised, developed, and continually extended and refined an algorithm which produces empty structures based on rules and parameters that have been gleaned from analyses of Beckett texts, the compositions of Bernhard Lang and Berio, and the orchestrational techniques of Arnold Schönberg (1875–1951). The current version of the algorithm produces a text printout with an overview of all the measures of the work to be composed, with indications for each measure concerning the duration of the measure, the number of instruments playing, the motives to be used in that measure, and the measure's underlying polyphonic harmonic basis. These empty structures are then filled in—composed—either with pitches and rhythms for traditional European orchestral instruments, or with instructions for the manipulation of computer-generated material for the creation of electroacoustic fixed media pieces, or a combination of the two.

The algorithm developed and the approach taken has led to the successful composition of over 15 works in the past four years, including instrumental duos and trios, fixed media pieces, works for fixed media and real instruments, multimedia installations, and a large-scale work for orchestra. Ten of these will be presented and discussed in this paper.

2

Background

The University Library of the University of Cambridge publishes online a list of modern composers whose work is intended to be acquired for the University Library's section of musical scores and recordings⁵. According to the site, the list is derived from the website of music distributor Harrassowitz⁶ and conforms to that site's categorization of composers into "well-known and prominent", "less well-known and established", and "other composers". The university then further divides the list into those composers of higher and lower priority for their teaching modules. The list encompasses more than 2000 entries, with 287 under the "well-known" category and over 300 on their high-priority lists alone. The author of this paper was still able to identify a number of composers with whom he is familiar that were not on the list (the majority of the most influential electro-acoustic composers of the past 60 years are not mentioned, for example), and he is only familiar with 128 of the composers listed as high priority. The birth dates of the high-priority composers span from 1845 (Fauré) to 1974 (Cattaneo); 115 of those composers are still alive and active, and 10 of those on the list have only died in the last 10 years.

The genres encompassed by this list of composers include but are not exhausted by Impressionism, Expressionism, Futurism, free atonality, twelve-tone techniques and Serialism, Neoclassicism, Neoromanticism, electronic music, electro-acoustic composition, acousmatic music, algorithmic composition, New Complexity, New Simplicity, Spectralism, Minimalism, Post-Minimalism, Conceptualism, Eclecticism, and Totalism, not to mention the fusions of Jazz, Art Rock, or World Music. Techniques span from fixed notation to improvisation to extended techniques, to computer generation and computer interaction, to site-specific sounds and silence. Each of these genres are still actively pursued today.

Considering the sheer number of individual composers, approaches, styles, and genres represented on this list and the fact that they are still actively represented by living, established, well-known composers, chapters on *Background* and *Related Work* in the context of contemporary classical music composition take on unrealistic proportions that go beyond the scope of a typical scientific dissertation. Instead of addressing each of these movements, trends and genres, the author will, therefore, briefly touch upon those that are most directly or most immediately indirectly linked to the development and praxis of his own composition, as well as those whose aesthetics, styles and artistic-political intentions could be seen to oppose the author's own approaches, but whose presence and impact are so strong and influential within the world of contemporary music composition that they compel any living composer formulate a position regarding them. Many composers whose work the author enjoys and appreciates and who have contemporary relevance, such as Giacinto Scelsi (1905–1988), Olivier Messiaen (1908–1986), Samuel Barber (1910–1981), Benjamin Britten (1913–1976), Witold Lutosławski (1913–1994), Iannis Xenakis (1922–2001), György Ligeti (1923–2006), Luigi Nono (1924–1990), György Kurtág (1926–), George Crumb (1929–), Gérard Grisey (1946–1998), Kaija Saariaho (1952–) or John Adams (1953–), will not be mentioned here or in the subsequent chapter on *Related Work* since their approaches to composition have neither influenced the author's own style and technique nor have they made such a musical-political impact that they compel a specific stance. The approaches and attitudes of a number of the com-

posers mentioned here and in the next chapter will be covered in more detail in the *Theory* section of this text.

Schönberg-Adorno

The reasons for mentioning Schönberg in this context are not related to any direct influence on the author's attitudes, approaches or style. Instead, they have to do primarily with Schönberg's influence on the modernist-structuralist approaches of the integral serialists of the 1950s, as the grandfather of their techniques, and with the position of great esteem Schönberg held in the eyes of Theodor W. Adorno (1903–1969) (Subotnik, 1996a)⁷, whose attitudes toward music production, reception and valuation are described by Tillman (2002) as having been a governing source of opinions surrounding many aspects of contemporary art music on the European continent in the 1950s and 1960s⁸. Discussions of the Schönberg-Adorno approach to structural listening, motivic-thematic development, and authenticity, and how these relate to the composer's own work will be discussed in more detail in the *Theory* section of this text, as will be the author's decision to appropriate Schönberg's early orchestrational techniques into one of his own compositions.

Anton von Webern

Webern's discussion of the value and function of repetition has had a direct influence on the author's own techniques and attitudes towards the compositional process. In a series of talks that Webern gave at a private residence in Vienna in 1932 and 1933 (which were stenographically recorded by Rudolf Ploderer and published in 1960 by Universal Edition as *Der Weg zur neuen Musik* ("The Path to New Music") (Webern, 1960)), one of the points he discusses is *Faßlichkeit* ("comprehensibility") in music. In Webern's view, repetition is the primary tool that composers can—and must—avail of in order to make their work intelligible to the listener. Although the composer has altered Webern's presumed concept of "comprehensibility" to suit his own interpretations, Webern's texts and compositions, with their crystalline, delicately concise content and structure, have had a profound

impact on the composer's own work since 2007. This too is discussed in more detail in the *Theory* section below.

Boulez

Pierre Boulez (1925–), as one of the predominant musical structuralists during the 1950s, is another composer whose approaches and attitudes must be mentioned because of their tangential correspondence to particular methods employed by the author, but whose work and dogmas have not directly influenced the attitudes and compositions of the author. In particular, his creation of strict processes for the generation of music during that period, and more importantly his tenet that music can only present structure, not carry content, as presented and discussed for example by Boulez (1963) and Nesbitt (2004), can be considered similar to certain aspects of the composer's own work. More detailed descriptions of this relationship, especially with regard to the similarities and contrasts between Boulez's work and that of John Cage, will also be presented in the *Theory* section below.

Cage

The author had already begun to develop his own approach to empty structure, non-subjective expression, and silence before taking the opportunity to explore John Cage's life, words, work, and concepts in detail, in part through reading publications by authors such as Nicholls (2002), Kostelanetz (1971), Cage (1961) and Pritchett (1993). He found in Cage a confirmation of the techniques and attitudes that he had begun to develop, and while his own music is worlds apart from that of Cage, he felt both excited and disappointed that such a great figure had solidly manifested these ideas into practice so boldly and with such consequence. Many of the author's own foundational principles echo those of Cage, though his manifestation of these are extended and filtered through sociological, philosophical, and artistic trends that have arisen since Cage's undertakings. His own work can be seen as following one of the many paths that Cage's endeavors opened the way for, without being a reiteration of outdated attitudes. Cage, too, takes up a considerable portion of the *Theory* section below.

Stockhausen

The music, techniques, and attitudes of Karlheinz Stockhausen (1928–2007) are actually quite unrelated to the lineage of the author's own work, with the exception of one very important point. Again, the composer had independently arrived at his own approach to disjunct fragments held together by an underlying, meandering harmonic sequence when he became aware of Stockhausen's *Momentform*. The composer's sources of inspiration for his own approach, as to a great extent for his conceptions of empty structure, non-subjective expression, and silence, were initially found in his collaborative work for audio-visual art projects, his analysis of the *Texts for Nothing* by Samuel Beckett, and his own informational (rather than practical) fascination with Buddhist psychology. Nonetheless, Stockhausen's own descriptions of the term he himself originally coined (Stockhausen, 1963) nearly identically correspond to much of the author's understanding of his own approach, and must be mentioned in this context⁹.

Carter

Elliot Carter (1908–) could be considered in many ways the American representative for the European *avant-garde* of the 1950s and 1960s. Though he did not involve himself with the serialist approaches of his European counterparts, he did develop a highly systematized and strict method of composition based on small groups of specific intervals and interval sets. His music is also, like that of the serialists, founded in non-redundancy. (See Schiff (1983) for more detailed insight into Carter's compositional approaches). Carter's work had a direct influence on the techniques of the author of this dissertation, particularly with regard to an avoidance of motives based on repeating melodic contours or rhythmic patterns, right up through the last instrumental work he composed prior to beginning work on his algorithm.

Reich and Glass

The composer's decision to reintroduce motivic repetition into his music was also influenced by the work done by Steve Reich and Philip Glass (1937–) in the 1960s and 1970s. As can be drawn from expositions of their work

by Potter (2000), their individual approaches are extremely relevant and consequential in relationship to the dominating principle of *non-redundancy* passed down to them from Schönberg through their *avant-garde* teachers.

Though the concept of *gradual process*, which governed the methods of these two composers, was not an approach that the author specifically adopted, it was his study of their work, combined with renewed study of the work of Webern and more intense study of the work of Austrian composer Bernhard Lang, that led the composer to begin contemplating ways to depart from his Carter-inspired attitude of non-redundancy and re-integrate aspects of motivic repetition into his own work.

Berio

Luciano Berio holds a unique position amongst the European composers of the 1950s and 1960s. On the one hand he fits squarely into the category of the 12-tone or serialist composers. He was also quite attracted to the concepts of open forms, discontinuity, automatism, and of valuing structure over content. As pointed out by Mussgnug (2008), he was stimulated by similar trends in the treatment of text at the time and inspired through his relationship with Umberto Eco (1932–)¹⁰. On the other hand, however, he maintained a certain relationship to content in his music, in particular the emotive content of sound. Many of his works involve voice and implement the voice in a manner that contains unintelligible or barely intelligible text, while making the expression of base-level human emotion very much the focus of otherwise discontinuous works.

One characteristic of his music that the author of this text feels is a natural consequence of such an intense relationship with text and voice is Berio's gestural approach to composition¹¹, resulting to a large extent in the frequent treatment of harmonic sequence from a *voice-leading* point of view, as described by Osmond-Smith (1985). This ties in with a technique, described in the same publication by Osmond-Smith, whereby Berio sustains the pitches of a melodic gesture to create the harmonic basis for that passage (or, seen from the other perspective, the harmonic column is already present, and the melody's pitches are taken from it; as each melodic pitch

sounds, the corresponding harmonic pitch is “awakened”.) The result is a further emphasis on melody in much of Berio’s music, the work *Eindrücke* being the highpoint of his masterful melodic skills.

These qualities and techniques have all had a direct influence on the work of the composer, as will become evident during the discussions of his own work below.

New Complexity: Lachenmann

Mention here of the so-called *New Complexity* composers, seen for example in the compositional approaches of Helmut Lachenmann (1935–) and Brian Ferneyhough (1943–), is primarily for the sake of touching upon a very strong and predominantly European strand of postmodern thought in music composition that took a direction very different from that which the author of this text has chosen, and one which will therefore only be mentioned briefly for the context of this text.

Ross Feller (Feller, 2002) describes this strain of postmodern music composition by defining it as a subgroup of “composers, performers, and listeners who try to resist the confines of slackening, pastiche, and reified appropriation[. . .] On another level their ‘resistance’ requires an aesthetic of excess, which is, according to Jean-Francois Lyotard [(1924–1998)], a condition of postmodernism”¹². Feller refers to Hal Foster’s label of this approach to postmodern composition in the context of *deconstruction*, as “a ‘postmodernism of resistance’ [which] appropriates modernist devices or materials and transforms them by deliberately exposing the inherent contradictions they contain[. . .] It attempts a critical deconstruction of tradition wherever it is found.”¹³

Lachenmann appears to have fervently followed the artistic philosophies of Adorno, by which, as described by Subotnik (1996a), artistic authenticity is found in a rejection of concepts that are perceived to have been constructed and maintained in the interest of keeping power in the hands of established institutions¹⁴. As Adorno vilified types of music that were conceived and consumed as a commodity, Lachenmann, too, as described by Feller, adopted an artistic stance within his own approach to postmod-

ern composition that rejected commodity-oriented music. The consequences he drew from these positions resulted in a “music” consisting of noise and characterized by an intentional lack of the Beautiful, the Melodic, or the Harmonious in any conventional sense¹⁵.

While the author respects and admires the intellectual discourse behind Lachenmann’s approach, and sincerely enjoys and appreciates Lachenmann’s music, this politicization of composition and deconstruction of the Modern are not trends that he has embraced in his own work.

New Simplicity: Rihm

Mention of the so-called *New Simplicity* composers, a label which in the continental European context is often most quickly associated with Wolfgang Rihm (1952–), is again necessary in order to differentiate between the concurrent strains of compositional approaches that developed out of the waning era of Modernism. The label itself is misleading and by no means consistent in its definition of traits. Nor is it a label that all composers to whom it has been applied find appropriate or with which they wish to be associated. The author’s former teacher, for example, Manfred Stahnke (1951–), is often grouped with the New Simplicity composers, though he most certainly pursues very different, oftentimes opposing, philosophical and stylistic aims than Rihm.

The primary defining characteristics most often ascribed to this particular group of composers led Kramer (2002) to refer to their approach as *anti-modernism* rather than *postmodernism*. These composers are seen to have made their stylistic decisions and formed their attitudes towards structure and meaning from the standpoint of “getting back to the roots” of music as a vehicle for catharsis and human (subjective) expression, in many ways rejecting the impersonal and dispassionate music of the modernist and structuralist composers. Siegfried Mauser (1990) reduces and reformulates Helga de la Motte-Haber’s identification of the characteristic features of the music and attitudes of these composers (Motte-Haber, 1987) as:

1. Extreme and excessive use of secondary parameters of tempo, dynamics, and articulation that guarantee the

sought-after expressive-hysterical effect.

2. Quotation of historical styles.
3. Return to traditional genres and forms.¹⁶

Again, the author of this dissertation respects and admires the skills and thoughts of these composers, even enjoys (much of) their work. However, a rejection or discrediting of music from the preceding Modernist era is counter to his own attitudes toward music production, reception and valuation.

Ives

The last composer to be mentioned here is Charles Ives (1874–1954). Ives's use of techniques of quotation (appropriation) of extremely divergent styles from many different eras (eclecticism) as well as his pluralistic, simultaneous overlapping of disparate musical material, as discussed for example by Robert P. Morgan (1997), have often been seen as predating postmodern approaches to such an extent that they actually took place even well before the Modernist era. Though the author of this dissertation again does not feel directly influenced by Ives's approaches, the similarities between the concepts of his own work and the techniques of Ives demand that Ives's unique groundwork in relationship to related concepts and techniques be given at least brief attention. More specific discussion of Ives, too, can be found in the *Theory* section of this paper.

3

Related Work

As was the case outlined in the *Background* chapter above, the number of contemporary composers pursuing similar approaches is too great to allow for an exhaustive introduction to contemporary related work. As above, the author of this dissertation will only briefly address a handful of contemporary composers whose work is related and of import because of their direct relationship to his own compositional endeavors or because of their dominance in a musical-political context compel the composer to take a stance on their approaches.

Bernhard Lang

The work of Austrian composer Bernhard Lang is of particular importance and relevance in both the continental European and greater international contexts. His substantial use of the exact and differentiated repetition of very short fragments as the primary feature of his music, described to date primarily in his own writings, is extremely significant against the backdrop of the strict rules of non-redundancy that permeated and governed the musical environment in which he was raised and educated (Lang, 2002a)¹⁷.

Lang's reintegration of repetition into his *concert music* (he has also been a participating member of several electronica-oriented groups) has been undertaken in a manner which is very sensitive to the instrumental traditions of technique, timbre and motive of the "classical", "art" tradition of music composition, making his work particularly valuable and groundbreaking. He has found a way, namely, to move *forward*, embracing and preserving the techniques and attitudes of his teachers while bringing European *art music* into a realm of contemporary relevance.

Lang's work has been particularly inspiring for the author of this dissertation. Details of this influence are discussed more specifically in the *Theory* section of this paper.

John Zorn

John Zorn's (1953–) practice of composing different pieces in different, identifiable styles of other eras, genres or composers, is a particularly bold example of postmodern approaches to quotation, appropriation, and eclecticism in the classical *art* tradition of Western music. His approaches and attitudes reflect and exemplify issues surrounding music as a commodity, authenticity, and the role of the author in a manner which seems to reject Adorno's moral and "socially true" music.

His work *Forbidden Fruit* for string quartet, which incorporates tape and female Japanese voice, is a radical example of the implementation of these attitudes and their consequent techniques within an extremely discontinuous, fragmented structure and eclectic juxtaposition of divergent existing musical styles. This work made a particular impression on the author when he first heard it in the late 1980s.

Post-Minimalists/Totalists

The labels "Post-Minimalism" and "Totalism", as described and for example by Taylor (2002) and Gann (1993), are again not categorically definable or unconditionally applicable to the composers generally grouped under these headings. The terms are often quickly used to refer to any of the contemporary composers who incorporate lengthy periods of repetitive osti-

nato patterns, à la Reich or Glass, and generally refer to composers who also tend towards the use of more traditional sonorities based on triads or major seconds, and who make use of electric instruments or the amplification of traditional orchestral instruments¹⁸.

One particular characteristic of a number of works by the composers often categorized into this grouping is the use of disjunct meters into which their pulses are wrapped. Works such as Louis Andriessen's (1939–) *Workers' Union*, David Lang's (1957–) *Cheating, Lying, Stealing*, or Donnacha Dennehy's (1970–) *Glamour Sleeper* are characterized in part by irregular, aperiodic, local rhythmic structures, the beginnings of which are often given a grand accent, and whose resulting sonority is one of discontinuity and fragmentation, producing a stuttering, staggering or hiccuping character.

The works of these composers focus more on an immediate sensuality of sound than does that of the author of this paper, but they do exhibit an indirect relationship to his work through their irregular structural subdivisions and their extended passages of fragmented discontinuity.

Hilario, Muenz, Mahnkopf, Koch

The last group of contemporary composers to be briefly addressed is that of one segment of the youngest generation of German composers. The composers Alan Hilario (1967–), Harald Muenz (1965–), Claus-Steffen Mahnkopf (1962–), and Sven-Ingo Koch (1974–) represent a school of thought and similarity of stylistic approach descending from the “postmodernism of resistance” propagated by their teachers, Lachenmann, Ferneyhough and Matthias Spahlinger (1944–). These composers, too, pursue discontinuity, fragmentation, pluralism, and excess in their work, but are representatives of approaches that also still follow the ascetic, anti-commodity stance of their teachers, rejecting the value of any form of art music which may be reminiscent of the decorative “entertainment” associated with bourgeois institutions and establishments. As with their teachers, the author has great respect and admiration for their skill and timbral creativity, but does not feel at all related to this strain of post-postmodern attitudes towards music conception, production, reception or valuation.

4

Theory

The author's primary theoretical focus during the course of his research has been on techniques and functions of the repetition of short musical fragments. In particular, the aim has been to explore the value and function of these fragments within the framework of larger musical forms whose structure is derived neither from *relationships between* these repetitions nor from the linear *development* of the individual fragments used, but rather from the order of the static juxtaposition of these repetitions. Many of the techniques of repetition and variation presented in this text can, at first sight, be thought to bear relationships to traditional concepts of motivic development or even invertible counterpoint, but the similarity is superficial and the distinction is to be found in the theoretical concepts behind the techniques chosen. While the composer indeed intentionally avoids romantic concepts of music as such as subjective expression or elevated inspiration, it is not his goal to recover earlier approaches to composition from Western tradition that may have emphasized, for example, number games in their methods. Instead, the techniques grow out of a combination of modern and postmodern theories and concepts of form, development, the role of the au-

thor, and in particular of the definition and categorization of various kinds and functions of difference and repetition.

The composer's focus on structures derived from static motivic repetition as a starting point for his research, and indeed for each of his compositions, results in an approach to composition in which local structure, and to some extent macro-structure, becomes the foremost attribute of the works composed, and in which the material used to fill those structures, such as pitch, rhythm and timbre, tends toward possessing a secondary function within those works. It also leads the composer to specific consequences and new pathways with regard to automated processes, discontinuous forms, concepts of non-development, non-structural functions of harmony, the use of stylistically divergent material, the role of authorial control over process and material, and in particular with regard to issues concerning *meaning* in music.

Meaning

Decisions concerning the approach to structure in music have much to do with the artist's concept of music's ability to transmit extra-musical meaning. If the composer's aim is to create interesting structures—empty slots of time which can be filled with any material—the material can potentially be seen to be arbitrary. If the material is or can be arbitrary, the question of meaning in music, which is often found or placed in the material, must first be addressed.

Of all the arts, music is the least capable of transferring specific meaning, in the sense of intellectual or abstract cognitive concepts or even of subjective emotion¹. Text and spoken word, already being our primary means of

¹The use of the word *meaning* here and elsewhere in this text refers primarily to the use of a symbol or sign that always represents the same object or concept. As opposed to written text, where the given signs (letters) always represent the same sounds (more or less), and the same strings of signs (words) always represent the same objects or concepts (more or less), mutually accepted by all members of a given community and thereby allowing for communication of complex constructions based on standardized *meaning* of these signs; and as opposed to spoken language, where the same sound formations, purely aurally and with no graphical symbols, always (more or less) represent the same objects, concepts etc.,

communication, are obviously the most efficient vehicles for the conveyance of meaning in these senses (though they too have their limitations¹⁹). Visual artists have the option of implementing iconic or archetypal symbols into their work that are attached to various degrees of common, conscious or unconscious definition. This lends the visual arts the capacity for a transmission of meaning that goes beyond the scope of relationships which may exist within the work itself, though in a form that is less precise than that of text. Stephen Davies (Davies, 1995) identifies the problem of meaning in music by relating it to the definition of one of his five categories of meaning, namely that of "Arbitrary Meaning Generated within a Symbol System." He defines this category by stating that within such a symbol system:

a symbol or sign has meaning as an element or "character" in an arbitrary symbol scheme that provides rules for the generation of meaning by the appropriate uses of these elements. Linguistic meaning is of [this category of] meaning²⁰

In his book *The Philosophy of Music. Theme and Variations* (Ridley, 2004), Aaron Ridley comments on Davies's conclusions by summarizing them as such:

Music cannot be construed as a "Symbol System" in the relevant sense. Hence, Davies says, music is not and cannot be meaningful in the way that language is meaningful²¹.

Following this line of thinking, it is the opinion of the author that music, however intellectual the activities of its production, reception and valuation may be, is first and foremost structured sound. This results in an attitude towards the production and reception of music that precludes any attempt to transmit specific or extra-musical meaning, in the sense of intellectual musical constellations, be they individual pitches, collections of harmonic or melodic pitches, timbres, rhythms, do not possess such standardized, mutually accepted, specific references to objects, concepts etc. beyond the sounds themselves, and thereby have no *meaning per se*. There are, of course, certain sound patterns within musical contexts that provide something *similar* to meaning within a purely musical scope, such as cadential patterns, either melodic or harmonic, which signal to the listener that a phrase, or perhaps the entire piece, is about to end, but these are unrelated to the transferral of extra-musical information or sentiment.

or abstract cognitive concepts, and which has significant consequences on compositional decisions with regard to structure, form, and content.

In the same book cited above, Ridley makes reference to Wittgenstein's comment that "understanding a sentence is much more akin to understanding a theme in music than one might think"²². Ridley draws from this that meaning in music is encapsulated in a minimal form of paraphrase instead of being found at a level of meaning-atomism (understanding the meaning of a sentence by "analyzing it into and understanding its constituent parts")²³. He suggests that this is why attempts by people such as Deryck Cooke (Cooke, 1959) to find "the musical equivalent of a linguistic vocabulary"²⁴ have failed²⁵. He briefly describes several kinds of paraphrase, from an expression that carries the same sentiment, simplifying the original, to more elaborate precision, increasing clarity over that of the original. If the expression of anything can be attributed to music, it is the the expression of sentiment that seems to be most frequent and most likely, "sentiment" of course having its root in the Latin for "feeling"²⁶.

It is not the desire of the author to continue this thread by examining in detail whether or not music is capable of carrying certain kinds or degrees of emotion, though it is a logical consequence of the qualities described above that its capacity to *express* anything precisely, including emotion, must be challenged. It suffices for the position taken in this text to acknowledge that most people recognize and accept the phenomenon that music seems to have the capacity to *elicit* emotion in the listener. At this juncture, two points are relevant for this text and the work of this composer. Firstly, there is a difference between *expressing* and *eliciting*. It is the author's conviction and experience as a listener that the emergence of emotion while listening to a piece of music lies as much, if not more, in the psychological activity of the individual recipient than in the music itself, or indeed in that which the composer desires to express. Even then, the emotional reaction to the same piece of music will differ at least slightly and potentially greatly from recipient to recipient or even within the same recipient on different hearings. This conviction by no means excludes the possibility that a composer within a specific culture or sub-culture may intentionally include certain musical elements in his or her work which consistently elicit similar emotional re-

actions within a majority of listeners who are familiar with those elements, either due to their mutual cultural imprint or due to their training in that style of music. However, the fact that even something as simple as *taste* can result in some listeners being moved to tears by a given piece while other listeners even from the same culture find the work boring or perhaps even annoying seems to clearly imply that it is not solely the music or its components which cause the emotional reactions within the listener. For this reason, the author distinguishes between the terms *emotional* and *emotive*, the former being a quality inherent to a work itself, the latter being a work's quality of eliciting emotion of any kind or to any degree within the recipient.

Secondly, the composer's tastes regarding music production and reception are more those of discretion than of subjective expression, leading him to a stance in his own composition whereby he produces music which may contain passages that are *emotive* but does not strive for a style whose goal is in any way geared toward the communication of the intricacies of subjective emotion.

As a result, the author finds himself satisfied and justified in approaching composition as structured sound, while indeed placing local importance on the emotive quality of individual gestures and fragments. There can be very beautiful or very exciting moments, though these have no subjective expression.

Modernist and Postmodernist Approaches

The composer embraces several historical approaches from eras and attitudes that have been labeled Modern and Postmodern, but leans much more towards postmodern approaches. The primary components of his work can be summarized as the attributes of and issues surrounding discontinuity, non-narrative, non-development, relinquishment of authorial control, non-subjective expression, the use of technology and automatic systems to generate a work, empty structures, pluralism, harmony freed from structural function, and aspects of appropriation. These are characteristics which are most often ascribed to postmodern works, but which also often overlap with modernist approaches, either in their original sense or in the sense that the

composer has implemented them.

There is an important distinction between postmodernism and *anti-modernism*. Joakim Tillman (Tillman, 2002) explains that the term “post-modern” in Germany was initially used “as a label for the young German[...] composers born around 1950 (Wolfgang Rihm, Manfred Trojahn[...]), who made their debut in the middle of the 1970s with music and aesthetics directed against modernism”²⁷. Jonathan Kramer (Kramer, 2002) distinguishes between the two streams of anti-modernism and post-modernism by stating that “for both antimodernists and modernists, unity is a prerequisite for musical sense; for some postmodernists, unity is an option[...] It is no longer a master narrative of musical structure.”²⁸. In the same article cited above, Tillman explains that one of the primary German writers concerned with formulating a definition of “postmodern”, Hermann Danuser, determined that anti-modernist approaches should not be included in his definition based on the criterium that “neither a total negation nor a minor modification of modernism qualifies a work as postmodern”²⁹.

In his article “The Nature and Origins of Musical Postmodernism”, Kramer provides a list of characteristics of postmodern music, writing: “Post-modern music. . .

1. is not simply a repudiation of modernism or its continuation, but has aspects of both a break and an extension;
2. is, on some level and in some way, ironic;
3. does not respect boundaries between sonorities and procedures of the past and of the present;
4. challenges barriers between ‘high’ and ‘low’ styles;
5. shows disdain for the often unquestioned value of structural unity;
6. questions the mutual exclusivity of elitist and populist values;
7. avoids totalizing forms (e.g., does not want entire pieces to be tonal or serial or cast in a prescribed formal mold);

8. considers music not as autonomous but as relevant to cultural, social, and political contexts;
9. includes quotations of or references to music of many traditions and cultures;
10. considers technology not only as a way to preserve and transmit music but also as deeply implicated in the production and processes of music;
11. embraces contradictions;
12. distrusts binary oppositions;
13. includes fragmentations and discontinuities;
14. encompasses pluralism and eclecticism;
15. presents multiple meanings and multiple temporalities;
16. locates meaning and even structure in listeners, more than in scores, performances, or composers.”³⁰.

He clarifies by saying that, “not many pieces exhibit all these traits, and thus it is futile to label a work as exclusively postmodern.”

Another author who has concerned himself with identifying common traits in postmodern music is Ihab Hassan (Hassan, 1987). His criteria include “fragmentation of musical structure, dissolution of systems and canons (in relation to rules of compositional technique), irony, and entertainment. The most important feature, however, is stylistic pluralism and the double-coding of material that does not lead to a unified work.”³¹.

Some of these characteristics will be discussed below, and the composer’s position to them, as well as how they are evident in his work, will be brought to light.

4.1 Using Technology and Automated Systems

The use of automated or semi-automated systems to generate a work is generally an approach, within a Western musical context, that is ascribed to

the modernists and structuralists, such as seen in the early works of Boulez and the integral serialists. The systems used by composers in this context are often accompanied by an attitude which grants the artist an elevated status and a desire to create autonomous works, as described in the sections on *authorial control* later in this chapter. In such work, the composer is conceived as the enlightened utterer, and the work created often purports to carry a sole meaning. This is an approach which the composer of this dissertation is not undertaking.

Nor is the composer's use of a computer algorithm to generate structures, harmonies and repetition fully akin to the opposite of these attitudes, such as seen for example in the compositional techniques of John Cage. Cage's use of extremely precise systems of chance as a means of reducing the extent of his authorial control over the resulting work is identified by Alastair Williams (Williams, 2002) as one reason why Cage can be seen to straddle the fence between modernist and postmodernist thought and technique³². On the one hand, his use of processes in his compositional methods is related to the modernist fascination with systems, while on the other his use of systems and technology results in a music that is less autonomous than that desired by the modernists, though his first implementations of such techniques do not produce a music that is any less closed or unified. It can be argued, for example, that Boulez's highly ordered *Structures* and Cage's chance-based *Music of Changes* both demonstrate the same level of unified character and sound.

Although the composer of this dissertation incorporates elements of chance into his own systems for generating music, his approach differs to that of Cage in that it is based on probability (weighted chance) rather than binary chance (discussed in more detail below). The composer's approach is thus somewhat more modernist than Cage's, in that the algorithm he uses creates structures and sounds over which he maintains a greater degree of authorial influence, but more postmodern than the systems of the integral serialists, because the product is not *one* autonomous work, it is *one of many instances* of the concept of essentially the *same* work.

4.2 Discontinuity, Non-narrative

Discontinuity is another trait that straddles both the modernist and postmodernist realms. Its initial origins can be found in early Modernism, with precursors in the stream-of-consciousness texts of James Joyce (1882–1941) (*Ulysses*, *Finnegans Wake*), the collage techniques of painters Pablo Picasso (1881–1973) and George Braque (1882–1963), and the compositions of Igor Stravinsky (1882–1971) and Claude Debussy (1862–1918).

Charles Jencks (Jencks, 1987) distinguishes between the discontinuity of the modernists and that of the postmodernists by emphasizing the aspect of “double-coding” in the work of the postmodernists. He defines this as work that is based on “both elite/popular and new/old”, saying that

all the creators who could be called postmodern keep something of a modern sensibility[...] whether this is irony, parody, displacement, complexity, eclecticism, realism, or any number of contemporary tactics and goals[...] Postmodernism has the essential double meaning: the continuation of Modernism and its transcendence³³.

He refers in the same article to a loose and improper use of the word “postmodern” by critics when he writes that to them, “postmodern meant everything that was different from High Modernism[...] They just adopted a current phrase for discontinuity and lumped every departure under it.”³⁴

The postmodern approach to discontinuity (and plurality) comes, in part, as a reflection of the society in which we live. In *The Saturated Self* by psychologist Kenneth J. Gergen (Gergen, 1991), Gergen uses the term “social saturation” to indicate “the condition in which we continually receive messages of all sorts, coming (often electronically) from many corners of the globe, all competing for our attention and involvement[...] Conflicting claims on our attention, as well as constant bombardment with information, lead to the fragmented sensibility associated with postmodern attitudes.”³⁵

Discontinuity within the context of postmodern collage also explodes and focuses simultaneously the dialectic of any composer with regard to his or her position in historical lineage. By filling discontinuous, empty

structures with disparate, appropriated content from multiple eras, the artist embraces the lineage of historical eras, while at the same time locating them all in one space and time, much in the same way that the composer himself or herself is made up of all of those elements in the same time. Kramer writes:

The avant-gardists of early Modernism (such as Luigi Russolo, Satie, Cowell, and Varèse) sought to escape history, but were hopelessly trapped in the continuity of historical development. To see themselves on the cutting edge, such avant-gardists (and also early modernists like Schoenberg, Webern, and Stravinsky) had to accept history as linear progress. But recent postmodern composers have moved away from the dialectic between past and present that concerned these early avant-gardists and modernists and that continued to plague their mid-century descendants, such as Boulez, Stockhausen, Nono, Cage, Carter, and Babbitt. Because they recognize history as a cultural construct, postmodernists (such as Aaron Kernis, John Tavener, Paul Schoenfield, and Thomas Adès) can enter into a peaceful co-existence with the past, instead of confronting it as latter-day modernists do. For postmodernists, "History is recast as a process of rediscovering what we already are, rather than a linear progression into what we have never been."³⁶

Within a postmodern context, time and temporal processes in general are no longer understood to imply a future-directed progress in which events are causally related. In her introduction to *Postmodern Music/Postmodern Thought*, Judy Lochhead (Lochhead and Auner, 2002) refers to Lyotard's identification of the trend towards more fragmented forms, stating that he "makes the link to historical thinking in *The Postmodern Condition*, arguing that the postmodern attitude eschews 'grand narratives' and embraces instead local stories of understanding"³⁷.

In this context, it is important to briefly address Stockhausen's *Momentform*, an approach to musical structure which Stockhausen used in works such as *Kontakte*, *Momente*, and *Mikrophonie I & II*. Stockhausen conceived

these works as a series of moments, in which none of the fragments are seen to develop out of the previous or into the next. He considered these compositions to have no beginning and no ending, starting in the middle and ending in the middle³⁸. Danuser (Danuser, 1990), however, considered Stockhausen's work to be modern, based on the fact that Stockhausen's work still confirms to the ideal of unity³⁹. Indeed, based on Jencks's requirement for a work to include the aspect of double-coding, Stockhausen's compositions with *Momentform* would again fail to fulfill the criteria necessary to consider them postmodern.

The composer's own implementation of discontinuity again straddles and assimilates both modernist and postmodernist approaches. His use of discontinuity does indeed correspond to Stockhausen's *Momentform* as it is described above, and the content of each of his individual pieces does maintain a high degree of unity in its sonority within the individual pieces themselves, suggesting a relationship between the composer and his works to modernist thought (though his emphasis on filling in empty structures *would* indeed allow those structures to be filled in with stylistically divergent material).

However, the composer also bases several of his own approaches on techniques of other artists from various periods, resulting in both the presentation of old *and* new as well as an eclectic and pluralist combination of simultaneous, differing material, aligning the composer's approach and techniques at least equally with the definition of postmodern characteristics put forth by Jencks, and reflecting the "peaceful coexistence with the past" described by Kramer.

The composer has also intentionally attempted to amalgamate moment-form with attributes of linearity, though with more emphasis on embracing the "local stories" referred to by Lyotard. While the pieces, on the one hand, are to be perceived as a sequence of now-moments, they still incorporate elements of motivic repetition and variation, as well as elements of polyphonic linear harmonic progression (or in the case of *Words Like Smoke* implied Tonic, Subdominant, and Dominant areas and implied relationships of functional harmony), in order to add a degree of linear coherence to the works and soften the otherwise fully fragmented form, but without creating

a “grand narrative”.

4.3 Non-narrative, Non-development

The definition and function of *non-narrative* overlaps the traits of discontinuity and non-development in the composer’s music, which, though related, have slightly different attributes and functions themselves.

According to Rose Subotnik, early modernist Schönberg and modernist Adorno advocated and valued structural listening as a sole approach to the assessment and experience of music⁴⁰. She defines “structural listening” as a “method that concentrates attention primarily on the formal relationships established over the course of a single composition”⁴¹, and explains that Schönberg and Adorno considered structure to be directly related to development⁴², further suggesting that the notion of *development* derives from the Classical period⁴³. She writes that, “both men place particular importance on the self-developing capacity of a motivic-thematic kernel, or on what they call ‘developing variation’”⁴⁴.

The composer’s own attitude towards developing variation differs from that of Schönberg and Adorno. The development of a motivic-thematic kernel establishes a future-based, linear relationship between musical (or sonic) events. The composer chooses, instead, to create works which are more static in nature. The natural consequence of this is the use of disjunct fragments that do not develop (i.e., whose repetitions or variations do not progressively change in a stepwise manner over time), though they may indeed repeat, either exactly or in varied form.

The composer’s choice to place repeating motives into non-developing forms stems in part from his appreciation of Webern’s concept of *Faßlichkeit* (“intelligibility” or “comprehensibility”) in music⁴⁵. The repetition of an event, according to Webern, contributes to its comprehensibility, and subsequently to the comprehensibility of the whole work. However, since the composer believes that music cannot carry or transmit anything which can be comprehended (in the sense of extra-musical *meaning*, as described above), he adopts a varied interpretation and stance from Webern’s approach as regards the definition and function of “comprehensibility”.

Instead of repetition allowing the listener to comprehend the *meaning* of individual musical events (or allowing the listener to extrapolate the meaning of an entire musical work based on the meaning of its constituent events), the composer uses repetition to allow the listener to define his or her experience of the work based on the elements that make up that work. If a listener is confronted by a work that is discontinuous in structure and contains no repetition, the experience is less defined by the perception of the work's individual components and more by the overall character of the components having no relationship to one another other than that they co-exist within the same relatively brief window of time. A work in which the individual motivic elements have no relationship to one another outside of occurring sequentially (as is the case in the chance-based pieces by John Cage, such as the *Music of Changes*) requires a specific kind of listening that, like the work itself, is *predominantly* directionless, in some cases shifting the work's existence and the listener's perception of the work nearly into a realm of *spatiality*⁴⁶ rather than *linearity*. A work that consists of repetition, either exact or varied, allows for some degree of focus, the mind being able to latch on to repeated elements as familiar and recognizable components. It is this ability to latch on to repeated elements in the context of creating a point of reference and a focus, ultimately allowing the listener to understand his or her experience in relation to the components of the work rather than in their lack of relationship to one another, that he ascribes to the concept of "comprehensibility".

The intention, then, is to combine attributes of discontinuity with attributes of repetition. In arriving at his own approach to techniques of repetition and variation, the composer leaned initially on the compositions and texts of Bernhard Lang, and then more specifically on the writings which Lang mentions as having been influential on his own approach to repetition in music, namely those of Gilles Deleuze and Jacques Derrida⁴⁷.

Lang's work has been centered for a number of years now around compositions entitled *Differenz/Wiederholung*, numbered sequentially. His selection of that title is drawn from the 1968 dissertation by Gilles Deleuze of the same name (Deleuze, 1968). In this dissertation Deleuze describes an aspect of repetition that occurs on the z-axis as well as the standard under-

standing of repetition on the x-axis. He refers to repetition on the x-axis as “dynamic”, suggesting that “in the dynamic order there is no representative concept, nor any figure represented in a pre-existing space,” and as an example of this kind of repetition he uses an artist painting the repetition of a decorative motif⁴⁸. This kind of repetition would apply to techniques of motivic development in musical composition.

Deleuze defines repetition on the z-axis as being “static”, and describes it as referring “back to a single concept, which leaves only an external difference between the ordinary instances of a figure”, the instances of a figure being manifest, the concept being hidden⁴⁹. This kind of repetition would present itself as several exact or near-exact instances of a given item which are not linear, incremental modifications of the original manifest instance of that item, but are rather equal, separate, individual manifestations of the same hidden concept, an approach which precludes techniques of development.

Similarly, Derrida expresses a related concept from the opposite standpoint. In his article “Différance” (Derrida, 1972a) he suggests that signs within a system of signs intended for the transfer of meaning do not mean anything on their own, but rather derive their meaning from that to which they differ and that to which they *defer*. With regard to *difference* he cites de Saussure, who posited that “in language there are only differences[. . .] The idea or phonic substance that a sign contains is of less importance than the other signs that surround it.”⁵⁰. With regard to *deferment* he writes that “the sign represents the present in its absence[. . .] When we cannot grasp or show the thing, [. . .] we signify, we go through the detour of the sign[. . .] The sign, in this sense, is deferred presence.”⁵¹.

This approach, too, includes the z-axis as well as the x-axis. The sign refers back to a concept that does not exist in concrete reality. The letters that spell the word “table” defer to the sound of the spoken word “table”, which in turn defers to the concept of a table.

The application of the ideas of these two philosophers in the composer’s work is found in his consideration of the motives in his pieces as referring, or deferring, to an imprecise, non-manifest concept. The repetition of the motives is not conceived as repetition on the x-axis, whereby the existence of

a later instance of a similar motive is necessarily dependent on the existence of an original instance of that motive. This would establish a hierarchy of source and derivative within the material itself and relegate repetition to a function of development. Instead, each instance of a motive, in any variation, is considered equal to all others, with no hierarchy; all instances are conceived as a repetition on the z-axis of an original that is never present because it does not exist in manifest form. This approach negates the option of the development of motives in linear time.

The composer's approach to non-development and discontinuity, then, differs greatly from the attitude towards development found among the modernists, differs somewhat to that of other postmodern composers, and leans much more towards the work of Bernhard Lang.

4.4 Empty Structure

The original idea for the use of pre-compositionally determined, empty structure in the compositional process emerged from the composer's experience creating electro-acoustic compositions that were to be the complement to video in audio-visual collaborations. In such projects, the videos were usually completed first and the structure of the work was therefore predetermined. In contemplating approaches for implementing such empty structures, the composer decided to lean on structuralist tendencies with a postmodernist slant. This eventually led him to an analysis of Samuel Beckett's *Texts for Nothing* as a source for empty structures.

Empty structure is also an attribute that is again at once modern and postmodern. It is a compositional technique that probably foremost recalls the methods involved in John Cage's "square-root form", and it cannot be discussed without mention of the works and words of Pierre Boulez (*Structures I & II*), as inherited from Schönberg and reinforced by Adorno.

As mentioned above, Rose Rosengard Subotnik identifies and discusses the approach to structure taken by Schönberg and Adorno in her article "Toward a Deconstruction of Structural Listening: A Critique of Schönberg, Adorno, and Stravinsky"⁵². She writes that their basis of musical production, reception and valuation on structure is accompanied by an attitude

which gives secondary or very little regard to style or content. She explains that “Both [Schönberg and Adorno] are thoroughly dedicated to the goal of reducing music to a condition of what could be called pure structural substance, in which every element justifies its existence through its relation to a governing structural principle[...] both advocate the renunciation of preexisting, externally determined conventions.”⁵³.

In her explanation, “structural listening looks on the ability of a unifying principle to establish the internal ‘necessity’ of a structure as tantamount to a guarantee of musical value.”⁵⁴

In her interpretation, this approach of “structural listening discourages kinds of understanding that require culturally specific knowledge of things external to the compositional structure.”⁵⁵

Boulez’s approach, then, can be seen to some degree to derive from this attitude. In a similar vein, Boulez’s modernist approach to structure explicitly banishes any transcendental elements from compositional production, reception or valuation. When writing of Boulez’s strict structuralism, Nick Nesbitt (Nesbitt, 2004) describes how “[Boulez] approvingly quotes Louis Rougier’s statement that ‘what we can know of the world is its structure, not its essence’”⁵⁶. While Boulez’s structuralism may be based on “relative” structures that “organize themselves according to varying criteria,”⁵⁷ they exceed Schönberg’s and Adorno’s severity with regard to its strict interior relations. Nesbitt writes, “it is not the exterior, dialectical relations of form and meaning, art and society, truth and expression, that interest both Adorno and Nono, but a relation of strict interiority,”⁵⁸ continuing that “Boulez presents a musical system in total abstraction from extra-musical meaning, and indeed from musical subjectivity (as hearing, imagining, sounding) in any form.”⁵⁹

Cage, on the other hand, arrives at empty structure from another direction. His final result, with regard to structure, does resemble Boulez’s at first hearing, in part perhaps due to their mutual appreciation of Webern. It consists, in words Cage used in a letter to Boulez, of “throwing sound into silence”⁶⁰, with no necessary subjective meaning. However, his works using pre-compositionally determined empty structures still allow for and incorporate many exterior relationships, such as a basis on the nine “per-

manent emotions” of Indian tradition in his *Sonatas and Interludes* or the Indian conception of the four seasons in his *String Quartet in Four Parts*⁶¹.

Cage’s inspiration for the use of empty structures has less (but not completely nothing) to do with Boulez’s search for an autonomous music and initially more to do with the attitude that structure should be based on “time lengths rather than harmony”, as influenced by Webern and Eric Satie (1866–1925)⁶². It is an attitude that is concerned with viewing music from an ontological viewpoint, as sound. Cage, too, was striving at this point to “liberate” sound from the constructed contexts generally ascribed to it, but as opposed to Boulez, his attempts were more to liberate it from its interior rather than exterior references. His efforts had the consequence, in part, of freeing pitch from harmonic function, the obvious upshot of which is to determine structures based purely on duration rather than harmonic motion.

Both Boulez’s and Cage’s approaches to empty structure are evident to a certain degree in the work of the composer of this dissertation, as well as in the concepts that govern that work. On the one hand, the algorithm he has programmed to produce temporal frameworks for his pieces generates structures that are governed by a semi-random sequencing of basic components based on probability tables. In this regard it is comparable to Boulez’s structuralist approach of emphasizing interior relationships of the composition, the resulting whole being perhaps even secondary. These relationships only fully become evident when observing different works created with the same algorithm, rather than when looking at only one piece. Similar to Boulez’s *Structures* pieces, the parts are essentially interchangeable, though not within any individual piece but rather when viewed in light of the fact that each new piece consists of the same basic structural components in different orders. Moreover, the material used to fill the empty structures is not dependent on the structures themselves.

At the same time, similar to Cage’s work, the content of those structures is considered to carry the potential for being emotive—for being non-subjective but potentially eliciting the recognition of similar emotions, taking into consideration that the perception of such content is contingent upon the requirement of a target audience that is at least somewhat versed in the

common musical constructs of Western Classical culture. It also incorporates large degrees of chance.

Empty, pre-compositionally determined structures also lend themselves to and indeed are the obvious consequence of the z-axis approach to repetition and motive described above. For if there is no developmental (i.e. future-oriented) relationship between the motives, there can only be vertical divisions of time. A temporal framework that starts as empty lends itself very well to the structural attributes required by such an approach to repetition and variation.

4.5 Harmony Within Form, Not Dictating Structure

The composer's approach to harmonic sequence cannot be immediately shown to have any position in relationship to postmodern or modern trends or characteristics. What is evident is a relationship to John Cage regarding the harmonic consequences of the structural approach described above.

Cage's use of harmony was one that was freed from its relationship to structure. David Bernstein (Bernstein, 2002) explains that "[Cage] also considered the possibility that harmony, freed from its structural responsibility, might also become a formal element, i.e., a component of a musical continuity, just as any other sound or silence"⁶³. Cage's use of harmony, in particular in conjunction with his gamut technique—the best example of which is found in his *String Quartet*—was one that was essentially and intentionally static.

The approach taken by the composer of this paper is, on the other hand, not static in the same way, at least not with regard to harmony. The harmonies move, with local direction, but they move aimlessly when looked at from the macro-level. This is the result of the composer's intention to use underlying harmonic progression to lend his compositions an element of non-narrative linearity⁶⁴, to provide "coherence", or "comprehensibility"—as described above—to works with no development. In one sole, initial composition (*Words Like Smoke*), this took the form of implied Tonic-Dominant-Subdominant relationships, and in all subsequent pieces the harmonic motion took the form of stepwise progression within polyphonic lines. There is

no functional harmony (with the exception of the first piece composed using the algorithm), and no ratio of more-to-less tension in order to demarcate phrasing or structure. Harmonic shifts do not take place with any structural rhythm, but rather continue to progress consistently regardless of structure. Harmony is used solely as one instance of vertical simultaneity that precedes or succeeds another. The melodic contours of the work adhere strictly to the harmonies predetermined for each phrase, similar to Berio's use of harmonic fields⁶⁵.

4.6 Pluralism

Another attribute commonly associated with postmodern art is that of pluralism. In describing the early discussions of the definition of postmodern trends in Germany, Joakim Tillmann explains that Wolfgang Welsch was one of the first to consider the term in a positive light. He reports that one of Welsch's primary criteria for a work to be considered postmodern is that "a fundamental pluralism of languages, models, and methods are present not only in different works but in a single work."⁶⁶ Alistair Williams (Williams, 2002) extends this criterium by identifying a "pluralism that allows multiple events to stand alongside each other within the same space."⁶⁷

The works of the composer of this dissertation reveal an aspect of pluralism that is initially and on the surface more related to Williams's description of the concept than Welsch's, in that they entail an intentional pluralism of events and techniques rather than styles. His work differs greatly, then, to the stylistically eclectic work of postmodern composers such as John Zorn with his 1988 *Forbidden Fruit* or Michael Daugherty (1954-) with his 1997 opera *Jackie O*.

In pursuing discontinuity, non-developing repetition, and empty structure within a linear context, the composer has chosen to use a very large number of melodic-rhythmic fragments to enhance these traits while intentionally obscuring some of the "comprehensibility". The large number of motives are generally presented simultaneously, sounding in different instruments at the same time, stretched and scaled or condensed and segmented such that they all fit into the given durations of the pre-

compositionally determined phrase-lengths of the structure. On the one hand, this plurality of separate musical gestures is reminiscent of the “saturated self” and “social saturation” referred to by Gergen, mentioned above. At the same time, it is an attempt to push the listeners (including the composer) to the boundaries and extremes of their capacity for perceiving the repetition of individual events within an otherwise chaotic sonority. His techniques allow for moments of highly ordered chaos, with a mass of simultaneously sounding, different motives, throwing up issues of the essence of chaos as well as the essence of order. The intention is not to undo the “comprehensibility” effected by the techniques of repetition described above; it is to probe the limitations of that comprehensibility, such that the comprehensibility is challenged but not dissolved.

The program note to the composer’s work *Flying Instants* reads:

The result is a sound event which does repeat, in which certain sounds and certain processes applied to sounds recur, for the sake of coherence and clarity, but in which such a large number of sounds and algorithmic motives are implemented that the coherence generally obtained through repetition is obscured by sheer number of things which are repeating. This distinguishes his work from other repetition-based composers, such as the American Minimalists or Bernhard Lang, since those musical styles incorporate repetitions of a very small number of motives. The composer wished to maintain overwhelming chaos, but re-incorporate the concepts of repetition and motive into his work.

The composer also incorporates pluralism into his work through the use of techniques appropriated from several different sources. This is indeed related to Jencks’s eclecticism or Welsch’s pluralism of models, but is applied in a much more subtle manner. The composer uses probability tables constructed from analysis of the work of Beckett, Berio and Schönberg (and Bernhard Lang in one instance) for the automatic generation of his structures, harmonies and instrumental combinations (orchestration). The resulting music does not sound like Berio or Schönberg, making the pluralist approach to the construction of the work more hidden than Jenck’s and

Welsch's descriptions. Also, the composer uses different aspects of each of his sources, further masking the eclecticism. He doesn't, for example, juxtapose the style of Berio with the style of Schönberg, which would be audible in pitch, rhythmic and harmonic content, or in orchestrational technique. Rather, he uses unrelated traits of each composer (and Beckett) simultaneously, such as Berio's harmony and Schönberg's orchestration, making an immediate audible comparison of style impossible.

4.7 Relinquishing Authorial Control Over Process

One of the primary issues associated with postmodern art concerns the role of the author (or artist, or composer etc.) in the creation of a work. The definition of the author's role in constructing a work has far-reaching implications for the methods by which the work is produced and the manner by which it is received.

The artist has traditionally been given a position of elevated status within Western cultures, often being considered to have exceptional insight as well as exceptional skill. We often speak of the artist (painter, composer, author) as being *gifted*, the gift having been granted by God, or perhaps by Mother Nature. In many eras and in many Western cultures, the artist is believed to see, hear or understand things that the rest of us cannot, and the artist's creations are considered to embody these these insights, making them something that must be interpreted. This paradigm puts the artist in the role of the utterer—the author—who imparts insight through the work of art, the meaning of which is found in its inspiration and expression rather than in its reception.

The Modern era was accompanied by a rapid increase in the development and dispersion of automation throughout many, if not most, aspects of Western culture. Steamboats, machine guns, assembly lines for mass production, vending machines, early computers and so on came to permeate the increasingly automated societies of Europe and America.

The modernist fascination with automation in society spilled over as well into the use of automated processes in the creation of art. Following one line of this spillover in the musical realm—though not fully automated—

early modernist Schönberg developed his serial technique of composition, which was continued and intensified by the techniques of the high-modern integral serialists starting in the 1950s, gradually taking more and more decisions away from the composer and leaving more and more to be made by the systems the composer had developed. The author/artist paradigm had shifted from the inspiration and craft of the Romantic era to include and even emphasize the devising of systems and processes for an automated creation of art.

Somehow, though, in many circles, the artist still held that traditional, elevated status described above, perhaps because it was the artist, now, who had possessed enough insight to devise and “author” these intricate, automated processes. And if many from outside of those circles were beginning to suggest that the composer (or other artist) could no longer claim to be the author of a work that was created by an automatic process, many from within those circles were dogmatically insisting that they were indeed entitled to maintain that elite status, as can be seen in Boulez’s 1952 assertion that “all non-serial composers are useless” (Boulez, 1952).

As the automation and ordered systematization of so much of society continued to increase in Western culture, subcultural reactions to this trend began to emerge. Some painters, authors and composers etc. began creating work that incorporated disorder, asystematic methods, and chance into the methods of the works’ production. In America in the 1940s, Jackson Pollack (1912–1956) began creating paintings by pouring, throwing or spattering brushes or buckets full of paint onto large canvases. American author William S. Burroughs (1914–1997) adopted and adapted a 1920s Dadaist technique used by Tristan Tzara (1896–1963) of creating poems by pulling random words out of a hat and began creating new texts from existing texts by cutting up the originals into single or small groups of words and reordering them, as he did in *The Nova Trilogy*. And composer John Cage leaned on the techniques of chance-based divination found in the *I Ching* to create musical compositions in which every pitch, every duration, every dynamic, every accent or performance technique, every tempo etc. was determined by a coin toss. In addition to reacting against the highly ordered automation of the society of their time, these artists took the question of whether or

not that automation meant that the artist was no longer the author and, instead of dogmatically defending their role as author, embraced the extensive absence of authorial control as an artistic concept of its own.

The author of this text also adopts an attitude by which he gives up much authorial control in his compositions. He infuses an automated process for generating musical structures through iterative computer routines—which could be considered a fundamentally modernist approach—with extensive degrees of probability—resembling the chance-based approaches of many postmodernists and artists active in the transitional period between the two eras.

The composer's process consists of rules for musical parameters that he has devised and refined based on their ability to produce consistent and reliably satisfying output, and which include parameters for musical elements such as polyphonic voice leading, horizontal and vertical interval structure, polyphonic density, and ratios of duration between phrases. He defines systems that generate his structures and harmonies while incorporating aspects of probability and various restrictions on these rules, thereby “withdrawing his own subjectivity from the creative process”⁶⁸ and giving up a considerable amount of authorial control over the final result.

The exact sequences of the phrases, their exact durations, the exact chord progressions etc. are generated by weighted chance. The element of randomness that the composer uses is not fully binary chance, as was the case with Cage, but consists of a considerable degree of chance with predefined likelihoods that certain characteristics from a predefined set of characteristics will emerge more or less frequently than others. While the work generated by Cage's chance techniques (his use of the *I Ching* for *Music of Changes*, for example, before he followed the implications of this withdrawal of authorial control to the next conclusive step and delved into more extreme indeterminacy) does generate music that consistently sounds similar in its character of discontinuous, pointillistic, non-developing gestures and events, the actual pitches, notes and structures etc. are less likely to exhibit repetition than those of the composer of this dissertation. The sounds Cage generated using chance are consistent in the same way that white noise or the snow on the television screen after the end of the broadcast day

displays a uniformity in sonority and visual impression. The basis on probabilities in the composer's own music, on the other hand, results in structures whose similarity is not found in the overall unity of the sound quality of a given piece, but in the similarity of structures and harmonies found when comparing several of his pieces.

4.8 Appropriation and Authenticity: Relinquishing Authorial Control Over Material

The final attribute often ascribed to postmodern art to be discussed here is potentially the most controversial characteristic that the composer has integrated into his own music, namely that of appropriation.

Techniques of appropriation can be found as early as the *contrafacta*, paraphrase or imitation masses, and parody masses of the 15th and 16th centuries⁶⁹. Composers such as Guillaume Dufay (c. 1397–1474), Josquin des Prez (c. 1450–1521), and Giovanni Pierluigi da Palestrina (c. 1526–1594) wrote many works which took a known secular or liturgical work, either its melody or several of its parts, and altered it somewhat through elaboration or augmentation and then wrote other parts around it.

Charles Ives is often named as the founding father of appropriation in music of the 20th century. In his article "Intervallic Structural Elements in Ives's Fourth Symphony", Gordon Cyr (Cyr, 1971) presents thirteen melodies by other composers and sources found in Ives's Fourth Symphony before stating that "The borrowed melodies quoted so far represent, of course, only a fraction of the tunes actually used in the Fourth Symphony."⁷⁰ Robert P. Morgan (Morgan, 1978) describes Ives's implementation of quotation by writing that, "Borrowed material is fragmented and juxtaposed against other kinds of music, combined simultaneously with different music, distorted through complex and ambiguous phrase relationships, or distanced by means of elaborate orchestrations that contradict the material's true heritage."⁷¹

Ives himself (Ives, 1920) writes:

If a man finds that the cadences of an Apache war-dance come nearest to his soul, provided he has taken pains to know enough other cadences—for eclecticism is part of his duty[...] let him assimilate whatever he finds highest of the Indian idea, so that he can use it[...] in his symphonies, in his operas[...] this is all possible and necessary, if he is confident that they have a part in his spiritual consciousness. With this assurance his music will have everything it should of sincerity, nobility, strength, and beauty, no matter how it sounds.⁷²

The predominant tendency during the first half of the 20th century was quite different to the the approach of Ives. The traditional role of the author/artist described above, whereby the artist is seen to have superior insight and skill, results in an essentially elitist approach to art. The meaning of a text or work of art was seen to be solely related to that which the author/artist intended to express or to the interior relationships of the work itself. The role and value of the author was very clear.

However, in the second half of the 20th century, these hierarchical systems began to be challenged. Arborescent hierarchies gave way to rhizomesque networks, as evident in Deleuze and Guattari's 1980 publication *Mille Plateaux* (Deleuze and Guattari, 1980).⁷³ The elitist status of the individual artist was weakened. The meaning of a work of art was now seen to rest at least in part and often in total in the interpretation by the recipient and the influence of exterior references rather than in that which the artist desired to express. In 1968 Roland Barthes declared that the Author, as a role or concept, was dead.⁷⁴

Another trait of the modernists, as pointed out by Kramer (2002), was a perception of history as linear progress, coupled with the goal of remaining on the cutting-edge of that linear development.⁷⁵ The concepts of the *cutting-edge* and of *progress* imply that new works or techniques, though arrived at through linear progression, are somehow an improvement over those used earlier and often even supersede them, setting up a potentially oppositional relationship to those preceding them in their historical lineage, however gratefully and respectfully.

As the century progressed from modernism towards postmodernism, the attitude that the state-of-the-art in the present was a linear progression with a cutting-edge that superseded events, attitudes and work in previous eras also began to be more and more interspersed with attitudes embracing the past as well as the present in their own work, as pointed out earlier by Kramer and Jencks⁷⁶.

Artists using techniques of appropriation were also repositioning themselves to their past in an embracing manner. The third movement of Berio's *Sinfonia* made use of appropriated music of Gustav Mahler (1860–1911), Schönberg, Richard Strauss (1864–1949), Ludwig van Beethoven (1770–1827) et. al. in a manner by which the direct quotation was not only a deconstruction of the individual fragments but also an homage to works and composers he admired.

The use of quotational fragments is often undertaken as an abstraction of the work's matter from its originally intended meaning, without implying that placing it into a new context gives it any new meaning. Often, works utilizing techniques of appropriation are not to be seen as a commentary or representation of the source material. In his article "Cage and postmodernism", Alastair Williams explains with regard to Cage's "Writing through Finnegans Wake" pieces that, "Envisaged like this, the piece is neither about Joyce nor an interpretation of him but, rather, a presentation of him."⁷⁷ James Pritchett explains that "[Cage] simply presents the situation unadorned, without comment[. . .] This understated approach to making a music that refers to the non-musical world is one of Cage's most exciting achievements as a composer."⁷⁸ Joakim Tillmann writes that Danuser "cites Peter Bürger's thesis that in postmodern thought signs just refer to other signs and not to something signified."⁷⁹ (None of this is to say that such techniques cannot ever be used as commentary or reflection. Björn Heile (Heile, 2002) comments that "these works [by Kagel] tend to be reflections on music as much as simply music. Music becomes the object of discourse as well as its medium."⁸⁰)

All of this radically altered the perception of the role of the author, in some interpretations making it fully redundant⁸¹. Not only the role of the author himself was in question, but also the role of other authors. One con-

sequence of this was a more increased trend towards appropriation within the creative process. The work or property of other artists, in whole or in part, was arrogated and incorporated into an artist's own work. If the meaning and value of the work was not solely that which was placed into it by the author but rather only emerged when interpreted by the recipient, the work could be seen to more rightly belong to the recipient, not the author. The recipient, then, since the work belonged to him, was free to do with it what he pleased. Of course, in adopting these attitudes and techniques of appropriation, the artist was also taking a position on his or her own role as an author, reneging to various degrees on his or her own authorial control.

Techniques of appropriation in a postmodern context therefore offer a strong provocation in regard to concepts of originality and authenticity. Being that authenticity is generally associated with that which comes from the source, referring in this context most directly to the author⁸², the "death of the author", in the Barthesian sense, dissolves the contingency of authenticity on authorship.

In a different slant on quotation, one that still makes room for the transferral of meaning, Umberto Eco (Eco, 1983) suggests that the value of sincere objects of expression can be diminished by the fact that they have been expressed before in an exceptional manner. His recommendation is to intentionally wrap any such sentiment in a referral to the remarkable versions of similar statements in the past, formulating it as a kind of paraphrase or indirect quotation. Should an artist wish to express something in a manner that has already been used to express similar sentiment by another artist, even if this is an expression of something that is common to all artists or all people, he or she risks implying a false innocence. This can be avoided, according to Eco, by quoting the original, thereby showing that the artist is not naive or falsely innocent, but expressing something authentic in an age of lost innocence. He writes, "At this point, having avoided false innocence, having said clearly that it is no longer possible to speak innocently, he will nevertheless have said what he wanted to say."⁸³ Eco's thoughts here appear to justify the use of appropriation as not only a legitimate but also a requisite vehicle for the expression of sentiments similar to those already expressed.

Adorno posited a measurement of artistic authenticity that was in great part based on his conception of the autonomous work of art as coupled with morality. Rose Rosengard Subotnik explains that “Adorno never sees himself as having to choose between structural and moral value, because for Adorno the two are essentially synonymous.” She quotes him as saying that “no music has the slightest esthetic worth if it is not socially true.”⁸⁴ Tillman explains that “The idea of authenticity in musical modernism during the ‘50s and ‘60s was governed by Adorno’s philosophy of music,” continuing that, “Only the composer who used the most advanced musical materials and avoided worn out ideas could claim to be authentic.”⁸⁵ He points out that “As postmodern music breaks with the ideal of progress and the modernistic canon of aesthetic prohibitions, it cannot be authentic in Adorno’s sense.”⁸⁶ In Subotnik’s deconstruction the Adorno-Schönberg-ian concept of authenticity via autonomy, she points out that, “[f]or most listeners, the barriers of Schoenberg’s style, which in many ways seem to simulate a condition of great cultural distance, are simply too formidable to be penetrated and discounted as secondary by a focus on structure. Most listeners stand a chance of becoming engaged by Schoenberg’s music only in the sense that by gaining sufficient access to the usages and characteristics of his style they might come to recognize its affinities with their own twentieth-century cultural experience.”⁸⁷

Following Subotnik’s train of thought, it appears logical that even a work performed in its “original” form with an explicit assignment of authorship to a given artist can no longer claim to meet the demands of authenticity that Schönberg and Adorno ascribe to structure and autonomous musical composition, in particular after the passage of a certain amount of time. Assuming, from the postmodern stance described above, which the author of this paper holds, that no work is truly autonomous and solely dependent upon interior relationships and references in determining its value and meaning for the recipient, no contemporary listener will have at their disposal the full spectrum of knowledge and experience required to determine an earlier work’s authenticity. This again suggests a legitimation of techniques of appropriation and quotation.

Against this backdrop of modernist and postmodernist concepts of the

author and authenticity, it can be stated that the composer of this dissertation has taken an approach and attitude more resembling that of postmodernist thought with regard to the justification of appropriation as a legitimate artistic technique. Similar to the later text-based works of John Cage, such as *Mureau*, *Muoyce*, *Empty Words*, or *Writing through the Cantos*, the composer's compositions are not about the work or person of the original author, but a presentation of them. Similar to both the work of Berio and Cage, he holds the artists whose work has been appropriated in high esteem, and the resulting works, if not about them, on one level all contain a degree of homage.

The primary difference between the composer's implementation of appropriation processes and those of the postmodern composers described above is that not the material is appropriated, but the artists' techniques. In other words, he does not make use of direct quotation of recognizable melodies. Instead, various attributes of the "quoted" artists' works are arrogated. Firstly, the proportional relationships of phrase-lengths in the texts of Samuel Beckett were analyzed and converted into probability tables to serve as the structural, time-based foundation (empty structure) for all of the works the composer has produced since 2007 (starting with the *Oracle*). A second instance of technical appropriation involves the homophonic harmonic sequences found in the *Dead Repetitions* of Bernhard Lang's *Differenz/Wiederholung 2*. Again, the chords of the original were analyzed to find rules and probabilities that would allow the composer to create new harmonic sequences which were at once original and yet can be seen to be the inherent essence of the source. These homophonic harmonies were then set aside for the remainder of the composer's work between 2007 and 2010 and were replaced by a third appropriated technique, namely that of the polyphonically based harmonic progressions of Luciano Berio in his *Ritorno degli snovidenia*. As with the other instances, rules were derived from an analysis of the original and converted into probability tables that were incorporated into a computer algorithm. The result is again the automatic generation of several new and individual instances of harmonic sequence, all of which can be seen as *being* the essence of the passage analyzed.

A fourth technique of appropriation is found in the composition *Rattling*

the Cage from 2009. In this work, the composer uses the exact rhythms and the melodic contours of 16 motives from Cage's *Sonatas and Interludes* as the source for his own motivic material. Though the exact pitches are modified (in line with the automated harmonic progressions based on Berio generated by the algorithm), the melodic shapes and rhythms are maintained.

The final appropriated technique is that of orchestration. For this undertaking, the composer used the work of Schönberg as a source for his appropriation. The decision to implement Schönberg's instrumental techniques into the work of the composer was arrived at after the completion of the first draft of his orchestra piece, now entitled *Return Through the Beautiful Sopping Mountain*. Because of this, the durational, harmonic, and motivic structures of the work had already been automatically determined, and the pitches and rhythms had all already been filled into the empty structures. No analyses of Schönberg's combinations had yet been undertaken and no probability tables had been derived from such analyses. The instrumental combinations were thus taken intuitively, "by hand" so to speak, from the score of the *Five Pieces for Orchestra* by jumping around through the various movements and choosing applicable passages, the instrumentation of which were then applied to the already existing score. This is a process that will be implemented into the algorithm for automation in its next version, in a manner such that the decisions will have already been made when the structure is output by the algorithm, making it an organic element that is incorporated into the actual writing of the work right from the start, rather than a technique which is applied to a preexisting composition.

In essence, all of the techniques of appropriation employed by the composer come together and find their culmination in *Return Through the Beautiful Sopping Mountain*, hence its name. The composer has chosen titles for all of his works from 2007 onward that reflect the source of his appropriation. Thus, the majority of the works were given titles consisting of two-word fragments from Beckett's *Texts for Nothing*, such as *Words Like Smoke*, *Creeping Saffron*, *Interminable Delirium*, etc. For the Cage homage, he made the title out of a play on the composer's name, *Rattling the Cage*. And the title of the culminating orchestral work, which appropriated characteristics of Berio, Beckett, Cage and Schönberg, he included references to all three

artists, *Return* from *Ritorno degli snovidenia*, *Through* from Cage's *Writing Through...* pieces, *Sopping* from Beckett's texts, and the *Beautiful Mountain* from Schönberg.

As a final note, it is important to mention that the manner by which the composer has incorporated all of these appropriated techniques further exemplifies his concept of repetition on the z-axis, as described above, a concept appropriated from Deleuze and Derrida via Bernhard Lang. In concept, all of the composer's compositions created from 2007 to 2010 are in essence repetitions on the z-axis of the same, unmanifestable composition. They are all based on the same rules of probability, which are deemed to be the essence of the techniques appropriated. From this standpoint, the composer considers none of the works to be autonomous or self-contained, and all of them to be extensively dependent on references to exterior objects for their existence.

5

Design, Material and Methods

The design of the research undertaken is similar to the conception of the individual works that this research has produced. Specific intentions were set forth, realized, and assessed on a step-by-step basis rather than as prescribed by a previously structured, initial design. The next step often only became evident during or after the completion of the previous one.

The author's objectives, as put forth in the *Introduction*, are not of the nature that they can be represented in one final, singular result attainable through one clearly designed path. Instead, they are intended to generate a series of rules that allow for a multiplicity of equally effective but otherwise potentially disparate results (compositions). The design of the research was therefore less linear and more modular.

The modular element of the research's design is seen in the stepwise extension of the algorithm by one or two new features or modifications with each new piece, gradually bringing the author closer to compositions that embody his attitudes in the kind of style for which he is searching.

The design is therefore a work in progress, and next steps are always emerging, even though a certain degree of arrival is always identifiable.

The specific path which has been followed can thus best be examined by a discussion of the works in their order of creation. This allows for a general categorization of the composer's work over the past four years into periods of 1) freely improvised fragments, 2) modular and linear repetitive structures based on Beckett, 3) an initial version of the algorithm with a tonal basis, 4) a second version of the algorithm with non-tonal, polyphonic harmonic basis, 5) an incorporation of harmony into the fixed media part of mixed works, 6) the use of an equal-tempered harmonic sequence as the pitch basis for fixed-media-only pieces, and 7) works with a pronounced degree of appropriation in the context of homage.

5.1 Freely Improvised Fragments

The point of departure for the composer consisted of an approach which consisted primarily of the layering of several improvised melodic fragments. The method used at the outset was to prepare an empty phrase structure in advance, to improvise melodic fragments for each of the instruments in each of the phrases using a MIDI keyboard and sequencer software (Digital Performer), and then to transcribe the music entered into a tidier form using the open-source, script-based music-notation environment LilyPond, editing pitch, interval, and rhythm based on personal preference and performability. The last work approached in this manner, *... all is noise...* is a transitional work to his most recent undertakings and is therefore the first to be discussed here.

5.1.1 *... all is noise...* (2005–2006)

... all is noise... is a work for temple blocks, piano, violin, cello and double bass. The work was requested by the ensemble Trigger of Hamburg in 2005 but was never performed, since the ensemble's instrumentation changed before the work was completed.

The work serves as a transitional composition between the use of freely improvised, non-repeating melodic fragments and the use of repetition in conjunction with a limited number of specific melodic-rhythmic motives.

The work has no underlying harmonic progression, and the melodic construction is based primarily on preferred intervals that give the work its aural flavor. Rhythmic figures predominant in this work continue to be used in the composer's current compositions. A preference is given to rhythms which obscure any sense of pulse or meter, making use of ties and tuplets to achieve this. The instruments seldom play any given attack simultaneously, though in this particular work, the use of both *tutti* simultaneous attacks and occasional *tutti* unison or octave pitches are implemented as a contrast to the otherwise asynchronous material of the composition.

The work also uses the approach of slight rhythmic and pitch-based variations of the same melodic gesture being performed by several or all instruments simultaneously. This technique, referred to by the composer as *precise imprecision*, is a modification of a technique maintained from his earlier stylistic approaches. It is expanded in this work to encompass philosophical and form-related standpoints new to the composer. Firstly, this technique of simultaneous variation was conceived in this piece as a presentation of several manifestations of the same non-manifest musical concept, as described in detail in the *Theory* section above.

Secondly, while the performance of two or more nearly exact melodic gestures was used as a blurring or shadowing effect of one *tutti* line in previous works, the blurring in this context was expanded to conceive the entire ensemble as one instrument rather than a combination of instruments whose parts each consist of different functions (such as fore-, middle-, and background or melody and harmony). An analogy can be drawn to the function of a group of singers performing a homophonic choral work. Another analogous constellation would be that of a church congregation reciting the same text during a responsorial within a mass. Each individual is speaking the same words, but at slightly different speeds, at slightly different pitch levels, and with slightly different intonation. The result is a kind of mumbling that was very attractive to the composer within a musical context.

The structure of the work was based, for the first time, on one of Beckett's *Texts for Nothing*. The first of the texts was spoken into a microphone by the composer and recorded to hard disk. The lengths of the individual phrases in the composition were then based on the lengths of the spoken

phrases of the text. One attractive aspect to this approach was Beckett's fragmented prosaic form, with short word phrases separated by commas, a form which could be seen as a combination of prose and haiku. The resulting reading was one with a short pause between the word phrases, induced by the commas. This was translated into the musical setting as rests.

The composer attempted, also for the first time in this piece, to adhere to the repetition of material in the text. Where paraphrases of similar content in the text occurred, the composer strove to create a comparable kind of "paraphrase" in the musical material. This was adhered to loosely for this piece, while later works adhered to the pre-determined word structure much more strictly.

One of the sources of the idea of preparing an empty structure in advance based on the outline of another medium—in this case text—came from the composer's previous work setting electroacoustic compositions to collaborative audio-visual projects. In all but one of these projects, the visual component was completed prior to the beginning of work on the musical composition. The structure of the composition (patterns of motivic material and divisions in time) was thus essentially predetermined. The composer decided to continue working with predetermined structures and motivic patterns by borrowing many of the techniques and atmospheres of the Beckett texts.

The work was quite successful, but not resoundingly so. The rhythmic figures are very difficult to perform, and the quintet would require a conductor for any semblance of synchronicity. While the composer is convinced that a proper performance would be possible and effective, he considers a refinement of the approach with more emphasis on performability necessary.

The complete score of the composition can be found in Appendix B.1 on page 202, and a MIDI mockup of the work can be found on the accompanying audio-CD.

5.2 Modular Repetitive Structures Based on Beckett

The next stage of work serves as the actual foundation of all following works in the ensuing period of research. One of the Beckett texts was analyzed in

detail to provide the structure and patterns of repetition for an electroacoustic composition. An approach to *modular structure* was developed, whereby the same macro-structure could be used repeatedly while the individual segments of that structure were interchangeable with other segments that had been composed using different material but had been devised to fulfill the same structural function. The primary work of this stage was the audio-visual-text installation *Oracle*, produced together with Robert Darroll for the ZKM (Zentrum für Kunst und Medientechnologie—Center for Art and Media) in Karlsruhe, Germany.

5.2.1 *Oracle* (2006–2007)

Oracle (*Orakel*) is an audio-visual-text installation that was created on request by the Karlsruhe ZKM for their 360-degree panorama screen. The work was created in collaboration with visual artist and digital animator Robert Darroll, with whom the composer had previously worked on two occasions for the audio-visual works *Noemata No. 1* (1999–2000) and *BED-LAM* (2004–2005). The work was produced with a grant from the ZKM Karlsruhe, where it was also premiered and has since twice been shown.

Concept, background

The installation offers the viewer an amusing interactive experience while providing an opportunity to contemplate the value and functions we currently ascribe to digital technology and the theories surrounding New Media and New Media Art. The basis for many truth-seeking rituals throughout cultures and history is and has been the interpretation of chance, be it the throwing of yarrow sticks to form *I Ching* statements, the reading of tea leaves, the random drawing of a fortune scroll, or divination through Tarot cards. Such rituals are often founded in two essential beliefs; firstly that there is an absolute Truth, and secondly that some higher power or essence, which exists in a dimension that we cannot perceive, possesses an ability to conceive such truth in a manner which is so beyond our capacity to understand that any statements it may impart will appear to us as incomprehensible riddles. Generally these statements are then relayed to us,

and occasionally interpreted, by other mortal humans who hold an elevated position within our society due to their special sensitivity to things beyond our perception. Although the artists' intentions were firstly and foremost to create a work with an aesthetic that is enjoyable and amusing in its own right, *Oracle* also plays, in part, on the mystical trust we place in digital technology, New Media, and New Media Theory—as well as in the relayers and interpreters of such technology and theories—by implementing the computer as a modern-day, digital, chance-based oracle.

The texts for the work (the oracular readings) were written by Robert Darroll. A German version of the texts was then translated from the English and prepared by Petra Kaiser of the ZKM. The texts were recorded by American-born, Heidelberg-based opera singer Ed Assali and German, Karlsruhe-based actor Harald Schwiers (see Appendix A.1.1 on p. 159 for an example of the English texts).

The original Oracle was created for projection on the ZKM's specially developed 360-degree panorama screen and 8-channel surround-sound system with a touch-screen podium at the center of the screen as the user interface. A database was used to store 77 video clips of between 45 and 120 seconds duration, each containing a sound-track. Upon the user's triggering of the sequence, a selection of 10 of these clips was made by software specially programmed by technicians of the ZKM that operated on chance-based rules governing the order of playback, and a sequence consisting of those 10 clips was played from the hard-disk.

The user stands at a podium approximately in the center of the 360-degree screen, which measures 2.5 meters in height and 8 meters in diameter. The podium consists of a touch-screen interface which allows the user to type in a question which they would like to pose to the Oracle. Once the question is entered, the user clicks on a virtual button on the screen to receive his or her oracle. The user is then shown a 6-to-8-minute, individualized sequence of digital animation, during which a series of oracular statements are made by gigantic talking heads, accompanied by an electro-acoustic composition heard through the 8-channel loudspeaker array located in a circle around the top of the perimeter of the panorama screen. When the sequence has finished, the screen returns to the default

welcoming state, inviting the next user to participate.

The structure of the Oracle project was based around 10 stages of various oracular rituals from different cultures. They consist of Clearing The Space, Creating the Circle, three instances of Religious Figures Calling Upon the Oracles (Song), three appearances of the Oracles themselves, Dismissing the Oracle, and the Destruction of the Circle.

Structure

The modular structure of the interactive installation posed a particular challenge for the composition of both audio and visual components of the work. The composer and the visual artist wanted each possible combination of segments to have the same structure, the same patterns of more and less intensity, and follow the same overall form. This meant that the overall structure and form must first be devised. Once this had taken place, the composer and the artist created several versions of each clip for each section. Each clip would follow the same overall arc and flow but would make use of different material, such that replacing one clip from a given section with another clip that had also been composed for that same section would not alter the overall structure or form of the resulting sequence.

To achieve this, the composer leaned on his previous use of Beckett's *Texts for Nothing* as a basis for the modular structure of *Oracle*, choosing the twelfth of these texts as a basis for this particular work. The text was analyzed with regard to its number of words, length of phrases, and its motives. Tables were then assembled, lengths were determined and scaled, and electroacoustic miniatures were created for each of the 77 animated video clips.

The text was first divided into ten sections. The division of the sections was set at the occurrence of a comma in the text so as not to break the phrases. The sections were roughly set to be slightly longer or slightly shorter based on the average lengths of the given video clips, which had already been created (see Fig. A.1 on p. 160). The number of phrases in each section were then counted, as were the number of words (see Appendix A.1.3 on p. 160).

Each of the phrases of the original text, determined by their separation through a comma, was isolated and given an identification number. The words within each phrase-fragment were analyzed for their meaning, and categories of meaning were determined. Each word in every phrase was assigned to a meaning-category. Assignment of words to categories was performed in a manner that was musical in nature; synonyms and paraphrases, as well as antonyms, were all allocated to the same category, much in the same way that variations of a musical motive, including its retrograde or inversion, would be categorized as the same motive. The meaning categories were thus translated into motive categories. Each motive category was given an arabic number, and each new member of that category was given a label constructed from the number of the motive category and a letter of the alphabet, the letters increasing sequentially with each new motive.

The individual phrases were then entered into a databank, line by line, and a list was made of the textual motives occurring in each phrase. The number of words in each phrase were also counted at this point. The resulting list of 145 phrases and the motives of which they consist, divided into 10 sections of unequal length, then served as the empty structure that was to remain identical for every version of the oracle sequence (see Fig. A.2 on p. 161).

All of the different clips of a given section (*Dance, Clearing, Singers* etc.) always had the same number of phrases, which in turn consisted of the same number of motives. The length of each musical phrase within a given section maintained an equal ratio to the number of words in the corresponding text passage. A musical phrase in the electroacoustic composition that corresponded to a text fragment with eight words would always be twice as long as a musical phrase that corresponded to a text fragment with four words.

Although the different clips belonging to a given section were occasionally of the same duration, they were generally of varying lengths. This was dealt with by scaling the duration (in seconds) of the section and the phrases that made up an electroacoustic clip in such a way that the phrase-length ratios always remained identical. To do this, the duration of the video clip was first determined, then divided by the number of words in the corresponding section of the text. This served as the "word length", or the basic unit of time

measurement, for that particular clip of that section of the electroacoustic composition. The durations of the individual musical phrases of that electroacoustic clip were then determined by multiplying this basic unit of time by the number of words in the corresponding text passage. The absolute start and stop times for each phrase were determined as well in this step. These were predominantly adhered to throughout the composition, though on a small number of occasions they were manipulated by the composer in order to synchronize with events in the video clips, or in order to better reflect the character of the clips (see Fig. A.3 on p. 162).

It should be pointed out that despite the intricate extrapolation of musical structures from the original texts, the point of the analysis was not to create an exactly accurate representation of the text, but rather to abstract a repetitive structure for the piece. The allocation of various terms to specific categories may therefore often be questioned, but this bears no final relevance for the musical work itself.

Sound motives

The next step in the process consisted of assembling a collection of digital sounds that would serve as motives for the work. This was done by first counting and identifying the number of motives found in each of the 10 sections of the text and the number of motives identifiable in each of the animation clips. This revealed, for example, that a total of 12 motives were used (motives numbers 1–12) in the first section of the text, which served as the underlying structure for the *Dance* section of the final composition; the second section of the text (the basis for the *Clearing* section of the final composition) contained 16 motives (motives 1–3, 5, 7, 10–12, and 15–22), and so on. Once this was determined, visual motives were identified in each of the animation clips. In instances where there were fewer visual motives in the animated material than were found in the corresponding text passage, the lower number was used for the final structure. Each visual motive was thereby allocated to a text motive, which in turn would be allocated to a sound motive.

The composer's modular approach to structure would only be effective

if each clip from the same section had the same number of motives. He therefore chose a limit to the number of visual motives that could be found in any given clip for a specific given section. If any of the clips had more than the selected number of motives, the strongest motives only were identified and labeled, their strength being based on how present they were in the overall image (large foreground images vs. smaller background images for example) or how likely the viewer was to have his or her attention drawn to that motive, be that based on color, contrast, detail or even the potential for eliciting more intense emotional reactions in the viewer; and the remaining motives were disregarded. Therefore, all three versions of the *Dance* section have 12 motives, for example, and all four versions of the *Dismiss* section have 16, and so on.

Each of the visual motives found were identified and labeled with regard to their material content. They were categorized into either hand-drawn motives, moving images from *found footage*, still images from found footage, effects, or *physical models*. Each motive in the text was always associated with the same motive in both sound and image, with a very small number of exceptions (see Fig. A.4 on p. 163).

One source sound was then determined for each of the visual motives identified. The source sound was created by a means which resembled the technique used to create the visual motive. Thus, images that were taken from found footage were always associated with sounds taken from field recordings of some form, and images that were created using 3D animation software were always associated with sound sources that were generated using IRCAM's physical modeling software *Modalys* (discussed in more detail below). Every time a visual motive appeared in any of the clips, the same source sound was used within the electroacoustic composition.

The digital source sound files were manipulated using the technique of *granular synthesis*. Various routines were written in the Lisp programming language, within the Common Lisp Music and Common Music programming environments by Stanford's CCRMA and Rick Taube. These would break the original sound files into very small segments (*grains*), alter the pitch and volume of each grain, and reassemble the grains into a new sound file. During reassembly, the grains could be put back in the original order or in a

different order; they could be separated by silence, or the endings and beginnings of each grain could be slightly overlapped; or several instances of the same grain, modified in different ways, could be superimposed upon one another. In some instances the entire source file would be fragmented; in others, only a segment of the source sound file would be used. By this means, the newly synthesized sound files could have a broad and differentiated spectrum of complexity, density, and overall character, from results that sounded barely altered, to those in which the source sound was unrecognizable; from sounds which were smooth, flowing, and sparse to those which were pulsating, jagged and complex.

Once the routines had been programmed for the manipulation of the source sounds, new scripts were written that resembled a score. These instructed the computer which source sound files were to be manipulated using which permutation routine, in which order—with start times and stop times specified—, and at which relative volume. One script was written for each mini-composition for each of the 77 animation clips, and once these had been each individually generated (rendered), they were attached as soundtracks to the corresponding clip.

Programming—CLM and CM

The software used for the *Oracle* project consisted of functions and routines programmed by the composer in the two Lisp programming environments Common Lisp Music and Common Music, as well as the commercial software Modalys, sequencing software Digital Performer, QuickTime and iMovie, and the open-source waveform manipulation software applications SoundHack and Audacity.

As a first step, a grain generation routine, referred to as an *instrument*, was programmed using the Common Lisp Music programming environment. This routine produces only one grain of sound as its output. The grain generation routine takes mandatory arguments for output filename and start-time of the output within the output file. Optional arguments are available for the grain duration, the relative volume of the grain, the sampling rate at which the grain is to be written, a longitudinal volume curve for the grain, the

beginning time-point within the source sound file from which the grain is to be taken, the virtual location of the generated grain along a 360° perimeter, the perceived distance of the sound from the listener, and the reverb depth. These optional arguments were assigned default values for instances in which they were not specified by the user. The meanings and default values of these arguments can be found in Appendix A.1.5 on p. 163. The granulation instrument itself can be found in Appendix A.1.6 on p. 164.

The next level of programming consists of two slightly different algorithms, referred to as *functions*, for generating an output sound file by assembling a sequence of grains. One of these algorithms generates a sound file that conforms to a specified rhythm, the other generates a smooth, or arrhythmic, output sound file. The primary difference is that the rhythmic algorithm takes a mandatory argument that specifies a sequence of durations, while the smooth grainer does not.

The *rhythmGrainer* function takes as mandatory input values for the output filename, the start-time of the output within the output file, a list of durations for each grain, and the relative volume of the output file. It has optional arguments (with default values when not specified) for the playback rate (pitch), the degree of random deviation of pitch, an envelope describing where the grains are to be taken from within the source sound file, the degree of random deviation from that location, a longitudinal description of the duration of each consecutive grain, the degree of random deviation from this duration, an envelope describing the changing volume of the output file over time, the overall volume of the output file, the virtual location of the generated sequence of grains along a 360° perimeter, the degree of random deviation from that location, the perceived distance of the sequence of grains from the listener, and the reverb depth. Each of these arguments can be entered as static values or lists of values that produce perceived movement or change over time in the resulting sound. The meanings and default values of these arguments within the *rhythmGrainer* are found in Appendix A.1.7 on p. 164. A segment of the *rhythmGrainer* function itself can be found in Appendix A.1.8 on p. 166.

The second iterative routine defined for the generation of grain sequences, labeled *smGrnEnv5* (*smooth grain envelope 5*) differs only mini-

mally from the first. This routine is intended for the generation of smooth (non-rhythmic, aperiodic) output sound files. Accordingly it is lacking the mandatory sequence of durations which specified the rhythm in the first routine. Instead, it allows for two additional optional arguments, one for the time interval between the attacks of consecutive grains, and the other for the degree of random deviation from this value. The first of these allows the user to determine a linearly changing time interval between the beginning of each consecutive grain, using breakpoint pairs in which the first value of the pair indicates the percentage of the total output file duration, the second value of each pair indicating the time interval between the beginning point of each consecutive grain. The second of these two arguments correspondingly modifies this basic time interval by adding or subtracting a random value (in seconds) from within the stated range.

When these functions are then called into action from within a “score” script, they continue generating one grain at a time until the stop time indicated in the score. With each iteration they pass the individual values calculated from the functions’ arguments to the arguments of the single-grain generating instrument described above. Two safeguards are included in the functions to prevent premature abortion and unsuccessful generation of the output sound files, namely a check to see if the current intended grain duration is long enough to apply a volume curve (this is not the case in grains of only a few samples, where there are too few samples to calculate a series of breakpoints), and, similarly, a check to see if the duration from the starting point of the final grain and the specified end of the output sound file is great enough to allow for a grain to be generated.

Each of these iterative routines are dependent on two smaller functions that are loaded into the Common Music programming environment at the beginning of a session. These consist of the *findGreatestListItem* and *rand-PlusMinusScaler* functions. The former determines the greatest value within a list passed to the function, and the latter enables the selection values of a range from $-x$ to $+x$ by only needing to state the positive value of x .

The third step of the programming consisted of creating a series of mini-functions, which the composer refers to as *algorithmic motive functions*, that attach specific values to each of the arguments from the *rhythmGrainer* or

the *smoothGrainer* and assign them to a variable name. By this means, the same pattern of granular synthesis can be repeated at any point and any number of times in the course of the composition. In an extended definition of the term “motive” specific to composition using iterative routines in computer-generated music, the composer considers the iterative process itself to be a motive, since it is an object of repetition, whereby the source sound file being permuted by this process may vary.

The application of this approach to algorithmic motives was very suited for the *Oracle* project. Since the structural concept behind the project consisted of having the same structure for each clip of the same section (*Dance01*, *Dance02*, *Dance03* for example), the visual components of which contained different images but served the same function, the music of each clip also adhered to the same function, using the same algorithmic motives while varying the source sound material.

In addition to the arguments of the iterative routines, these algorithmic motive functions also had three of their own arguments, namely the start-time in the output file, the end-time in the output file and the relative volume of the sound segment generated. These arguments were programmed into the mini-functions themselves to enable the composer to call them from within the “score” scripts.

The *Oracle* project made use of one algorithmic motive function for each motive identified in the text and animation. A separate instance of each algorithmic motive function was defined with the same parameters for each sound source that was used in conjunction with that motive. Since each clip may have many different image motives, requiring many different sound sources, a total of 1542 algorithmic motive functions were defined. A specific labeling system was devised to identify them so that they could be recalled at any point in the scores. Each of the motives were tested individually first, before they were combined and mixed with other generated sounds. This allowed the composer to ensure that there was no distortion or clipping in the output files. Examples of the algorithmic motive functions can be found in Appendix A.1.9 on p. 167.

The final step of this stage of the programming consisted of putting together what the composer calls a “score” script for each of the musical seg-

ments. The concept of the score script is much more related to the use of the Csound music programming environment than to that of Common Music and Common Lisp Music environments, but it suited the needs of the composer for this project.

The score scripts function in a very basic manner. The composer made use of the *with-sound* operation that is a component of the Common Lisp Music (CLM) programming environment and has a number of arguments of its own that facilitate the sound generation process. The arguments made use of by the composer included those to determine the number of output channels, the sampling rate and bit-depth, an overall amplitude value, the selection of which reverb instrument was to be used, and the decay-time for that reverb instrument. Once this information had been entered, the composer created a list of *function calls* that would run the predefined algorithmic motive functions in a particular order, passing them the specified values for start-time and end-time within the the output file, and the relative amplitude (volume) scaling of that sequence of grains. The score scripts also included comment lines that identified the corresponding segment of the original Beckett text. An example of a score script used for the *Oracle* project can be found in Appendix A.1.10 on p. 167.

Drawbacks to the CM-CLM programming for this project

One of the drawbacks of constructing an electroacoustic work in this manner is the lack of ability to specifically graphically mix the resulting sounds. Functions such as E.Q., inserts and sends, and subtle volume balancing could not be applied to individual sounds within the mix.

Another initial drawback that ended up becoming a positive feature was an inconsistency that arose through the multiple layers of instruments and functions programmed by the composer. The result was a maximum scaling of each component in the mix. Though this was remedied in later versions of the composer's algorithm, the version used for the *Oracle* excluded the option of drastic dynamic differences (in particular, very quiet passages) without extensive effort. This became a positive feature, however. The resulting sound of the *Oracle* compositions is essentially one that has been

highly compressed, creating a “wall of sound” that is immersively dense and powerful and very well suited to the character of the installation.

Programming—Modalys

As mentioned above, the source sound material was chosen or created in a manner related to the selection of the visual images. As the visual images, the source sounds were either taken from “found footage” (sound effects CDs, internet audio sample sources etc.) or were generated using physical modeling software. The sounds created using physical models were generated in the Lisp programming language using the IRCAM Forum software Modalys.

As opposed to software used to create 3D visual physical models, the audio physical modeling software Modalys functions with no graphical interface for the user. Instead, the user *describes* the physical attributes of at least two physical objects and instructs the computer in scripted form as to how these objects are to interact. Furthermore, the audio file that is generated from this approach is not a reflection of the resulting sound of the entire object constellation from a specific distance, as would reflect the real situation of a human listener. Instead, the user indicates at least one virtual “microphone” point located on at least one of the interacting objects. The waveform created by the vibrations of the object at the location of the virtual microphone are then written to disk as an audio output file.

Modalys comes with numerous pre-defined objects, each of which takes a number of arguments to define its physical characteristics. These objects include strings, circular membranes, free-floating circular plates, fixed circular plates, closed tubes, tubes open at one end and closed at the other, tubes open at both ends, piano soundboards, rectangular membranes, rectangular plates, violin and cello bridges, single points, and coupled points. Combinations and hybrids of these objects are also available, and the user can always define his or her own objects as well.

The descriptive arguments available for these objects include attributes such as length along the x-axis, length along the y-axis, thickness, density, tension, radius, Young’s modulus for the amount of inharmonic partials cre-

ated by the sounding object, stiffness, rate of frequency loss, and the rate of overall loss of energy.

Once at least two objects are defined, at least one point of access is determined on each of the objects where the two meet during interaction, and the type of interaction (referred to as the *connection*) is defined. Types of connection include adhering, bowing, applying force, the presence of a hole in the object, absolute position, plucking, velocity, striking, and the presence of a reed (such as in the modeling of a clarinet). These connection types also take arguments to describe the effect they have on the objects they are connected to, such as initial position, position over time, velocity in meters per second in a specified direction, and force in Newtons in a specified direction. In many cases two or more of these connection types must be combined in order to generate a sound. One such case would be striking a rectangular plate from above with a smaller object, in which case the initial position of the smaller object must be defined prior to instructing the computer to project the smaller object towards a collision with the larger object by means of applying a specific velocity or force to the smaller object.

Other sources of input energy can be used to excite the larger objects in addition to a second object. These include white noise, sine waves, band-limited noise, breakpoint envelopes, midi files, scales, or previously recorded sound files. Thus, for example, a recording of a human voice singing or speaking can be used to excite a circular membrane. When the vibrations that this interaction causes in the membrane are recorded, the result is a sound file that imitates the sympathetic resonance created by a singer projecting his or her voice into the membrane of a kettle drum, for example.

Various other functions are also available for the definitions of objects, such as “with-pitch-adjustment”, which allows the user to determine which pitch frequency is to be generated by the object constellation described. In this case, the values necessary for the other arguments in order to create this pitch are calculated automatically by the program.

The Modalys software was essentially created for the purpose of studying and recreating real sounds based on the physical properties of the interacting objects and the laws of Newtonian physics. While this can prove very

helpful in providing insight into the mechanics of real sound by inputting the most accurate values possible for the arguments provided, the composer concerned with abstract sound finds himself or herself more attracted to the sounds resulting from *inaccurate* values. These *wrong* sounds are often much more interesting to the composer of abstract music than are the realistic sounds, if for no other reason than that they are not immediately identifiable as concrete, existing sounds attached to concrete existing objects and are therefore not laden with pre-existing associations in the mind of the listener, freeing the listener to experience and the composer to create sound-based compositions that are *more likely* (though obviously not completely) capable of being perceived and received in and of themselves. The sounds that result from such *flawed* values are still generated based on the laws of nature, making them realistic in themselves although they are not ascribable to real instruments or objects. As a simple example, the user can instruct the computer to calculate the waveform that results from striking a 40-meter silver cable, with a radius of 7cm and a specific tension, using a 13cm hammer made of malleable aluminum and striking with a degree of force beyond the capabilities of the human arm. Should the resulting vibrations be too quiet to be heard—so long as the frequencies are within the perceptible auditory range—the software will amplify them to an audible level.

Using this software and its programming environment, the composer generated more than one hundred source sounds for the *Oracle* project. The models were created using templates for virtual membranes, air columns, plates and strings, and by making use of striking, plucking, and bowing connections. The resulting sounds were then minimally processed using the software SoundHack and Audacity, primarily to eliminate subsonic frequencies, to select segments of the resulting sounds, or to fade them in and out at the beginning and end of the file to prevent unwanted clicks and pops caused by termination of the recording at non-zero crossings. An example of the Modalys programming code for the *Oracle* project can be found in Appendix A.1.11 on p. 168.

ZKM DeGEM Internet Radio Version

In August of 2008, the ZKM invited the composer to have some of the sequences generated by the *Oracle* algorithms broadcast on the ZKM-DeGEM web-radio station. The Deutsche Gesellschaft für Elektronische Musik (DEGEM—German Society for Electronic Music) and the ZKM have an internet radio broadcast dedicated solely to electroacoustic compositions. The composer took the opportunity to create *concertante* versions of several sequences without the spoken text. Each of the clips were re-rendered in higher-quality audio, with a sampling rate of 48kHz and 24-bit resolution, and generated in stereo sound. Time was taken to clean up the source sounds to an even higher degree, applying low-pass filters to all of them to filter out sub-sonic frequencies, and removing a small number of the source-sounds that had minimal artifacts that had not been audible in the original versions because of the immense density of simultaneous sounds.

The opportunity was taken to adhere strictly to the structures generated by the Beckett analyses, with no overlapping of phrases, and all of the segments were generated anew. A small Lisp script was then created which randomly constructed new sequences, and 16 new full-length sequences were created. These were then broadcast in October of 2008 for two hours at a time twice daily.

Game version

An interactive DVD version of the *Oracle* is currently in progress. The visual artist, Professor Darroll, is currently creating an interface using Adobe's Flash environment, and the composer will be producing new, shorter versions of the audio. The DVD project is intended to allow users to interact with the *Oracle* on their personal computers, without the need for the 360° installation equipment. The new version is to have a 16:9 aspect ratio, cutting out the selected remainder of the originally generated visual material, and the sound will be in stereo. The structure is also to be shortened. Instead of the *Oracle* appearing three times, the talking heads will now appear only once in each segment. This will reduce the average length of each generated sequence to between 4 and 6 minutes, rather than the original 6 and

8 minutes. No deadline has yet been set for the completion of this version.

Performance and reception

The *Oracle* has been installed at the ZKM twice since its completion. The first showing was in November of 2007, when it was visited by over 1800 guests at ZKM's Media Museum in the period of a few days. The second showing was in August of 2008 for a period of several weeks. The number of visitors was not recorded for that showing. Photo images of the installation can be found in Appendix A.1.12 on p. 168. Recordings of the work and segments of the video clips can be found on the accompanying DVD.

5.2.2 *Flying Instants* (2007)

Immediately upon completion of the *Oracle* project, the composer took the opportunity to apply the same approaches developed for that project to a purely electroacoustic composition. The same overall empty structure was used that had served as the underlying basis for the *Oracle*, and the physical models from the same pool of source sounds for the original project also served as the source material for this project, though they were not used in the same order as in the *Oracle* project. Since only one version was made of each segment, the composer required far fewer source sounds. The selection of source sounds was based primarily on the composer's intuitive taste. Sounds that changed over time in their timbre, rhythm, or pitch content, and sounds that had stronger emotive character were given preference. Many of the sounds chosen might be described as "dirty" or "abrasive".

A shorter "word length" (basic unit of duration; see above) was used for the generation of the empty structure. The intention was to create a much more rapidly changing structure. The title was taken as a two-word fragment from the Beckett *Texts for Nothing*. It was chosen, on the one hand, for its relevance to the fast-paced trajectory of short phrase-fragments flying past the listener in time, while on the other hand serving as an homage to the source of the composer's approach to structure for this piece. *Flying Instants* was the first of many pieces based on the Beckett approach to structure that used two-word fragments from the texts as titles.

The composer's desire to reintroduce repetition into his work while still maintaining an atmosphere of structured chaos had been accommodated by the *Oracle*'s large number of source sounds and motives, and he wished to test the musical viability of this approach to structure and repetition in a purely musical setting. A total of 69 algorithmic motive functions were used in the work, a number of them with as many as 6 variations, and 56 source sound files were utilized.

A simpler approach to the nomenclature for the algorithmic motive functions was developed for the score script of this piece.

The piece was premiered in the context of the Crash Ensemble's *Shindig* concert in Dublin in October of 2007. Examples of the algorithmic motive functions use in the piece and a segment of the score script can be found in Fig. A.5 and Fig. B.1 on pp. 169 and 237. A recording of the work can be found on the accompanying CD.

5.3 First Version of the Algorithm with Tonal Basis

During the composition of the electroacoustic composition for the *Oracle* project, the composer was aware of the potential this approach to structure and repetition could have when applied to compositions for real instruments (traditional European orchestral instruments). Two smaller works were first composed using the exact same structure as *Oracle* and *Flying Instants*. The first of these was a one-minute work for guitar quartet entitled . . . *that puts the jizz in you. . .*, requested and premiered by the Dublin Guitar Quartet in 2007. The second was a five-and-a-half-minute work for trombone and cello entitled *Creeping Saffron*, written and premiered in the context of a concert put on by the Young Composers' Collective in January 2008. A third piece, for string trio, was also started using the exact same temporal structure and motive patterns, but abandoned before completion. Though the composer was quite satisfied with the first two of these works, it became clear to him during work on the trio that the use of the exact same structure (time and order of motives, patterns of repetition etc.) for consecutive pieces was limited in scope.

As a remedy to this, the first step was taken on the path towards the cre-

ation of an algorithm to generate empty structures and patterns of motivic repetition based on rules of probability. The algorithm begun at this point in March of 2008 has become the basis for all of the works that the composer has written since.

The intention was to be able to create structures that had the same properties as the one used for *Oracle*, but which would not be the exact same as that specific structure. To this end, the original structure was analyzed with regard to a number of parameters, charts and tables were assembled, and probabilities were calculated for certain kinds of structural and other musical attributes. These were then incorporated into an iterative routine, programmed in Lisp using the Common Music programming environment, which would generate a printout of the desired kind of empty structures.

Although the composer considered the use of non-pitch-based, extended techniques for the instrumental compositions he intended to compose, he decided to first focus on equal-tempered, pitch-based material to be able to pursue his preference for melodic gesture. An approach to harmonic progression was also decided upon which would be founded in implied functional-harmonic relationships of Tonic, Dominant, and Subdominant areas. Probability tables were assembled for the harmonic progressions as well, and subsequently incorporated into the algorithm.

5.3.1 *Words Like Smoke* (2008)

Structure—General

In keeping with the work done on *Oracle*, *Flying Instants* and the subsequent two smaller works, the composer intended to further explore the options of creating work-encompassing structures that were based on exact and non-exact repetitions of non-developing motives set in phrases of varying lengths. The resulting structures were to take the form of a discontinuous sequence of fragments unfolding above an underlying component of implied tonal harmonic progression that was intended to provide the work with a degree of cohesive linearity.

Whereas the phrases in the *Oracle* and subsequent works proceeded *attacca*, with no pause between them, resulting in an attractively intense and

constant flow of non-stop sound, the composer chose for his next work, *Words Like Smoke*, to return to the technique of separating the phrases with an element of silence, as was done in . . . *all is noise*. . . In the period leading up to the composition of *Words Like Smoke* the composer had studied much of the work of John Cage. Cage's approach to silence reinforced the composer's own conceptual approach to disjunct fragments and larger pauses in his music, as described in more detail in the *Theory* section above.

Beckett's 12th *Text for Nothing* was analyzed to provide the probability tables that would govern the algorithm's generation of empty structures. The initial attributes analyzed included the duration of each phrase, the number of motives occurring in each phrase, and the chance of a new motive occurring in any given phrase. As in the *Oracle* project, each individual motive was labeled with a consecutive numerical I.D. to enable further analysis. These numerical I.D.s were sorted consecutively to provide the entire set of available motives. Knowing that the intention was to use a weighted random function to select motives for each phrase by drawing from a different subset of consecutively numbered motives, the texts were then analyzed to determine the span between the highest and lowest numbered motives appearing in any given phrase of the Beckett, as well as the span between the highest numbered motive actually used and the highest possible numbered motive available at that point in the text.

Structure—Durations

To analyze the durations and their probabilities, the total number of phrases were counted in Beckett's *Text for Nothing No. 12*. The total number of phrase fragments was 145. The number of words each phrase contained was then counted. This was to become the number that would be translated into the relative duration of each musical phrase. In the concerned Beckett text this number spanned from 1 to 18. The number of instances of each numerical value were then counted. There were 14 phrase fragments in the original text with 1 word, for example, 11 instances of phrases with 2 words, 32 instances of phrases with 3 words etc. These numbers were then divided by the total number of phrases (145) to yield the percentage of

total phrases consisting of that specific number of words, as scaled from 0.0 = 0% to 1.0 = 100% (calculated to four decimal places). For example, 32 instances of phrases with 3 words divided by a total of 145 phrases yields a scaled value of 0.2207, meaning 22.07% of the phrases are 3 words long. These values were then assigned as a list to a variable in the algorithm such that the probability of any given musical phrase being 3 beats in duration was 22.07% (see Figs. A.8 and A.12 on pp. 171 and 175).

Structure—Number of motives in each phrase (polyphonic density)

The next step was to devise a means to translate the number of motives in each text fragment to the number of motives in each musical phrase. The number of motives occurring in each phrase of the Beckett text (which is not always the same as the number of words) had already been counted in the context of the *Oracle* project. In the original text and the *Oracle*, the number of motives occurring in each phrase spanned from 1 to 8 (see Fig. A.2 on p. 161).

In the context of the *Oracle* project, a decision needed to be made as to whether to implement the motives in a phrase vertically or horizontally. On the one hand, it would be truer to the text-model if the motives were performed consecutively. This, however, would have resulted in a monody, a solo voice. It was decided, then, to implement the motives vertically; in other words, to have them occur simultaneously. This would allow for multiple voices and varying degrees of polyphonic density, an attribute the composer wished to use within this work.

Since this work was to be for string trio, the number of motives used in any given phrase was limited to three, assuming that each of the instruments could only play one motive at any given time. A new version of the original *Oracle* table of motives was created, in which a maximum of three motives were cataloged for each phrase. This required a decision be made for how to select which of the motives would be discarded. The solution chosen was to always keep the highest numbered motives in instances where more than three motives occurred in the original table.

A new enumeration of the text-based motives was devised for the con-

text of *Words Like Smoke*. Since the motive table was no longer based on corresponding text, but was abstracted from the *Oracle* table, the motives were renumbered so that they were fully sequential with no gaps. The number I.D.s of the motives for *Words Like Smoke* was thus 1 to 54, as opposed to the *Oracle*'s range for the same motives of 1 to 69.

Once the new table was assembled, with no more than three motives in each voice and all motive I.D.s renumbered, the number of motives in each phrase was counted and probability tables were derived. As with the durations, the number of instances of each number of motives was counted and divided by 145 to determine the probability of each of the three possible numbers of simultaneous sounding voices. The result was 34 occurrences of a single motive ($0.2345 = 23.45\%$), 44 instances of two motives ($0.3034 = 20.34\%$) and 67 instances of three motives ($0.4621 = 46.21\%$). The noticeably higher number of instances of three motives was obviously the result of there originally having been instances of phrases with more than three motives. These percentages were then assigned as a list to a variable in the algorithm and used as a basis for the weighted-random selection of the number of simultaneous motives (which in this case is equal to the number of simultaneously sounding instruments) in a given phrase of the resulting composition (see Figs. A.6, A.7, and A.13 on pp. 169, 170, and 175). The composer was satisfied with the considerably higher percentage of three simultaneous voices, since it was his preference to make use of all three instruments of the trio more often than to make use of only solo voices.

Structure—Chance of a new motive occurring in any given phrase

A method was then devised for determining the probability of whether or not a new motive would occur in any given phrase. It was immediately evident that the chance of a new motive occurring in any individual phrase would be either 0% or 100% if assessed on a phrase-by-phrase basis, which would result in an identical pattern of motives each time. It was decided, then, to determine the probability over a greater span of phrases. Thus, the total number of already existing motives occurring between each appearance of a new motive was counted, and the probability of a new motive

occurring in any given phrase was determined to be 1 in the number of motives of that group. If a total of 4 old motives occurred before a new motive was introduced in the text, the probability for the emergence of a new motive was deemed to be 1 in 5 (4 old motives plus the new motive), or 20%, for any of the phrases in that group.

Two approaches were taken to whether variations of the same motive (e.g. 5a, 5b, and 5c) were considered to be the same motive. For the sake of determining the point where a new motive occurred, the variations were considered to be the *same* motive, not a new motive. For the sake of determining how many motives occurred in a given group of motives between appearances of a new motive, each variation was counted separately.

The resulting list of probabilities was then assigned to a variable in the algorithm as a set of breakpoint pairs. Since the routine was programmed to generate structures with more or fewer phrases than the source text, the list is first scaled to the desired length of the new structure. Values between breakpoint pairs are determined through the creation of a new curve based on linear interpolation. At the generation of each new phrase, this curve is accessed and the value from the the corresponding point in the interpolated curve is taken as the probability of a new motive occurring in that phrase. The number of phrases that the new empty structure contains is therefore one of the first calculations made by the algorithm.

This approach does not generate a structure which is completely true to the text. The probability of a new motive occurring in any given phrase in the text is higher than that of a new musical motive occurring using this approach. However, the resulting probabilities are similar to those in the text, and the lower probability in the musical context was preferred and intentional. Although it was the composer's intention to create music with a high number of motives, a lower number than was in the text made more sense for a musical context (see Figs. A.9 and A.14 on pp. 172 and 175).

Span between highest and lowest motive in a phrase

As a text progresses, the words and motives (subject, content, meaning) of a given passage are likely to be more related to the other words and motives

of that same passage than they are to words and motives from earlier or subsequent passages in the text, though a number of words and motives from earlier passages will of course also be present. Probability tables were constructed to reflect this characteristic such that any passage in the music is more likely to include more recent motives, with a lower probability of motives occurring from earlier sections as well. The model of the Beckett texts provided a basis for this progression which incorporated both gradual as well as more sudden shifts in the motivic content of any given passage.

In order to create the probability tables for this trait, two aspects of the phrase-motive table were analyzed. Firstly, the absolute span between the highest numbered motive and the lowest numbered motive in any given phrase was measured. Thus, if a phrase contained the motives 7a, 8a and 2b, the absolute span was 6. Secondly, the highest numbered motive occurring in a given phrase was not necessarily the most recent new motive to have appeared. An analysis was therefore also performed of the span between the most recent new motive and the highest numbered motive occurring in each phrase.

The resulting list of differences were then sorted into sequential order and the number of instances of each difference was counted. The values for the absolute span between the highest and lowest motives of any given phrase encompassed a range from 0 to 48. The values for the difference between the most recent new motive and the actual highest numbered motive in a given phrase encompassed a range from 0 to 41. The number of instances of each possible difference were then divided by the total number of phrases (145) to yield the probability of that number occurring at any given point in the musical structure being generated. For example, there were 11 instances of the highest and lowest numbered motives in a phrase being 11 steps apart. This was reflected by a probability of $11/145 = 0.0759 = 7.59\%$. Similarly, there were 6 instances of the difference between the highest possible motive and the actual highest motive in a phrase being 4. This resulted in a probability of $6/145 = 0.0414 = 4.14\%$ that the highest motive in any given phrase would have an I.D. number that is 4 less than that of the most recent new motive (see Figs. A.10 and A.11 on pp. 173 and 174).

The resulting measurements were put together as lists and assigned to a variable in the algorithm. These lists are consulted at the beginning of each new phrase generated by the iterative routine, and a weighted random function using the number in the list determines, firstly, the highest numbered motive occurring in the phrase and, secondly, the number I.D. of the lowest numbered motive in the phrase. Further motives in the phrase are then randomly selected from the range spanning between those two values. The probabilities for these two attributes were constant for each phrase; they did not progress with the course of the piece (see Fig. A.15 on p. 175).

Harmony

An approach was then chosen for the determination of the sequence of vertical sonorities in the ensuing works. It was decided to model first steps in this direction on a similar concept found in the work of Bernhard Lang, by which repeated fragments were held together using implications of an underlying harmonic progression.

The composer's own analysis of the first part of Bernhard Lang's *Differenz/Wiederholung 2* had revealed to him an excitingly obscured simplicity in the work's underlying harmonic progression. A reduction of the basic pitch content for that work revealed an emphasis on pitch centers which stood in a relationship of fifths and fourths to one another, with much emphasis on leading-tones and upper neighbors (second scale degree) in the local melodic figures. (A copy of the composer's harmonic analysis of the Lang can be found in Appendix A.3.3 on pp. 176 and 177.)

The harmonic sequences in this segment of Bernhard Lang's work were then analyzed with regard to the probabilities of certain vertical sonorities progressing to other specific vertical sonorities. Tables were constructed and probabilities were calculated. These were inserted into a subroutine of the algorithm for the generation of new, semi-random sequences of harmonies based on the same rules of harmonic progression found in this section of the Lang piece.

Harmony—Number of chords per measure

As the first step of analyzing rules governing Lang's harmonic progression in the first section of his *Differenz/Wiederholung 2*, the chords underlying his music were entered into a spreadsheet in pitch-name format (e.g. E-A-B). Each row of the spreadsheet represented a measure of the piece. The number of chords in each measure were then counted. The resulting numbers were then sorted in ascending order, and the number of instances of each number of chords was counted. The number of instances of a given number of chords-per-measure was then divided by the total number of measures in order to determine the percentage of measures with any of the given numbers of chords-per-measure. The results showed 89 measures with one chord only ($89/209 = 0.4358 = 43.58\%$), 94 measures with two chords (44.98%), 23 measures with three chords (11%), one instance of a measure with four consecutive chords (0.48%), and two measures with 5 consecutive chords (0.96%). These percentages were then assigned to a probability table within the algorithm and used as the basis for a weighted-random function to determine the number of chords in a given measure of the composer's own work as it was being computed by the program (see Figs. A.16, A.17, and A.18 on pp. 178, 179, and 180).

Harmony—Routine to determine probability of any chord progressing to any other chord

An iterative routine was then programmed that would create a new series of chords based on one aspect of the rules of progression found in the chords identified in the Lang piece.

It was first confirmed that the final chord in the Lang sequence was also found elsewhere within the chord sequence to ensure that any chord from the sequence would always have at least one other chord to which it could progress. Most of the chords in the Lang sequence occur more than once and progress to a different chord each time. This also strengthens the potential for variety among randomly generated sequences.

The chords were put into sequence in list form and assigned to a variable to be accessed by the algorithm (see Fig. A.19 on p. 180). The user

stipulates an initial chord to set the process in motion. (This initial chord must, obviously, be one of the chords from the Lang sequence). The iterative routine then scans the entire sequence for all instances of that chord, in its exact spelling, and for each instance of that chord it notes the next chord in the list. All of these *next chords* are collected in a new sub-list. One chord is then chosen by random from this sub-list to become the next chord in the new harmonic progression, and the routine begins again. This process is repeated for however many chords are determined by the previous step to be contained within the piece.

Silence

The composer returned to the incorporation of silence between fragments in this piece. However, instead of separating every individual fragment with a brief pause, silence was introduced in this piece as a separate musical entity. Sounding musical moments were interspersed with non-sounding moments. The silence served both to demarcate the individual sounding moments and give a greater sense of their lack of development, as well as to experience the silence itself for its own value.

A variable for the *silenceRatio* was incorporated into the algorithm. The value of this variable was included in the probability table for polyphonic density. In addition to the probabilities for the occurrence of one, two and three simultaneous voices, the *silenceRatio* functioned as the probability for the occurrence of a measure with *zero* voices. Having been included in this manner, the silent bars would be assigned a duration (in number of beats) in the same manner by which the durations of the sounding bars were determined. The work is therefore interspersed with occasional measures of rest, lasting anywhere from 1 to 18 pulses (see Fig. A.13 on p. 175).

The algorithm's dependent functions

The algorithm is dependent on three additional predefined functions. The first is a function that converts note-names to numerical MIDI key numbers. Numerical representation in the MIDI format of the the pitches (consecutive enumeration of chromatic pitch) allows for mathematical computation

within the algorithm.

The remaining two functions enable *weighted random* procedures. Thus, when performing a random function, one or some of the numbers from within the range specified for the random function are more likely to be returned than others (hence, they are given more *weight*).

These two functions were taken from Rick Taube's book *Notes from the Metalevel* (Taube, 2004), an introduction to algorithmic composition using his Common Music programming environment. The first of these two functions (*make-ptable*) assembles a probability table based on a list of numerical breakpoint pairs, such as ((1 11) (2 13) (3 67)). The first number in the breakpoint is one of the possible results yielded by the function. The second number in the pair is the number of instances of that first number within the set that includes all instances of all the numbers listed in the first breakpoint values.

For example, the list ((1 11) (2 13) (3 67)) would indicate that in a set of 91 items (11+13+67), 11 of those items are the number 1, 13 are the number 2, and 67 are the number 3. The function first sums the number of instances and then divides the total set into a number of parts equalling the number of breakpoint pairs, giving them relative size (1 to 11, 12 to 24, 25 to 91). It then scales these to a range from 0.0 to 1.0 (0.0 to 0.1209, 0.1209 to 0.2634, and 0.2634 to 1.0). When a random decimal number between 0.0 and 1.0 is selected using this weighted random function, it is then compared with that scale. If the random number generated falls between 0.0 and 0.1209, the number "1" is returned. If the random number generated falls between 0.1209 and 0.2634, the number "2" is returned, and if the random number generated falls between 0.2634 and 1.0, the number "3.0" is returned. This random accessing of the given probability table is performed using the second of the two functions, *pran*. Repeatedly calling *pran* with a pre-defined probability table will return values, the frequency of which corresponds to the probabilities determined in the list of breakpoint pairs (see Fig. A.20 on p. 180).

The algorithm

The algorithm at this stage of its development uses predefined values for its arguments and requires no input from the user other than to set the iterative routine in motion. The predefined arguments determine values for the desired duration of the structure to be generated, the durational value of the basic pulse in the piece (beat), the rhythmic duration used to determine the tempo, the metronome marking for the tempo of the piece, the silence ration, the number of instruments in the piece, and the starting harmony. Detailed descriptions of these arguments can be found in Appendix A.3.6 on p. 181.

The algorithm proceeds in the following sequence. First, the algorithm's dependencies are evaluated, assigning the *rawListNotes->keynums*, *makeptable* and *pran* functions to a variable so that they may be called within the general iterative routine. Then the list of harmonies is evaluated, storing the list in memory for real-time analysis during the progression of the routine.

The initial and global parameters are then assigned values before the algorithm proceeds to define the probability tables for polyphonic density, phrase length, chance of a new motive, difference between the highest possible numbered motive and the actual highest numbered motive, the absolute span between the highest numbered motive and lowest numbered motive, the likelihood that any given motive will be chosen, and the number of consecutive harmonies in a bar.

The algorithm then generates all the phrase lengths for the resulting structure and stores them in a list. It passes through the list and, for each phrase in that list, generates weighted-random values based on the probability tables for the number of simultaneous instruments in the phrase, whether there will be a new motive in any of those voices, the actual highest motive in the phrase, and the lowest possible motive in the phrase.

It then progresses to an iterative sub-routine, with the number of iterations being equivalent to the number of simultaneous instruments chosen. It determines which motive will be assigned to each instrument for that measure before determining the number of consecutive harmonies in that phrase. After the number of harmonies is determined, it loops for the num-

ber of iterations identified by the number of consecutive harmonies chosen, determining at each pass the subsequent chord in the manner described above.

The algorithm stops its processing when it reaches the end of the list of phrases. A segment of the algorithm at this stage can be found on p. 181.

Algorithmic output: Structural outline only

At each pass of the routine, the algorithm prints the information it has generated to the screen (to the Lisp *Listener*). There is no output to a file in this first version of the algorithm. It first prints the values of the pulse basis, tempo unit and metronome mark in a once-off statement. It then proceeds by printing the information generated for each phrase. This information is formatted with tab-stops, indents, and carriage returns to facilitate reading of the resulting structure.

For each phrase the algorithm outputs the phrase number, phrase length in number of pulses, duration of that phrase in seconds, the absolute cumulative time at the beginning of the phrase, the absolute cumulative time at the end of the phrase. It then prints a list of all instruments actively playing in that phrase and the motives assigned to them. The last line of output for each phrase is a printout of the list of consecutive harmonies for that phrase.

At the end of the printed output, the algorithm prints a number of lines with statistics on the structure generated, including the total number of pulses in the entire structure, the total number of phrases, the total number of motives, and the total duration of the structure. The user can run the routine repeatedly until a structure emerges that most closely resembles his or her preference (more or fewer motives, for example). Once the final structure is selected, the printed form is copied from the *Listener* and pasted into a text file to serve as an empty structure, which is then filled in with music in a primarily intuitive manner. An example of the output can be found on p. 182.

Filling in the structure

With a printout of the empty structure at hand, the composer then set about composing the work. The approach taken was one of an intuitive composition of each new motive as indicated by the predetermined structure. A catalog was kept of the original version of each motive. This catalog was referenced each time a new version of that motive was to occur in the work, and a number of techniques were implemented for constructing new versions.

Harmony equals Melody

An approach to the relationship between harmony and melody was determined for this work that has been maintained for all subsequent works as well. The composer places extreme importance on gestures and phrases in his music. The intention, however, was to create work which was phrase- and gesture-based without being narrative.

For this reason it was decided to ascribe harmony and melody to essentially the same function. Thus, the pitches of the individual melodic fragments are taken directly from the vertical sonorities generated by the iterative routine. The pitches move upwards and downwards through the column of the vertical sonority, or hover on one of the pitches of that chord.

The result of this approach to harmony and melody means that there is no melody with harmonic accompaniment. Since each of the voices always perform melodic fragments, there are also no chords *per se*. There is a polyphonic, melodic progression through harmonic “fields”, similar to the approach taken by Berio⁸⁸, and these fields are linearly related to each other, in this piece, through implied relationships of traditional functional harmony (Tonic, Dominant, Subdominant).

While this approach reflects Cage’s conviction that harmony should not dictate structure, in that the structure is generated by the algorithm, it does, however, extend that approach, in that the use of traditional harmonic functions create an implied world of tonality and tonal relationships, in which the motion from one area of tonal function to the next does indeed take place at the bar lines of the structure.

The composer also intuitively approached register. A rule of octave equivalence was maintained throughout the work. This was used to help the progression remain interesting, and, again, to provide an underlying sense of direction that did not emanate from the development of melodic or harmonic material in the work.

Techniques of differentiated repetition

Each new instance of a given motive was different with regard to a number of its components. The melodic contour was kept essentially the same for each instance, while various elements of the rhythmic makeup of the motives were altered from instance to instance.

The pitches were pre-defined by the harmonic output of the algorithm, but the composer chose intuitively which of those pitches to use while maintaining the same melodic shape.

Leaning on the approach taken in the *Oracle*, the first technique of rhythmic differentiation implemented was that of augmentation and diminution. Thus, the durations of a motive were scaled to to the duration of the corresponding measure, always only to a degree that the composer considered performable; certain rhythms were rounded to the nearest triplet or sixteenth values in order to avoid the new, scaled rhythms from becoming too complex.

The second technique of rhythmic differentiation was that of *interruption*. In this technique, a given motive would most frequently begin at its beginning, maintaining the same durations, then cease prematurely at the end of the new bar's duration. In some instances the motive was started at a point towards the middle of the motive, using only an inner fragment, or completing the full durations of the motive to its completion at the end of the new bar.

The third technique of rhythmic differentiation was the repetition of inner fragments, whereby inner figures of the motive were repeated exactly until the additional pulses of new measures were filled out.

The fourth and final technique of differentiated rhythm used in *Words Like Smoke* was that of *precise imprecision*, a technique borrowed from the

composer's earlier work. In instances in which more than one instrument performs the same motive, the rhythms take slightly different forms among the instruments. For example, an upward run of 32nd notes in one instrument may present as an upward run of sextuplet 16ths in the second voice and a run of quintuplet 16ths in the third. This technique embodies more than the others the concept that each instance of the motive is a repetition on the z-axis of a motive that only exists in an un-manifest state.

Dynamics were kept the same for each instance of the motive. This allowed for varied intensities and colors in the overall instrumental output. It was, however, one potential weakness, and an approach that was modified in later works. Articulation, too, always remained the same for each instance of a motive.

Performance, Score and Recording

The work was premiered in Hamburg by Trio Sonar in May of 2009. The musicians prepared the work without the ability to consult with the composer. Their interpretation is predominantly successful and accurate, though the lack of linear development did seem to challenge them and have a slightly negative impact on the latter moments of the performance. For a best effect, the various sections of the piece must all be performed such that there is a constant feeling of freshness. This should be strived for and achieved by performing each momentary fragment with the utmost of concentration and character locally, as a little gem of its own. A copy of the score can be found in Appendix B.3.1 on page 238, and a recording of the Hamburg performance can be found on the accompanying audio-CD.

5.4 Second Version of the Algorithm: Non-tonal, Polyphonic Harmonic Basis

Though the composer considers *Words Like Smoke* to have been a very successful composition, he found himself interested in modifying the approach to the underlying harmony within the algorithm to allow for harmonies beyond the scope of traditional Tonic-Dominant-Subdominant relationships.

To this end, the existing iterative routine was expanded such that the algorithm would generate a harmonic progression on its own from a series of rules and probability tables, rather than by selecting chords from a predefined sequence of harmonies.

Since the composer's work primarily focused on melodic fragments and gestures, he decided to assemble a series of rules that would govern the algorithmic generation of vertical sonorities as a secondary result of horizontal voice leading. To this end, a segment from one work of another composer was chosen as a model, namely *Ritorno degli snovidenia* by Luciano Berio.

The composer analyzed the the first 10 pages of the Berio score with regard to several characteristics. These included the linear intervals within individual voices, the polyphonic density of any given vertical sonority (number of voices in a chord), the likelihood of a new voice being added to a chord or an existing voice being removed, the likelihood of new voices entering at specific intervals above or below the existing chord, the probability of a voice being added or subtracted to or from the top or bottom of the previous chord, and the likelihood of a given number of chords appearing in any given measure. Probability tables were drawn up from these analyses and used as the basis for new code programmed into the algorithm.

The general character of the harmonic progressions generated by this new sub-routine is defined by stacked, quasi-melodic lines constructed from consecutive intervals of between -4 and +6 half-steps, vertical intervals that do not surpass 7 half-steps, and gradually fluctuating polyphonic density ranging from one solo voice to a maximum of 47 simultaneous voices (representing a complete chromatic cluster from the C \sharp below the bass clef to the B \natural above the treble clef). The gradually changing polyphonic density also contributes to guiding the macro-structure of the work.

Harmonic Reduction of the Berio

For the harmonic analysis of the Berio passage, a reduction of the harmonies was first made. Melodically occurring intervals were considered to be members of a harmonic column and written in vertical simultaneity in the reduction. Vertical sonorities ranged from 1 to 5 simultaneous pitches. They were

notated as solid note-heads with no duration, and bar-lines were drawn to be able to facilitate later analysis of the likelihood of any given number consecutive chords occurring in a phrase (see Appendix A.4.1 on p. 183).

Determination of individual polyphonic lines

The next step was to determine individual polyphonic lines within the reduced harmonic progression. Lines were considered to consist of pitches of consecutive chords that remained within a few half-steps of each other. The lines were occasionally less than precise, in part since some lines merged and others were created or removed from the inner voices of a given chord at certain points. Also, to maintain a melodic line, intervals of up to +6 half-steps and -4 half-steps were occasionally considered to be skips within the same melodic line rather than the inception of a new line (see Appendix A.4.2 on p. 183).

Probability analysis of linear intervals

The intervallic character of individual lines was analyzed by first entering each of the layered melodic fragments into a spreadsheet in note-name form. The consecutive intervals of each of these fragments were then identified and entered into the next column in positive and negative half-step values. Thus, a melodic line of G-F \sharp -G-G was determined to consist of the intervals -1, +1 and 0. This was done for all of the melodic fragments.

The resulting column of intervals was then sorted from low to high, resulting in a total of 320 interval instances ranging from -4 to +6. The number of instances was then tallied for each interval and divided by 320 to determine the percentage of 2-note melodic progressions in the passage that consisted of each given interval. There were, for example, 4 occurrences of one note moving down a minor third—or -3 half-steps—to a nearby note in the next chord, resulting in a percentage of $4/320 = 0.0125 = 1.25\%$ of the 320 melodic intervals consisting of a downward minor third. The largest percentage of the intervals was made up of 0, meaning there was no upward or downward motion in the voice. There were 228 instances of 0, representing 71.25% of the intervals identified.

The percentages were kept in their decimal form, scaled to a range between 0.0 and 1.0, and assigned as a list of breakpoint pairs to a variable in the algorithm. The first numerical value of each pair was the interval itself (with a positive or negative value); the second was the number of instances of that interval in the passage. This list of breakpoint pairs was then used to construct a probability table that would be consulted during the iterative routine to determine how any pitch of a given chord would melodically progress to a nearby pitch in the next chord of the sequence.

The fact that there were so many 0s is very important to note. The large number of zeros means that roughly 70% of the notes of any given chord will remain the same in progressing to the next chord. This attribute results in a chord progression that is very gradual, only less than a third of the pitches in any given chord likely to change with each step through the harmonic sequence. See Figs. A.21, A.22, and A.32 on pages 184, 185, and 193 for a list of the intervals and their probabilities, as well their translation into a variable within the algorithm.

Probability analysis of polyphonic density

When determining the probabilities for the number of pitches in any given chord of the sequence, the composer was not looking for the absolute number of pitches in each chord but rather the rules which governed the expansion and reduction of the number of pitches in any given chord as the chord sequence progressed.

As a first step to this analysis, therefore, the chords of the Berio sequence were entered into the first column of a spreadsheet in note-name form. In the second column, the difference in the number of pitches in the given chord as compared to the number of pitches in the previous chord was entered. These differences were identified in terms of positive and negative numbers. Thus, if a given chord had 3 pitches and the previous chord had 2, the number +1 was noted. The resulting list of positive and negative numbers was then sorted in ascending order, and the number of instances of each value was counted. Since there were a total of 88 chords analyzed, and the first chord in the sequence had no previous chord by which to de-

termine a difference value, a total of 87 difference values, spanning from -5 to +7 were determined. The number of instances of each difference value was then divided by the total of 87 differences to determine the percentage of two-note chord progression that added or subtracted each specific number of pitches to or from the second chord. The most frequently occurring modification was to extend the number of pitches in a given chord by one new pitch (voice) in the next chord, with 26 instances ($26/87 = 0.7027 = 70.27\%$). By determining the sum of all the difference values we can see that the overall trend of the harmonic progression that will be generated will be one of adding notes.

These values were then collected first into two groups, namely values which represented a change in the number of voices between two chords and difference values of 0, representing no change in the number of voices. These groups consisted of 23 instances of no difference in the number of voices from one chord to the next, representing 26.44%, and 64 instances of values which indicated a change in the number of voices, at 75.36% (see Figs. A.23 and A.24 on pp. 186 and 187).

The number of instances of the individual intervals were then transcribed into breakpoint pairs for the *make-ptable* function and assigned to the variables *addNumNotesTable* and *subtractNumNotesTable*, to allow for a weighted-random decision of how many voices would be added to, or subtracted from, a given chord in progression. When the algorithm determined to add voices to the next chord, the *addNumNotesTable* was consulted; when the algorithm determined to subtract notes from the chord, the *subtractNumNotesTable* was consulted (see Fig. A.33 on p. 194).

At this stage of the algorithm's development, the composer had not yet decided to limit the number of voices any given chord could possess. Instead, at this stage, any given chord could consist of any number of pitches, as long as those pitches fell within a range of the MIDI key-number values of 37 and 83 (inclusive), which equate to the pitches of the C \sharp below the bass clef (CS2) staff and the B \sharp above the treble clef (B5). Further limitations to the number of pitches any given chord may possess were the secondary result of horizontal voice-leading rules and rules governing the selection of vertical intervals.

Probability of whether new voices will be added or subtracted

The 64 instances of changing values were then separated into groups of positive versus negative difference values. These groups consisted of 27 negative difference values and 37 positive difference values, or 42.19% and 57.81% respectively. These values were used for weighted random functions within the algorithm in the form of an *if* clause to determine whether chords that were changing the number of voices would do so by adding or subtracting voices from the existing chord. Here again we see the overall trend of the progression generated by the iterative routine will be towards adding new voices rather than subtracting them.

Probability of intervals at which new voices enter

The next step was to determine the pitch-level at which new voices would enter. In the original Berio segment, voices ceased to progress and were subtracted from the inner voices of the chord as well as at the top and bottom of the existing chord, and new voices were also added among the inner voices as well as at the top and bottom. For the scope of the composer's algorithm, it was decided that the addition and subtraction of voices would only occur at the tops or bottoms of the chords.

The focus of this step was to determine the interval between the uppermost or lowermost note of the previous chord and the new pitch in the subsequent chord when voices were added. No intervals needed to be analyzed for the subtraction of existing voices, since such subtraction was only to be performed by taking away a certain number of the uppermost or lowermost pitches of the existing chord.

In order to analyze this attribute in the Berio segment, the composer first entered the entire chord sequence in note-name form into a spreadsheet. The composer now entered the note-names of the chords' pitches vertically, such that each consecutive column contained each subsequent chord of the Berio segment, and such that each column contained one chord only and each cell contained one pitch only. The resulting spreadsheet thus roughly resembled a musical score.

Attention was paid to preserving the voice-leading within the chords. In

some instances, cells within the spreadsheet were left empty to accommodate for a better visual representation of the progression of the individual voices.

The note-name entries were color-coded using red and green. Pitches that were seen to progress from an unbroken line were marked with a green background. Pitches which were new to the chord were marked in red.

The intervals between the pitches contained within the existing highest and lowest green cells and the new pitches were measured (in half-steps) and recorded in a separate row below the progression. Despite the decision not to add or subtract notes from the inner voices, the intervals of entrance for newly appearing inner voices were still recorded to provide a larger set. The intervals were notated as either negative or positive values, positive indicating an upward interval and negative indicating a downward interval. In cases where more than one new pitch was added to a chord, the intervals were measured in succession, not with consistent reference to the lowest or highest pitch to which they were added. Thus, if an A \sharp and an F \sharp below that were added to an existing E \flat at the bottom of a chord, the intervals were labeled as -6 (E \flat to A \sharp) and -4 (A \sharp to F \sharp), and not -6 and -10 (see Fig. A.25 on p. 187).

The entire list of intervals recorded, spanning from -10 to +11, was then sorted into ascending order on a new spreadsheet. It was decided to amalgamate the positive and negative intervals into one list of absolute values (i.e., always positive versions of the numbers). This would allow the algorithm to decide in four steps firstly whether to add or subtract a pitch at all, secondly whether it would be added or subtracted, thirdly whether this addition or subtraction would occur at the top or the bottom of a chord, and finally at which interval to add a new voice should a new voice be added.

The number of instances of each of the absolute values of the intervals were then determined, and those numbers were then divided by the total number of intervals in the list (100) in order to determine the percentage that a given interval made up of the entire set. The specific absolute interval values were then coupled with the number of times they occurred in the list and entered as breakpoint pairs to the *make-ptable* function. The resulting probability table was assigned to a variable (*newNoteIntervalTabl*) so that

it could be called upon from within the algorithm to serve as the basis for weighted-random clauses (see Figs. A.26 and A.34 on pp. 188 and 194).

Probability of whether the addition/subtraction of a voice occurs at the top or bottom of a chord

Once the probability table was constructed for the absolute intervals themselves, a quick analysis was made of the probability for whether voices are added to/subtracted from the top or bottom of an existing chord.

Two additional rows were simultaneously maintained on the most recently described spreadsheet, namely one that identified and recorded whether pitches that were added to chords appeared at the top or bottom of the existing chord, and one that identified and recorded whether pitches that were subtracted from an existing chord were subtracted from the top or bottom of the existing chord. These values were marked as either -1, for additions/subtractions at the bottom of the chord, or +1, for additions/subtractions at the top of the chord.

The total number of added voices was 56. Of these, new voices were added at the bottom of the chord in 33 instances and at the top of the chord in 23 instances, representing %58.93 and %41.07 respectively. These values were included as a nested *if* clause in the algorithm, such that if the algorithm had determined in the previous step to add a voice to the chord in that passing, the computer would then add the new voice to the bottom of the previous chord approximately 41% of the time and to the top of the existing chord approximately 59% of the time.

The same was quickly analyzed for the subtraction of voices. From a total of 55 instances in which a voice was subtracted from the existing chord, the voice was subtracted from the bottom in 29 instances and from the top in 26 instances, representing 52.73% and 47.27% respectively. These values too were incorporated into an *if* clause within the algorithm, whereby should the algorithm decide to subtract a voice from the existing chord, that voice would be removed from the top of the chord approximately 47% of the time and from the bottom of the chord approximately 53% of the time (see Fig. A.27 on p. 189).

Probability of specific numbers of chords in a measure

An analysis was then made of the number of chords in each measure of the Berio segment. This was done by counting the number of consecutive vertical sonorities in each measure and entering each number into a spreadsheet column. The resulting list of numbers, which spanned from the value of 1 to the value of 6, was then sorted in ascending order, and the number of instances of each individual value was determined. These numbers of instances were each divided by the total number of measures analyzed (41) to determine the percentage of measures made up of any of the specified numbers of chords identified. Thus, 15 of the 41 measures analyzed contained two chords, making up 36.59%, etc.

These percentages were then translated into probability tables within the algorithm using the *make-ptable* function. The numbers were entered as breakpoint pairs using the number of chords and the absolute number of instances of those numbers found in the passage analyzed (see Figs. A.28 and A.35 on pp. 190 and 194).

New probability analysis for number of simultaneously occurring motives (polyphonic density)

A new probability table for the number of simultaneously occurring motives was drawn up for this version of the algorithm. The first version of the algorithm, used for *Words Like Smoke*, was based on an analysis that was limited to three simultaneous motives. That limitation was enacted by modifying the list of motives derived from the Beckett text during the *Oracle* project through removing the “extra” motives from any measure with more than three motives. For this version of the algorithm, the original list of motives from the *Oracle* project was used, preserving the full number of motives in each measure and counting them anew.

The resulting list consisted of values spanning from 1 to 8 simultaneous motives. The list was sorted into ascending order and the number of instances of each value was determined. Since the original contained instances of all numbers of simultaneous motives up to 8 excluding 7, an estimate of 2 was entered for the number of instances for the value 7. The final

number of instances for each value was then divided by the total number of measures analyzed ($145+2=147$) to identify the percentage of measures made up of any given specific number of motives. Thus, for example, 39 of the 147 measures contained 3 motives, or 23.13%. The absolute numbers of instances were then entered as breakpoint pairs together with the given value and used to define probability tables the algorithm (see Figs. A.29, A.30, and A.36 on pp. 191, 192, and 194).

This version of the algorithm included the user-definable argument of *numInsts*, allowing the user to determine the number of instruments for which the structure was to be generated at run-time. At this stage of the algorithm's development this number was synonymous with the number of simultaneous motives. The intention was to define the curve created by the list of breakpoint pairs using the values of 1 to 8, and assign it to the *density-table* variable so that it could be scaled to the number of instruments chosen by the user. If, for example, the user were to generate a work for 17 instruments, the curve created by the breakpoint pairs spanning from 1 to 8 would maintain the same shape, but would now have 17 breakpoint pairs, the values of which were determined using linear interpolation. Thus, the probability of having 1 motive remained the same ($34/147 = .2313 = 23.13\%$) and the new last value (17 instead of 8, in this example) would also maintain the same probability (0.68%), while the values from 2 to 16 would be evenly distributed along the curve created by the breakpoint pairs of the original 1-to-8 range (see Fig. A.31 on p. 193).

However, an error in the programming resulted in the scaling of the new number of instruments being representable as a straight, increasing line rather than the intended curve. The result was that the probability of fewer simultaneous motives was lower and the probability of more simultaneous motives increased steadily with each possible number of motives. The effect was a greater probability of most or all of the instruments playing at the same time and fewer chances of passages consisting of solo instruments. The composer decided that this unintended distribution more closely resembled a goal that he felt was musically defensible at this stage, so the error was not corrected, and all of the pieces generated using the algorithm up until March of 2010 were constructed using the latter, linear probability.

Extensions to the algorithm—New function dependencies

In this version of the algorithm, many elements that were originally included as hard code within the programming were now declared as functions attached to variables outside of the algorithm. In addition to the *rawListNotes->keynums*, *make-ptable*, and *pran* functions of the very first version of the algorithm, the polyphonic density (*density-table*), chance of a new motive in a given bar (*chanceOfNewMotiveList*), difference between the highest possible and actual highest numbered motive (*difHighestPossibleActualHighest-table*), absolute span between the highest and lowest numbered motives in a given measure (*absoluteSpanBetweenHighestAndLowestMotive-table*, the likelihood of any given motive being selected within that absolute span (*motiveProbability-table*), the number of consecutive harmonies in a given measure (*numHarmsInPhraseProbabilityTabl*), the probability of phrases being of specific lengths (*phraseLen-table*), the intervals available for melodic motion and their probability of occurrence (*melodicMotionTable*), the likelihood of a certain number of voices being subtracted from a given chord when progressing to the next chord in the sequence (*melodicMotionTable*), the likelihood of a certain number of voices being added to a given chord when progressing to the next chord in the sequence (*addNumNotesTable*), the probabilities of new voices being added at specific intervals (*newNoteIntervalTabl*), and the weighted-random function itself (*chance?*) were now defined outside of the main algorithm.

In addition to this, two new functions were defined upon which the algorithm was dependent, namely a function to translate the MIDI key-numbers of pitches to note-names (*keynums->notenames*), and a function that would generate a MIDI file for the playback of the harmonic sequences created (*chordPlayer2*).

A very small number of lines was added to the end of the algorithm to allow for the output of the harmonic sequence generated as a MIDI file in the form of a piano-reduction. Each consecutive chord of the sequence generated by the algorithm is appended to a dynamically increasing list of the entire sequence at each iteration. The final step of the algorithm goes back through this list and, using the *chordPlayer2* function, processes the list

by exporting each of its pitches and chords in sequence to a MIDI file, whose path and filename must be specified by the user at run-time. At this stage of the algorithm's development, should the user also desire MIDI output of the resulting harmonic progression, the entire call must be preceded by the command *events*, and a path to the output file must be specified.

The definition of these variables and functions must be evaluated and loaded into memory prior to running the main algorithm (see Fig. A.37 on p. 194).

Extensions to the algorithm—New arguments

This version of the algorithm also incorporated for the first time arguments which allow the user to specify values for the various parameters at run-time. Instead of being defined statically within the algorithm, the values for the desired duration of the piece, the pulse basis, the tempo unit, the metronome marking, the number of instruments, the starting pitch-list and the ratio of silence must now be defined when the user runs the algorithm. Parameters such as the uppermost and lowermost possible pitches are still defined as fixed values within the algorithm. An example of how this version of the algorithm is run can be found in Fig. A.38 on p. 195.

Algorithmic output

The output produced by this version of the algorithm was still printed solely to the Lisp Listener within the Common Music environment (using the Emacs text editor and Lisp interpreter). The data printed to the Listener window was then copied and pasted to a new text document so that it could be saved and consulted during the composition of the piece.

As with *Words Like Smoke* and all subsequent works, the composer then adhered to the phrase-lengths (number of beats in each measure), number of instruments playing, the number of simultaneous motives and which motives were being used, and the harmonic progression generated by the algorithm (including how many consecutive chords were contained in each measure), while composing intuitively the actual rhythms, melodic shape and differentiated versions of these elements into the empty structure. The

composer maintained the same techniques for differentiation of rhythm and melody as described above, and his consideration of melody as equivalent to harmony was also maintained for all subsequent instrumental works.

5.4.1 Orchestra Piece Preliminary Work

Structure generation

This version of the algorithm was developed to create the basis for the orchestral work *Return Through the Beautiful Sopping Mountain*. However, the composition and subsequent re-orchestration of that work spanned a period of one-and-a-half years, during which many aspects of the interpretation and filling-in of the structure were modified. The output generated at this stage remained as the structural basis for the work as well as for the majority of its motivic patterns, making it important to mention here (see Fig. A.39 on p. 196).

Randomized overlapping of motives

One new technique that was developed for use with the orchestra piece, however, should be mentioned at this point, since it is a technique that was incorporated into all subsequent works as well. That is the technique of overlapping phrases.

The use of the fragmented form during the composition of the *Oracle* included the intentional use of disjunct transitions from one fragment to the next. Each fragment was to end abruptly and each subsequent fragment was to begin *attacca*. In the context of setting the electroacoustic composition to the *Oracle* clips, however, it was often deemed more suitable to the overall content and atmosphere for these transitions to possess a smoother character. To that end, in several instances within the electroacoustic composition for the *Oracle*, certain fragments were extended in their duration to overlap the following fragment. These overlaps would extend through the entire duration of the ensuing fragment (rather than stopping midway or just after the beginning of the next fragment, for example), such that an overall sensation of sudden juxtapositions would still be present throughout

the work while the disjunct transitions would in some instances be obscured in order to create more of a sense of line or flow.

Somewhat in line with this, and for a similar reason, the composer decided to employ a comparable approach to smoothing out his structures starting with the preliminary work begun on the orchestral piece. At this stage, the overlapping was performed by hand rather than being integrated into the calculations and output of the algorithm. The composer set up a very simple random-generator within the Common Music programming environment, which for all practical purposes imitated the function of a three-sided die (though this, of course, is not physically possible). For each motive of each measure, the composer “rolled” the virtual die to obtain a number between 0 and 2. In those instances when the computer returned a 0, the composer lengthened the corresponding motive by overlapping it with the entirety of the next measure. The same approaches to rhythmic and melodic variation were applied to the new durations as described above, and the melodic pitches of the individual motives were altered to suit the harmonic sequences of the new measures.

The decision to implement random procedures for making musical decisions was strengthened by the composer’s study of the works and techniques of John Cage. Like Cage, this specific random process was refined until a result was found that suited his intuitive taste. Although the technique itself is very straightforward, several experiments were made with other ranges for the random-generator, from 1-in-2 to 1-in-7, before it was decided that a probability of 33% for an overlap resulted in a work that sounded disjunct enough while still providing enough linearity to the work to suit the composer’s tastes.

5.5 Incorporation of Harmony into the Fixed Media Part for Mixed Works

The next stage of the algorithm’s development was to create a series of new functions which would allow specific control of the harmonic and rhythmic components of the electroacoustic parts of compositions for fixed media

and real instruments. The goal was to achieve a better blending of the electroacoustic and instrumental parts of such works by having the fixed media part consist of the exact same equal-tempered pitches and the exact same rhythms present in the instrumental part.

This was achieved by writing a two new functions for the algorithm. These allow, firstly, the fixed media part to be “tuned” to equal-tempered pitches, enabling the fixed media part to follow the same harmonic-melodic sequence that governs the progression of the instrumental part. Secondly, the algorithmic motive functions for the fixed media part can now also consist of dynamic curves that are based solely on the rhythms of the motives in the instrumental part. These dynamic curves allow both the matching of the actual dynamic level between fixed media and instrument, but also enable the implementation of the exact same rhythmic patterns by instructing the volume of the fixed media part to diminish to *niente*, thereby separating sound events and creating rhythms.

In composing for fixed media and real instruments, therefore, the composer can now avoid the common trap of composing either the fixed media part or the instrumental part first and writing the other part *around* that initial construction. That particular approach most commonly leads to works in which the electroacoustic and the instrumental parts sound completely unrelated, or in which one part is an illustration, embellishment, extension, or accompaniment of the other.

The goal of this new technique, in contrast, was to write for both fixed media and real instruments in the same manner that one would write for two real instruments, namely through the use of common material (melodic patterns, rhythmic patterns, harmonic patterns, dynamic patterns, performance techniques, timbral combinations). In short, the computer part is treated like a full-fledged instrument, rather than a background or a complement, and the work gains a tremendous amount of cohesion, unity, and clarity by limiting the material it involves.

In addition, the source material for the tape part in these works consists of only recorded samples of the real instruments in the work. This is a technique first encountered by the composer in 2001 in Horacio Vaggione’s (1943–) *Thema* from 1985 for bass saxophone and tape, and a technique

which the composer has consistently used in all of his works for fixed media and real instruments ever since. The production of the fixed media part through the use of source material that consists solely of recordings of the real instrument(s) performing in the work strengthens and further unifies the sound world of the work through timbre.

It could be argued that these techniques ignore the potential and natural qualities of sound production and sound processing presented by the use of computers in music composition, and that they merely constrain the computer's potential sound world, one which is free of rhythm, pitch, and timbre, by forcing it into equal-tempered systems and timbral sonorities of traditional instruments. However, the challenge of successfully merging electroacoustic sounds with real instruments is well known, and these approaches were chosen as one possible option for achieving such success.

It must also be mentioned at this point that two other aspects of electroacoustic music challenge the successful blending of fixed media parts with real instruments, namely multichannel localization techniques and the capturing of the acoustic qualities of the space in which the source sounds were recorded in the samples themselves.

The first issue makes both performance and reception of mixed works problematic, since the ensemble is generally located at the front of the room in one group while the electroacoustic work is located in the space filled by the audience (and created by several loudspeakers in periphery around the audience). Two immediate options are available for a successful merging of the two sound source types. The first option is to also distribute the performers throughout the room, physically rather than only in the mix on the loudspeaker playback. The second is to limit the loudspeaker playback to a linear panorama also located at the front of the stage. (Other options are also available, such as placing individual speakers in locations throughout the ensemble and using them to playback only one individual sound, with no virtual spatialization created by dispersing the source sounds unequally on different speakers). The composer addressed this issue in the second of the two following works by choosing the latter strategy.

The second issue is another source of unsettling difference in the two sound source types within mixed works. Should the acoustic resonance

of the room recorded in the sample differ from that of the reverberation of the real instruments in the actual performance space, the spaces in which each element is reverberation contradict each other, and a successful unity of sound is very difficult to achieve. The solution selected by the composer for this issue is to find, firstly, source sound recordings that are extremely dry, with as little room resonance and reverberation of the recording space as possible. The second technique for addressing this discrepancy is then to run both the tape part and the real instrument(s) through reverberation hardware, thereby placing them in the same virtual space, and amplifying all of these over the linear speaker setup at the front of the stage.

The two works that will be discussed in this context are *Thriambos*, for trombone and 8-channel playback (2008), and *Interminable Delirium*, for Xylophone, Harpsichord, Viola, Violoncello, Contrabass and 5 virtual voices in stereo playback (also 2008).

5.5.1 *Thriambos* (2008)

Background and Program Notes

The first piece to use these new pitch, dynamic, and rhythmic features of the algorithm was composed at the request of trombonist Dr. Sean Scot Reed, Director of Brass Studies at the New York University Steinhardt School of Culture in New York City. It was premiered in September of 2008 at NYU.

As described above, the fixed media portion of the work incorporates no physical models or other sound sources beyond short sampled recordings of the solo trombone.

Also as described above, the structure of the piece is not conceived as trombone with fixed media accompaniment. Instead, the trombone is considered to be one of 9 independent voices, 8 of which are present virtually in the fixed media part.

The title of the piece and the background concept surrounding the work is taken from the presumed but not certain etymological source of the word “trombone”. A *thriambos*, or a *thriamb*, was an ancient Greek fanfare or hymn sung to the Greek god of wine, Dionysos—also known as Bacchus in the Roman culture⁸⁹. Being the god of wine, Dionysos was also associated

with states of indulgence and chaos. Literary traditions use his name in conjunction with instinct and emotion, as opposed to the faculties of order and reason ascribed to Apollo. Some sources also associate Dionysos with the Cult of the Souls, in which context he has been said to have had the ability to facilitate communication between the Living and the Dead. This last point made the choice of this context for this work particularly interesting to the composer, since the Beckett *Texts for Nothing*, upon which the structure of the work is founded, are written in the narrative form by a being who exists somewhere between Life and Death.

Extensions to the algorithm—New functions *freqRat*, *rhythDynEnvMakr*

This stage of the algorithm saw the introduction of two new functions, namely *freqRat* and *rhythDynEnvMakr*. The first of these translates a list of note-names into playback speed values such that the source sound file will playback at the equal-tempered pitch levels of the note-names specified. For this to work, the user must first identify the fundamental pitch and duration of the source sound file. To accommodate this, the algorithm starting with this version must now also be given a list of the source sound files to be used, including a statement of their fundamental pitch and their duration (see Fig. A.40 on p. 197).

Using this data, the new function then passes through the list of pitches entered as the argument for the playback pitch of the algorithmic motive function (the melodic motion in equal temperament), determines the frequency in Hertz of these pitches, and divides them by the frequency in Hertz of the source sound file's fundamental pitch. Due to the logarithmic nature of frequency relationships, this yields an easily manageable value for the modification of the playback speed for the source sound file. Within the Common Music programming environment, a playback speed of 1.0 indicates that the source sound file is to be played back at original speed; a value of 2.0 indicates that it is to be played back at twice the speed, or an octave higher; and a value of 0.5 indicates that it will be played back at half the speed, or an octave lower. Frequency relationships function in the same manner, in that the octave above any given frequency is twice the number

of Hertz, and the octave below the same frequency is represented by half the number of Hertz. The *freqRat* function thus passes the result of this division to the granulation instrument via the algorithmic motive function, resulting in pitched playback of the source sound file in equal temperament, and allowing each component of the fixed media part to be given specific, melodic progressions, the combination of which results in specified, equally-tempered harmonic sequences (see Fig. A.42 on p. 197).

This new function required the addition of new arguments to the algorithmic motive functions and a new format for the corresponding score scripts. The algorithmic motive functions must now be told for which instrument they are generating the grain sequence. Based on this, the algorithmic motive function determines the original pitch and duration of that instrument if it is a sound file by looking these values up in the source sound file list. In addition to the already existing mandatory entries for the start-time, end-time, and relative amplitude of each sequence of grains, the algorithmic motive function must now also be given a list of note-names by the user. These lists are entered manually into the score script. Using this information, the the algorithmic motive function then produces a breakpoint envelope for the playback speed of the sequence of grains it produces and passes that to the *rateEnv* variable of either the *rhythmGrainer* or the *smGrnEnv5* (see Fig. A.43 on p. 197).

The second new function, *rhythDynEnvMakr*, takes a list of rhythmic values and combines them with a list of dynamic levels. The Common Music programming environment includes shorthand abbreviations for specific relative rhythmic values from traditional instrumental notation. The programmer can enter the letter “q” when a quarter note is desired, a letter “e” when an eighth note is desired, the letters “ts” when a triplet sixteenth is desired, etc. The CM environment then parses lists of such values into absolute durations as scaled by a stated metronome marking defined earlier in the programming code. The environment also has similar predefined shortcuts for dynamic levels, by which the user can enter letter combinations spanning from “niente” through “p” and “f”, to “ffff” and have these translated into amplitude values scaled from 0.0 to 1.0.

Using these two features of the the CM environment, the composer first

created a function called *rhythmToTimeEnvelopeMaker* that creates a list of percentage-based duration values, scaled from 0 to 100 percent for the duration of the measure at hand. These serve as the first value in a series of breakpoint pairs for the overall dynamic envelope variable (*overallAmpEnv*) of the algorithmic motive function. A second function, *rhythEnvPlusDynToTimEnvMaker*, then combines these percentage values with the list of dynamics entered directly into the algorithmic motive function to create the second value of each of the breakpoint pairs for the same *overallAmpEnv* variable. Using these functions, the sound output generated by any given algorithmic motive function will possess a dynamic curve, which can include a reduction of the sound to *niente* for the creation of rhythms.

In the implementation of these features within a composition, the exact same number of algorithmic motive functions are defined for the fixed media part as there are motives composed for the instrumental part. As each new motive is composed, its dynamic and rhythmic structure is applied to both the instrumental part and the algorithmic motive function for the fixed media part. The pitches are then passed to the algorithmic motive function from the score script, ensuring that the fixed media part and the instrumental part consist of the exact same rhythms and melodic-harmonic pitch content (see Fig. A.44 on p. 198).

Output of algorithm now formatted as a score script

To facilitate the compositional process, the algorithm's output was modified in this version to include the formatted text necessary for a score script as was required by the functions of the *Oracle* project. The algorithm's output at his stage is still first printed to the Listener and then copied from the Listener and pasted to a text file.

The algorithm's arguments have remained the same as those in its last version. The definition of the pitch range and the number of voices available in a given chord are still defined statically within the algorithm, though the pitch ranges have been adjusted to a range between 36 and 83 to accommodate the range of the trombone.

In entering the parameters for the arguments at run-time, the user is

required to enter the *total* number of instruments, including the real instruments and the number of virtual voices in the fixed media part. Each of the voices in the fixed media part is represented by and assigned to *one* specific source sound file. The algorithm's output then includes in each line of the score script a statement of the name of the algorithmic motive function (i.e. *mot1*), the numerical I.D. of the source sound file to be used, the start- and end-times of the grain sequence within the output of the fixed media part (in seconds), empty parentheses for the later definition of the melodic pitch sequence for that voice during that phrase, and a new variable for the relative amplitude of that voice during that phrase.

For this to work properly in *Thriambos*, it was necessary to enumerate the source sound files in the predefined list of sound files starting with 2, since instrument 1 was assigned to the trombone. Within the score script generated, the trombone is indicated by *instrument 1*, but these lines are placed in comments so that they are not calculated by the computer while generating the fixed media part.

Composition (fixed media and instrumental)

The trombone's melodic fragments were composed intuitively, based on the lists of harmonies output by the algorithm for each phrase. As each new motive was composed, it was cataloged, and its rhythmic durations and dynamic levels were entered into the corresponding algorithmic motive function for the fixed media part. The same techniques for rhythmic and melodic differentiation were used for this work as were used for the string trio, and the same equation of melody to harmony served the basis for melodic content.

The pitches for the melodic progression of the individual fixed media voices were entered by hand, intuitively, into the empty sets of parentheses after the score script was generated. These too were taken from the lists of consecutive harmonies printed out by the algorithm for each phrase. Filling in the melodic pitch motion for the fixed media voices followed the same equation of melody to harmony, though the melodic shapes of the motives were not maintained. Instead, the fixed media voices followed the same

rhythms as the trombone motives, but may have consisted of other orderings of pitches from the same chords.

The same technique of overlapping segments based on a 1 in 3 chance of overlap, as described above, was also processed by hand for the trombone and fixed media voices of this work.

The scores (for trombone and tape) and MIDI mockup

Copies of the scores for the trombone and fixed media parts can be found in Appendixes B.4.1 and B.4.2 on pp. 255 and 256. A recording of the work consisting of a stereo version of the fixed media part and a MIDI-driven version of the trombone part using virtual instrument samples can be found on the accompanying audio-CD.

5.5.2 *Interminable Delirium* (2008)

The second work to be discussed in this context of pieces for real instruments and fixed media is *Interminable Delirium*. This work was composed in predominantly the same way as *Thriambos*, with the addition of three relatively minimal extensions to the algorithm.

The work was composed for the Ensemble ICC of Dublin and was premiered on 04 December, 2008 in Galway, with a second performance on 05 December in Dublin. It is scored for Xylophone, Harpsichord, Viola, Cello, Bass, and five electroacoustic voices in stereo playback, essentially creating an instrumentation of five real instruments and five virtual instruments. As with the work for trombone and fixed media, the individual computer voices were kept distinguishable by always consisting of permutations of the same source sound file. Also like *Thriambos*, the real and virtual instruments were given equal weight and presence throughout the score with regard to their being led as fully independent voices, as well as with regard to the various instrumental combinations possible at any given point. It was equally likely, for example, that a combination of three instruments in a given phrase would consist of three real instruments, three virtual instruments from fixed media, one virtual voice and two real instruments, two virtual voices and one real instrument, etc. Any combination was possible.

Another similarity in technique between *Interminable Delirium* and *Thriambos* was the use of source sound files for the fixed media part that consisted solely of recordings of the real instruments of the ensemble, facilitating, as discussed above, the successful merging of colors and qualities between the two parts.

For this particular piece, the independence of the voices in the computer-generated fixed media part was enhanced by limiting their spatial placement within the linear, stereo loudspeaker panorama to specific, static locations. Only very minimal wavering of the computer voices around those static locations was employed.

Extensions to the algorithm

The algorithm was extended only minimally for this work, by adding the arguments of *uppermostPch* (allowing the user to set the highest possible pitch of any chord produced by the algorithm), *lowermostPch* (allowing the user to set the lowest possible pitch of any chord produced by the algorithm), and *maxNumVox* (allowing the user to set the maximum number of pitches in any chord produced by the algorithm). These values are declared at run-time by the user (see Figs. A.45 and A.46 on p. 198).

One other minor extension to the programming was the requirement of values for the two new variables *numAcousticInsts*, for the number of acoustic instruments in the ensemble, and *numTotalInsts*, for the total number of real and virtual instruments in the piece. These values facilitate the automatic identification of the index number of a given source sound file in the sound file list, as well as facilitating the calculation of degree values for the equal distribution of the electroacoustic voices across the stereo panorama.

Composition of the work on the basis of the generated empty structure

The score script of the fixed media part was again outputted to the Lisp Listener and copied and pasted to a text editor for further modification. At this stage of the algorithm's development, the score script is still generated with empty parentheses for the melodic-harmonic progressions, which are then filled in intuitively, by hand, based on the harmonic sequences generated by

the algorithm for each phrase. The same technique of unifying the rhythmic and dynamic components of the motives for both the instrumental and fixed media parts was also applied in this piece that was used in *Thriambos*.

The instrumental part was composed in the same intuitive manner as described above for the trio and trombone-fixed media pieces. The same techniques of rhythmic differentiation were used, a catalog of the motives was maintained, and the same equation of melody and harmony was followed in this work. The composer also continued use of his technique of *precise imprecision* in this piece.

For this particular work, the composer re-barred the measures from the original, starkly varying lengths generated by the algorithm (from 1/4 to 11/4) into simpler time signatures (3/4 and 4/4) for the sake of facilitating rehearsal.

More pulsating character

With *Interminable Delirium* the composer took a step towards a different kind of musical atmosphere for his works. The primary difference in character is one governed by more instances of much more pulsating rhythms. While many of the rhythms in the piece still preserve the disjunct, lyrical quality that the composer is partial to, in which the meter is generally obscured through ties or rests, many of the motives in *Interminable Delirium* consisted of fast repetitions of a single note or steady rhythms that accentuate the primary pulse basis (quarters) of the work, including very fast measured tremolo. The initial reason for this approach was to accommodate the lack of durational capacity in the harpsichord, but the character soon became a focal point of its own right. The result is a sound that is much more driving in character, and at the same time one which produces interesting combinations of stuttering lyrical fragments with blocks of very busy and less differentiated sound.

At this stage of the algorithm's development, the composer was still equating the total number of instruments to the total number of possible simultaneous motives. If 10 instruments (real and virtual) were playing there was a certain probability that 10 different, simultaneously sounding motives

would occur. The fact that many of these motives were much more pulsing and much less rhythmically differentiated in character, however, led to a greater chance of the simultaneous sounding of those rhythmically pulsing motives. This in turn contributed to the presence of many more passages that were primarily of a “blocky”, full, and driving character. The use of such rhythms and the resulting motivic combinations also made the disjunct transitions from one fragment to the next, especially in those cases where there was no calculated overlapping of motives, much more abrupt.

The piece was very successful and was received very well by the performers and the audience.

The score script, the instrumental score, and the recording

The score script for the fixed media part and the instrumental score of *Interminable Delirium* can be found in Appendixes B.5.1 and B.5.2 on pp. 261 and 262. A recording of the Dublin performance can be found on the accompanying audio CD.

5.6 Harmonic Sequence as Pitch Basis for Fixed Media Pieces

Having written a number of works for instrumental ensembles or combinations of instruments with fixed media, the composer decided to return to fixed media-only pieces. It was his intention to see if the harmonic and rhythmic-dynamic techniques devised for the fixed media part of *Thriambos* could be successfully incorporated into works for fixed media alone.

Through a selection of source sounds that were a mixture of both sounds with an identifiable pitch and sounds which were primarily noisy in content, the harmonic sequence of the work as generated by the algorithm is not clearly present throughout. Instead, moments with more of a noisy, non-pitched character are interspersed with moments of identifiable pitches, intervals, and chords, as well as with moments of mixtures of both pitched and unpitched sound.

The rhythmic patterns and dynamics contributed greatly to recognizable,

repeating motives in the work. In the same way that the same rhythmic pattern would be passed through several different instruments in an ensemble work, the same rhythmic pattern was now audible at various points in the composition as carried by the different source sounds. Additionally, the recurrence of algorithmic motivic functions (pitch and amplitude envelopes, panorama placement, grain sizes, distance, and reverb depth, etc.) continued to be a unifying factor as well.

5.6.1 *More Than Is Wise* (2009)

The first of the two works to be discussed in this context is *More Than Is Wise*, composed for and premiered at the 30th *klubKatarakt* concert put on by the Hamburg composers' collective *katarakt*, of which the author is a former directing member. The concert was held in the context of a three-day series of performances and presentations at the *kampnagel fabrik* in Hamburg in January of 2009. It was designed as an 8-channel work, though it was premiered in stereo. It was presented in its 8-channel form at the SARC in Belfast as part of the CMC concert of the 2009 Sonorities Festival.

Extensions to the algorithm—Output to file, minor bug correction

The algorithm was again extended for the composition of this work, though the core processes remained the same. The most significant extension allowed for the writing of the algorithm's output to a text file on disk, rather than being printed out to the Listener from where it would be copied and pasted. In conjunction with this new function, the new argument of *file-NameOut* was added to the algorithm, and is now a mandatory entry when running the algorithm (see Figs. A.47 and A.48 on p. 199).

A second modification was undertaken within the functions (*rhythm-Grainer1d* and *smGrnEnv5*). The modification removed a small bug in the programming that would very occasionally interrupt and abort the score generation process.

Composition

A number of specific decisions were made for the composition process that would enhance and further differentiate the material of the work. Periods of silence were included with presence than had been the case in the previous two works with instruments. The result is a very spacious work, in which either the silence could be seen as a punctuation of the sounding fragments or the sounding fragments could be seen as punctuating the silence. From both perspectives, the sounding and silent components are integral and related, the material spanning from nothingness to “all-ness”.

The composer also used the parameters of virtual distance and reverb as compositional elements to a much greater degree in this work, which also contributed to the sensation of space. The perceived distance of the sound from the audience, created in essence by a combination of volume and the mix of reverberation signal to source signal, was used both statically and dynamically. Sounds were placed up close, with no reverb, or far away in the distance with very little signal in relation to the amount of reverb, or anywhere in between, and could move from any of these virtual locations to any other, either smoothly or suddenly. Different sounds were given different depths of distance, expanding the spatial characteristic of the sounds in the composition, which up till now had been placed at a different locations along the perimeter of the audience, through a degree of virtual depth in space. The more extensive use of these parameters provided further components of the sound which could be repeated and differentiated.

In selecting the source sounds for this work, the composer returned to the use of physical models, restricting the work to physical model sounds rather than allowing the inclusion of found sounds or recordings of real instruments. Eleven sounds were selected from his archive of physical models from the *Oracle* project.

The composer also introduced a new element of randomness to the composition process by instructing the computer to select the 11 physical models randomly from the archive. Starting with this piece, the composer has allowed the computer to randomly choose the source sounds for his pieces from a list of the physical model sounds in his archive, subsequently remov-

ing the selected sound files from the list. For the next piece, then, another random selection of sounds from the reduced list will be chosen and crossed off the list, and so on. The goal is to avoid repeating sounds in more than one piece, thereby creating works that have markedly different characters.

For *More Than Is Wise*, the composer used a template of his algorithmic motive functions from earlier works and altered the values of their parameter settings to create new granulation processes. This stage of the work was the most important and most intuitive stage. During this stage the composer's procedure was to design the algorithmic motive functions in ways that would create the most interesting musical gestures, be they sweeping and sudden or subtle and delicate. Having determined the initial parameters and envelopes for an algorithmic motive function, the composer tested each motive function with each of the source sounds, tweaking the lists of breakpoint pairs, grain lengths and modulation, distance, reverb, amplitude curves etc. until the resulting gesture was musically interesting to him.

The motivic use of rhythms and dynamics introduced in *Thriambos* became a very focal aspect of this work. Dynamics in particular contribute greatly to the emotive nature of the fragments. While it is still the composer's intention to avoid attempts at subjective expression, the emotive characteristics (as described earlier in this dissertation) of the individual fragments in this work were given more specific attention than those in other previous works.

Score and recording

A segment of the score script of *More Than Is Wise* can be found on page 297 in Appendix B.6.1. A stereo version of the work can be found on the accompanying audio CD.

5.6.2 *Imperishable Raptures* (2009)

Imperishable Raptures was composed for the opening of the Arts Technology Research Lab at Trinity College Dublin and was premiered there in a diffused stereo version in April of 2009. It was performed in its 8-channel version at a concert of the Spatial Music Collective in Dublin in June of 2009. It was

the second of two pieces for fixed media only in which the composer incorporated the use of rhythmic-dynamic motives and equal-tempered harmony.

As with *More Than Is Wise*, the composer used only physical models as the source sounds for this work. He again used the same random process to select the source sounds for the composition, and a faster tempo was chosen to make the piece a bit more active and a bit less contemplative than previous works. He also carefully and specifically programmed new algorithmic motive functions for the work to differentiate it from the other works, testing each of the new functions with each of the sound sources and repeatedly modifying and tweaking them to ensure the resulting sounds suited his tastes. *Imperishable Raptures* also continued to make more extensive use of the parameter of virtual distance as a motivic compositional component.

The core of the algorithm remained the same, but two extensions were added to provide more features of automation. As with the last piece, the source sounds for *Imperishable Raptures* had varying degrees of pitch and noise content, again producing a work with occasional glimmers of equally tempered pitches, intervals, and chords within a sound-world that also included much unpitched noise.

Extensions to the algorithm

The two new extensions to the algorithm consisted of the automatic distribution of pitches in the individual lines of the score script and automatic incorporation of the random overlap of phrases with corresponding adjustment of end-times, also placed immediately into the score script.

The first of these was undertaken in order to automate a process which the composer had been performing manually with quite consistent rules up to this point. Pitches from the harmonic sequences generated by the algorithm are now selected by the algorithm and semi-randomly placed into the parentheses in the score script to govern the pitch envelopes of the individual fixed media voices. Rules were devised to ensure that the lowermost and uppermost pitches from the chord generated by the algorithm for that phrase would always be contained in each phrase, and that the pitches from the inner voices of any given chord would repeat neither these outer pitches

nor themselves in the initial distribution of the chord throughout the voices. Further clauses were implemented to ensure that if there was only one voice in a phrase, the lowest pitch of the chord would be chosen, and if there were more voices in a phrase than there were pitches in a given chord, all pitches of the chord would be placed before any of the pitches were repeated.

Although it was not implemented in this version of the algorithm, the intention of the composer remains to extend the algorithm to automatically choose the most sensible *next pitch* when assembling the pitch envelopes for each voice. This will be done by adding definitions of voice-leading rules to this portion of the algorithm, such that the computer will select the *closest* pitch to a given pitch in the subsequent chord (determined by the smallest interval between the two pitches), thereby creating a more natural voice leading in the fixed media part. As the algorithm stands in its current state, the composer goes back through the score script generated by the algorithm and manually edits the pitches automatically selected by the algorithm to create the smoothest possible voice-leading for each individual voice.

One of the resulting features of the electroacoustic music generated by this means is a large amount of glissandi. In the current version of the algorithm, the pitch envelopes are generated by lists of breakpoint pairs consisting of a percentage value and a pitch ratio. The percentage value refers to the percent of the duration of the entire grain sequence generated, such that an entry of (50 2.0) would indicate that halfway through the generated grain sequence the grains are to be generated with a playback speed twice that of the original (an octave higher). In any given envelope, a limited number of pairs are entered, such as (0 1.0 25 0.5 66 3.7 100 2.0). Linear interpolation is used to generate the playback values for grains falling between two specific pairs, resulting in gradual, *glissando*-like motion between any two specified playback rates. For these two pieces, this was considered a feature of the algorithm and maintained as an intentional characteristic of the resulting composition. Should the composer desire sudden pitch shifts, these would have to be generated, as the algorithm stands at the moment, by entering two consecutive breakpoint pairs with percentages that are very close together, such as (50.0 1.0 50.001 2.0). The composer has not yet and does not yet intend to extend the algorithm to include a simpler way

of indicating when pitch change is to be approached suddenly or through linear interpretation (*glissando*).

The dynamic curves created by the rhythmic-dynamic envelopes function in the same manner, with the temporal space between two specified dynamics consisting of a *crescendo* or *decrescendo* between the two dynamic levels rather than a *glissando*. Here too, sudden dynamic changes can be achieved through breakpoint pairs whose first items (the percentage value) are very close in value.

The second extension to the algorithm consists of an automation of the overlapping technique the composer had been using in other works up to this point. Two new arguments were introduced to the algorithm: *overlapChance* and *overlapNumPhrases*. The *overlapChance* argument results in more or fewer instances of any given voice extending the duration of its motive in a given phrase to include the full duration of one or more consecutive phrases, thereby to some extent smoothing out the otherwise fragmented character of the work. The *overlapNumPhrases* argument indicates the maximum number of consecutive phrases to be overlapped in the context of this function. The user enters a value for this argument, and a random function within the algorithm chooses any number between one and the number entered with equal probability.

The current state of the algorithm allows the user to indicate the value for the chance of overlap, but still restricts the overlap to one phrase only. This is a feature which must still be ironed out in the next stage of refining the algorithm. One specific control feature that must be programmed, first, for this to be completely successful, is a look-ahead function to determine whether the randomly chosen number of phrases to be overlapped is greater than the remaining number of phrases in the work, in order to prevent the process from aborting with an error. This is, however, a very valuable feature, whose implementation will most certainly be completed soon in order to further extend the spectrum of character in pieces which the algorithm is capable of generating.

Score and recording

Examples of the algorithmic motive functions of *Imperishable Raptures* can be found in Fig. A.49 on p. 199. A segment of the score script can be found in Appendix B.7.1 on p. 299. A stereo version of the work can be found on the accompanying audio-CD.

5.7 Homage through Appropriation

The last three pieces to be discussed share a more direct relationship to the techniques of appropriation described in the *Theory* section of this dissertation. The first, *Rattling the Cage*, for prepared piano and stereo fixed media, takes the melodic contours and rhythms from 16 motives of John Cage's *Sonatas and Interludes* as its material, while the other two pieces, *Wistling Dixie* and *Return Through the Beautiful Sopping Mountain*, take the instrumental combinations from Harrison Birtwistle's (1934–) *Secret Theatre* and Schönberg's *Five Pieces for Orchestra* as the material for their orchestration. All three pieces are open homage to the composers whose material serves as the source for the composer's appropriated techniques, and the titles of the pieces reflect both the source and the homage.

5.7.1 *Rattling the Cage* (2009)

Rattling the Cage was composed for a concert of the Trinity College Dublin *Node* series in April of 2009. The call for works requested pieces for prepared piano, following the preparation guidelines of Cage's *Sonatas and Interludes*. Samples of each of the keys of the prepared instrument were made available by Donnacha Dennehy, who had made recordings of a piano prepared for an earlier concert with the Crash Ensemble.

The composer decided to create a work of approximately four-and-a-half minutes duration that would make use of the prepared piano and incorporate a stereo fixed media part constructed of source sound files from the samples of the prepared piano itself. As the piece was conceived as an homage to Cage, specifically in relation to his work *Sonatas and Interludes*, the composer chose to use 16 source sound files and 16 motives, the melodic

contour and the rhythm of which were to be taken from one of each of the 16 sonata movements in the work.

Extension to the algorithm

The algorithm was extended by the inclusion of one primary new feature that approached the structural generation in a slightly different way. A new segment was added to the algorithm which would result in the simultaneous generation of a structure for the fixed media part and a separate structure for the solo instrument part. This meant a departure from the approach taken up to this point, in which the composer considered each of the voices of the fixed media part to be separate, fully individual, and equally weighted instruments.

The intention of that earlier approach was to avoid reducing the functions of the real instruments and the fixed media part to those of solo and accompaniment, achieving this in part through an equal distribution of activity and rest in the real instruments and each of the virtual voices. The approach is very effective in ensemble works, where various combinations of the real instruments are playing at any given time. However, for works with solo instrument and fixed media, in which there are more voices in the fixed media part than there are real instruments, the result is that the soloist spends a lot of time resting. While this approach is philosophically convincing and can be viewed as thoroughly effective, the composer desired for this piece to feature the prepared piano more centrally in the work, and altered the algorithm to generate a separate, parallel structure for the solo piano and one for the virtual fixed media voices.

The practical effect of this approach is that each phrase of the empty structure generated by the algorithm was the same length for both the fixed media part and the instrumental part, and consisted of the same harmonic progression in both the fixed media part and instrumental part, but the percentage of silence was applied separately, once to the cumulative voices of the fixed media part, and once to the prepared piano part. In short, the piano is active most of the time, and the silences in the piano do not coincide with the silences in the fixed media voices. (The composer chose a relatively

low amount of silent phrases for this work, at only 5%.)

The new section of the algorithm used a separate weighted-random function to determine whether the piano would play in any given measure and, if so, which motive it would perform. Its output included a separate line in the score script for the solo instrument that specifically indicated the results of these decisions. This line was placed in comments in the output file, so that the score script could serve as a guideline for composing the piano part as well as function as a score script for the fixed media part with as little additional editing as possible (see the segment of the score script in Appendix B.8 on p. 300).

Composing the work

The composer first constructed a virtual sampler made up of the recorded samples provided by Donnacha Dennehy using the NN-XT virtual Sampler Device in the Propellerhead software Reason (v. 3.0.5). Samples of unprepared keys were included as well, to provide the composer with an entire, virtually prepared piano as would be assembled under the guidelines of the Cage score for *Sonatas and Interludes*. He then set up a virtual MIDI connection between the Sibelius notation software and the Reason sampler using an Inter-Application Connection (IAC) on a Macintosh computer. This enabled immediate playback of the score as it would sound on a prepared piano during the composition process.

The composer then ran the algorithm a number of times until it produced an empty structure with exactly 16 motives. 16 motives were then chosen from the 16 sonatas in the Cage work to serve as the basis for the material in this piece. Within *Rattling the Cage*, the composer then repeats and differentiates the motives in the same manners as described above, also employing the technique of applying the rhythmic and dynamic patterns of each of the motives to the algorithmic motive functions for the fixed media part.

Sixteen of the recorded samples of the prepared piano were then selected to serve as the source sound files for the fixed media part. These were chosen purely on the basis of taste rather than for any specific intellec-

tual reason. As with *Thriambos* and *Interminable Delirium*, the samples were analyzed for any dominant fundamental pitch (not all of the preparations result in a sound with an identifiable pitch), the durations were noted, and the filenames were entered into the list of source sound files to be used for the fixed media part. New values were assigned to the arguments of the algorithmic motive functions and tested with each of the source sound files. The values were tweaked until they produced a satisfying result. As with the composer's other works that employ this technique, the decisions involved in this step of the process were made to the greatest extent intuitively, though the value for the relative volume was obviously affected by whether or not the resulting electroacoustic output stayed within non-distorting levels.

As with the previous composition for tape, the pitch curves for the score script of the fixed media part were generated automatically. These were then edited afterwards to ensure that the most linear, stepwise voice-leading was maintained throughout. The fixed media part was then rendered for performance in stereo at 44.1kHz and 16-bit.

Recording and score

The score script for the fixed media part and the instrumental score for the prepared piano part can be found on in Appendixes B.8.1 and B.8.2 on pp. 300 and 301.

There has been no live-recording made of *Rattling the Cage*, but the composer has produced a mockup of the piece using Cubase and Reason. The piano part was exported from Sibelius as a MIDI file, imported into Cubase, and used to control the NN-XT sampler from Cubase via ReWire. The fixed media part was then imported into Cubase and synchronized with the instrumental part, and both parts were bounced to disk in stereo. A copy of the mixdown can be found on the accompanying audio-CD.

5.7.2 *Return Through the Beautiful Sopping Mountain* (2008–2010)

Return Through the Beautiful Sopping Mountain is the culmination of all of the various aspects of the composer's work presented in this text. Though

it is the most recent work completed by the composer, it was begun at a very early stage of the algorithm's development. With the completion of this composition, many facets of the approach the composer has taken since 2007 have been exhausted, and new directions are now being developed. For these reasons, the work will be discussed here as the penultimate work presented in this dissertation.

Altered approach to the number of instruments and number of motives

As described in section 5.4.1, the empty structure for the work was generated in 2008 at a relatively early stage of the algorithm's development. The approach taken at the time was one in which the number of instruments determined by the user was equivalent to the maximum number of simultaneous motives. The composer recognized a weakness in this approach in the context of works for orchestra or other large ensembles relatively quickly. Firstly, while it has been the composer's intention, as described in the *Theory* section of this text, to institute a plurality of motivic material for the sake of pushing the boundaries of comprehensibility, the sheer number of individual voices available in an orchestra resulted in a complexity of polyphonic texture that went *beyond* the boundary of comprehensibility. To address this, the composer decided to alter his approach to the distribution of the motives throughout the ensemble.

The output of the algorithm at the time-point that empty structure for this work was generated still included the automatic assignment of specific motives to specific instruments. Thus, for the work *Interminable Delirium*, for example, each of the real instruments was indicated by an instrument number in the algorithm's printed output. When "Instrument 1: Motive 2" appeared in the score script generated by the algorithm, the composer gave Instrument 1, which was consistently the xylophone throughout the work, the second motive he had composed for the piece.

On generating the empty structure for the orchestra piece, the composer chose to run the algorithm using a value of 31 for the number of instruments, based on one voice for each individual woodwind and brass instrument, one voice for each of the 5 string sections, and one voice for each of

three percussion lines. This resulted in an algorithmic output which would theoretically assign as many as 31 separate motives to as many as 31 individual instruments to be played simultaneously. The composer decided that this was too many individual simultaneous motives to maintain the desired degree of comprehensibility, recognizing that in instances with the full number of motives simultaneously sounding, the result would be a fully chaotic atmosphere in which none of the motives were distinguishable, rather than a borderline-chaotic atmosphere in which the individual motives were still barely distinguishable.

The composer also realized that the automatic distribution of motives to instruments in its current form, though effective for smaller ensembles, would not allow for the effective use of timbral combinations for coloring, through coupling and doubling of various instruments and instrument groups, which he considers a necessary aspect of orchestral composition.

The composer therefore decided to disregard the automatic assignment of specific motives to specific instruments generated by the algorithm, and instead “manually” distribute the motives selected by the algorithm for each phrase, using the algorithm’s printed output as a guideline but choosing the specific instrumental combinations intuitively. This decision led the composer to redefine the function of the algorithm’s arguments for the next work, *Wistling Dixie*, in which the argument for the number of instruments is treated as an indication for the maximum number of simultaneously sounding motives, and decisions concerning which instruments play which motives are left to the composer.

The algorithm had produced a structure whose maximum number of simultaneous motives in a given phrase was 17, even though there were instances of 31 simultaneous instruments. This is the result of the method by which the algorithm assigns a motive to each given instrument at this stage of the algorithm’s development. The assignment is performed independently for each individual instrument through the use of a weighted-random function, producing multiple instances of the same motive assigned to different instruments in the same phrase. In the first stage of composing the work, the composer chose to indeed incorporate all of the motives selected by the algorithm for the given phrase. This large number of simul-

taneous motives was then reduced at a later stage, as discussed in more detail below.

This limitation to the algorithm's current output made it clear that the next extension to the algorithm must consist of a routine for orchestration decisions, since the assignment of instruments to motives is very dependent upon which instruments combine well in which pitch ranges and at which dynamic levels etc. In order to develop such an extension, the composer will have to devise a different approach to the relationship between instrument combinations (timbrel color, orchestration) and motives in his algorithm. This in turn will have a bearing on the approach to pitch selection for the harmonic sequences, in that not only instrumental ranges but also the instruments' best registers must be taken into account when assembling the harmonic sequence. The implementation of this as an automated routine of the algorithm will therefore be a very complex undertaking and require a complete restructuring of the algorithm. This restructuring is planned but has not yet been implemented. For the context of this piece, the composer decided to "manually" apply orchestration in a manner that would resemble the decisions made by such an automated routine, as described in more detail below.

Composition

The composer proceeded with the composition of the work in the same manner by which he had produced the string trio, the trombone part in *Thriambos*, and the instrumental parts in *Interminable Delirium*. The same techniques of repetition and differentiation of rhythms were used, and the same concept of melody being equal to harmony was maintained as a governing principle for the work. Since the algorithmic output had been generated prior to the inclusion of an automatic determination of overlap, the composer implemented this technique by hand, as described above, by instructing the computer to select a random number between 0 and 2 for each motive in the entire piece. As in the earlier works, if the computer returned a 0, that particular instance of the motive would overlap the next phrase for entirety of the next phrase's duration.

The melodic fragments were composed intuitively, using the same kinds of rhythms described above. Initially, the composer intended for the dynamic markings of each of the motives to be maintained for each instance of the motive, based on the assumption that this would bring out different elements of focus in each of the motive combinations that would occur during the work. While this was maintained for the first draft, subsequent drafts of the composition did away with this feature, as it often ran counter to the orchestration applied, and the same motive would appear with different dynamics in different instances.

One difference in the approach to filling out the empty structure in this piece involved the implementation of the harmonic sequence into the work. The rules by which the algorithm selects intervals for the vertical sonorities still produce relatively small intervals in the lower registers of the chords it generates. It was clear to the composer that small intervals in low registers risk a muddying of the sound, and to avoid this he intentionally omitted certain pitches from the lower ranges of the harmonic output of the algorithm.

It must also be noted that the composer did not change the maximum upper and lower values for the range of pitches from which the algorithm would select its harmonies for this piece. These arguments had not yet been incorporated into the algorithm as user-definable arguments, but were still stored as fixed values within the algorithm itself. The result is a range that does not make full use of the entire scope of the orchestral registers. To counter this, the composer allowed for octave doubling of the upper pitches in order to avail of pitch ranges and timbres of the high flutes and piccolos, high violins, etc.

As with *Interminable Delirium*, the score initially consisted of wildly alternating bar-lengths and time signatures, which were simplified as best as possible for the final score. Also, all bars of rest generated by the algorithm, which initially consisted of any of the same durations available for the sounding bars, were shortened to only one beat. This decision was made upon hearing the score and deciding that the sounding material demanded more immediately disjunct fragments with less of the quality of meditative space that longer periods of silence will create. In subsequent drafts, the composer also deleted a significant number of measures from the score in

which the energy was felt to drop, reconstructing the harmonies in these locations such that the voice-leading between the newly consecutive bars would adhere to the same rules that governed the algorithm.

Approaches to orchestration

The first draft of the work was composed for a slightly more than medium-sized orchestra, consisting of three of each of the woodwinds (with no auxiliary instruments), four horns, three trumpets and three trombones, various percussion, and 5-part strings. As described above, it became clear at the outset of the composition process that instrumental combinations generated by the algorithm would not be satisfactory, so the composer leaned on his training in orchestration techniques to intuitively distribute the motives throughout various instrumental combinations.

At this stage, the composer's primary training in techniques of orchestration were based on the textbook *Study of Orchestration* by Samuel Adler (1928–) and the *Principles of Orchestration* by Nikolai Rimsky-Korsakov (1844–1908). It soon became evident that the fore-, middle-, and background approach in these textbooks was not fully suited to the composer's use of multiple, simultaneously sounding motives. Even the relatively brief attention given to contrapuntal and polyphonic techniques by Adler didn't allow for the complexity of multiple simultaneous voices chosen by the composer. Despite this, the composer decided to maintain the use of these approaches to orchestration for the first draft of the composition, with the intention of reworking the orchestration at a later stage.

Once the first draft of the composition had been completed, the composer began re-orchestrating the work in a manner that would be more suited to the pluralist treatment of multiply layered motives. In searching for a model to form the future basis of appropriated rules and probability tables for instrumental combination in his algorithm, the composer settled on Schönberg's *Five Pieces for Orchestra*. The orchestral works of Schönberg make use of a pluralist approach to the presentation of multiple simultaneously sounding motives in any given bar, allowing his work to lend itself very well to the composer's own approach to simultaneous motives.

The composer proceeded to re-orchestrate his composition by selecting a much larger orchestra (4x woodwinds, 6 horns, 4 trombones) and jumping around through the pages of the Schönberg score, selecting passages whose instrumental combinations could be transferred nearly one-to-one into the composer's own work. This technique was meant to imitate the effect that will be achieved through implementing probability tables based on analyses of Schönberg's orchestration in the next version of the algorithm.

As a result, many moments in the composer's score are essentially quotations of Schönberg, without reproducing the exact melodic, rhythmic or harmonic content. Certain bars are so unmistakably Schönbergian in their orchestration that even without a direct quotation of the pitch and rhythmic material the listener recognizes Schönberg's *Five Pieces* straight away.

Decisions for which passages would be used from the Schönberg were primarily based on the number of motives in a given measure or group of consecutive measures. Another attribute that determined which measures of the Schönberg would be appropriated as a basis for the composer's own instrumentation was that of pitch content. On the whole, the composer attempted to find passages in the Schönberg that corresponded in their register to the pitch content of his own work. This would ensure an adequate balancing of color, dynamic, and instrumental timbre.

This manual approach proved to be less than fully satisfactory. It became clear relatively quickly that the weighted random functions of the algorithm with regard to the number of simultaneously sounding motives were not fully suited to an application of orchestration after the initial work had been composed (as would have been the technique of Beethoven, Brahms or even Stravinsky). This reinforced the composer's decision to rewrite the algorithm to include rules of orchestration at a much lower level. It also resulted in the composer's decision to greatly reduce the number of simultaneously sounding motives in the piece. Even with the very large number of instruments called for in the *Five Pieces*, Schönberg seldom makes use of more than 6 simultaneously sounding motives, with an absolute maximum of 11 in very few instances. Recognizing this has also had a bearing on the composer's conception of which parameters must be included in future developments of the algorithm.

The composer's understanding of the effect that orchestrational decisions have on the flow of a piece as a whole also became clearer through his implementation of this technique. Altering the orchestration drastically from bar to bar neither produced a sound that satisfied the composer, nor did it result in a practical use of the instruments. The composer therefore decided to maintain a given orchestration for several bars at a time. This awareness, too, will have an impact on the programming of parameters for instrumental combinations in future versions of the algorithm.

It is important to emphasize again that despite the algorithm's determination of various features, final decisions regarding melodic pitch, rhythm, harmony, structure, which instrumental combination to choose, and how to modify it to suit his own music were made intuitively by the composer based on how the work sounded as it progressed. These components were all worked and reworked until they suited his ear with regard to balance, color, and the contrasting degrees of discontinuity and linearity in the work.

Score

Return Through the Beautiful Sopping Mountain was completed in February of 2010. A copy of the score can be found in A3 format in the separate volume accompanying this dissertation. A MIDI mockup using the Sibelius Essential Sounds samples has been constructed, but the Garriton Personal Orchestra sound library lacks many of the performance techniques called for in the score, such as the extensive use of straight mutes in the brass. A copy of the MIDI mockup has been submitted with this dissertation, but with the *caveat* that it could mislead the listener.

5.7.3 *Wistling Dixie* (2010)

Wistling Dixie is not the most recently completed work by the composer but is the piece most recently begun. Its composition incorporates a number of different approaches to rhythmic differentiation, an intuitive approach to the harmonic sequence, and a slight modification of the probability tables that serve as a basis for the algorithm. It is thus the most forward-looking of the composer's works and will therefore be discussed here as the last piece

examined by this dissertation. The title of the work is a play on the spelling of Harrison Birtwistle's name, whose instrumental combinations served as the source of the composer's orchestrational decisions for the work.

The work initially began as a composition for the 2010 *Node* concert at Trinity College Dublin. It became clear to the composer relatively quickly that the complexities of the rhythms he was writing would not suit the performance skills of the student players in the Node Ensemble. He decided, however, to continue the work with the same degree of complexity, since this would allow him to pursue certain new approaches which were quite promising, and to submit a different, more playable piece for the node concert. The piece was composed between mid-December 2009 and mid-January 2010. It has not been performed, but the composer believes it is his most successful composition to date, together with his work *Interminable Delirium* for five real instruments and tape.

Number of instruments becomes number of simultaneous motives

The experience of composing the orchestra piece made the composer aware of, on the one hand, the necessity to leave room for instrumental combinations (coupling and doubling) when writing for ensembles, and on the other hand, his desire to drastically reduce the number of simultaneously sounding motives in his compositions for the sake of even more comprehensibility.

He therefore redefined the function of his argument for the number of instruments in the work. Although he has not yet renamed the argument within the algorithm and he has not yet reprogrammed the algorithm such that the algorithm generates corresponding output, his run-time assignment of a value to the *numInsts* argument of the algorithm for this piece was 5. For the context of this piece, this value indicated the number of simultaneous motives being performed, rather than the number of instruments, as the number of instruments was 13 (Flute, Clarinet, Bass Clarinet, Horn, Trumpet, Trombone, Xylophone, Piano, Violins I and II, Viola, Violoncello, and Contrabass). This would allow him to distribute the motives in a manner that incorporated differentiated doubling and coupling of the instruments.

The empty structure generated by the algorithm was thus interpreted

and incorporated differently. Although it still indicated automatically which instrument would play a given motive, this was fully disregarded. Instead, the composer interpreted the listing of what was labeled as “Instrument” in the output as “Motive” instead (e.g. “Instrument 1” was read as “Motive 1”). He endeavored to translate the number of instances given motive in the printout as a guideline for the number of instruments playing that motive, though this was not followed strictly. Thus, in measure one, for example, for which the algorithm had printed out four instances of Motive 1, the composer assigned the first motive to the top four strings, and in the second measure, for which the algorithm had indicated three instances of Motive 1, the composer removed the cello from that combination.

Reduction of options for phrase length

As a further refinement to his algorithm based on musical criteria, the composer decided to modify the probability table for possible phrase lengths. After years of producing works in which the phrase lengths could consist of anywhere from 1 to 18 pulses, the composer restricted this to a range from 2 to 7. The value of 1 and all values above 7 were removed from the probability in part because of the impracticality of notating such measures. Their removal also supported the composer’s desire to more metrically unify his compositions. The result is still a discontinuous series of fragments, but the fragment lengths are not as drastically different. The original probabilities for the values from 2 to 7 were appropriately rescaled by the *make-ptabl* function, resulting in the same probability ratios among the remaining original values (see Fig. A.50 on p. 200).

Reduction of the number of harmonies in a given measure

Another refinement of the the output that was undertaken manually for musical reasons was the number of consecutive harmonies in a given measure. The current probability table for the number of harmonies spans possible values from one to six. The composer modified this for two reasons. The first, again very practical, was that the shorter bar-lengths make it difficult to accommodate a greater number of harmonies. Secondly, the composer

had chosen a relatively quick tempo for the work, at a quarter = 72. This is the same metronome marking for the orchestral piece, and during the composition of that work the composer discovered that not only was it impractical to put 6 consecutive chords into a 2/4 bar at that tempo, but also that the perception of any change in those harmonies was lost due to the melodic quality of the material.

A third reason for modifying the maximum number of consecutive harmonies in any given measure was to increase the degree of stasis in the harmonic motion, making the repetitions more exact and the harmonic progression more gradual.

The modification of the number of consecutive harmonies in a measure was not instituted by any modification of the algorithm, though this is planned. Instead, the composer used the algorithmic output as a guideline in the form it was produced and made the decision that no bar would contain more than two harmonies. Any bar in the printed output that was indicated to have more than two consecutive harmonies was immediately reduced to two.

Self-composed harmony

The composer also decided, for the first time since the initial programming of the algorithm, to compose the harmonic sequence himself rather than depend on the harmonic sequence generated by the computer. His selection of harmonies was fully intuitive but based on the same rules of probability that he had set up for the algorithm in 2007, which had by this point become quite internalized. The primary practical benefit of this approach was that he had control over the intervals of the vertical sonority, allowing him to spell chords in such a way that the lower regions were not muddied by small intervals and the textures of the inner voices were not too thin as the result of larger intervals.

He had originally planned to extend the harmonic rules of his algorithm to accommodate this automatically, and had already even incorporated a new argument for the maximum interval between voices. He decided against using this new feature, however, for reasons that included, on

the one hand, the time constraint for the deadline of the piece, but on the other, more importantly, the desire to move away from the automation he had constructed and back towards an intuitive control over the harmonic aspect of the work.

The process of composing the harmony still arose, however, from the same concept of local direction without any ultimate goal. The harmonic sequence was therefore constructed simultaneously to the composition of the work, in the form of a piano reduction, and always only a few bars at a time.

The composer is quite pleased with the final harmonic sequence, feeling that it achieves the proper balance between overall aimless motion and a certain degree of local direction through the use of linear voice leading, a consideration of the intervals chosen, and an increase and decrease of complexity through polyphonic density.

New and modified approaches to rhythmic differentiation

The composer has achieved a slightly different aesthetic in *Wistling Dixie* through the employment of new and modified techniques of rhythmic differentiation of the motives. Firstly, his technique of *precise imprecision*, while still implemented, is implemented far less frequently and in a slightly different manner. Its modified implementation is dependent on the second feature of his new approach to rhythmic differentiation, that of exact repetition of smaller rhythmic cells within the melodic fragments.

For all of the other instrumental compositions constructed using the algorithm, the composer employed basic techniques of augmentation and diminution when applying a given motive to phrases of differing durations. In this composition, the compression of the motives takes place by means of interruption, beginning the motive at its beginning and breaking it off before it is finished, while the stretching of the motives takes place by repeating one or several of the smaller rhythmic cells within the motive to until the entire new duration is filled out. These cellular repetitions always encompass exactly one beat of the basic pulse (one quarter-note in this case).

The resulting atmosphere of the composition is therefore much more re-

semblant of the compositional styles associated with the *American Minimalists* and the current trend of the so-called *Postminimalists*. The composer's treatment of these repetitions of rhythmic sub-cells distinguishes itself from these two groups through one primary attribute. The rhythmic sub-cells are fragments of melodies whose rhythms are *ametric*, rather than consisting of ostinato patterns whose content is more harmonic than melodic. The effect of the composer's technique is more of a "skipping record" effect within a melodic gesture that otherwise obscures any sense of pulse or meter, bringing an element of periodic repetition into an aperiodic environment.

The compositional-philosophical and aesthetic implications of this, of course, indicate a potential shift away from the conception of each instance of a motive as being a repetition on the z-axis, as described in the *Theory* section of this paper. In many ways, such a technique of repetition can be seen as related to variations of the original motive on the x-axis. However, despite this, even this form of repetition still negates any concept of development, since the motives and their rhythms do not actually change in a progressive manner over a linearly conceived time; there is still no future-oriented direction implied by or perceptible in this technique of differentiation.

The effect this has on the composer's technique of *precise imprecision* is twofold in nature. Firstly, when several instruments carry the same stretched motive in the same bar, he often chooses to repeat *different* rhythmic cells of that motive, or to repeat them at different locations within the bar. An example of this can be seen in the difference between the Violin I and Violin II parts in the second measure of the score.

Secondly, there is a far greater number of instances in which the composer chooses to repeat the exact same rhythmic cell in all of the instruments carrying a given motive at the same time and in the same manner, resulting in an overall texture that is much more homophonic in texture than the predominantly contrapuntal textures of his other works from 2007 to 2010.

These are techniques with sound results which the composer finds very promising. He intends to maintain and explore in these techniques more extensively in future compositions.

Limited amount of silence

The composer chose to incorporate a very limited amount of silence into this piece, setting the run-time value for the amount of silence at 0.05%. He also chose to apply the random overlap for the piece manually again, “rolling the dice”, so to speak, separately for each motive of each measure. The result was a large number of instances in which the silent bars generated by the algorithm were overlapped by material from the previous bars, further reducing the amount of silent bars in the piece. The few remaining bars of silence were reduced to a consistent duration, as with the orchestra piece. In this case, they were reduced to the duration of one complete 2/4 bar. The final result in the context of this very full and busy piece, consisting of much contrapuntal texture and much more homophonous, hiccuping texture, is one of stuttering or staggering that adds an accentuated element of discontinuity and a more disjunct character to the work.

Appropriation of Birtwistle’s orchestration

The final attribute to be addressed in the context of *Wistling Dixie* is again that of the appropriation of techniques of instrumental combination. Despite the weaknesses he had identified in his implementation of this technique through the appropriation of Schönberg’s instrumentation for *Return Through the Beautiful Sopping Mountain*, the composer felt this technique has a lot of potential and decided to explore it further from a different angle. He decided to try a different source for the instrumental combinations, in part to test the suitability of different source material for the technique, and in part to give the new work a different character.

His selection of source material was again based primarily on the desire to find a composer whose music is similar to his own with regard to contrapuntal complexity, at the same time reflecting his interest in irregularly metered pulse, and he decided upon the music of Harrison Birtwistle. The selection of Birtwistle’s music was further based on the similarity between Birtwistle’s orchestrational treatment of melody and that of Berio in his *Ein-drücke*. The work selected was *Secret Theatre* from 1984.

During the process of applying the instrumental techniques of Schön-

berg to his own work for orchestra, the composer became aware of the advantageous effect that assuming the instrumental combinations from more than one consecutive measure at a time had on the linearity of his work. He therefore decided to appropriate the exact instrumental combinations, in exact sequence, of the first 126 bars of the Birtwistle score. The result would be the use of the composer's own structure (based on probabilities derived from the patterns governing Beckett's *Texts for Nothing*), his own polyphonic harmonic sequence (intuitively constructed based on the probabilities derived from his analysis of Berio's *Ritorno degli snovidenia*), his own rhythmic and melodic content (based on his preference for aperiodic gestures with obscured beats and meters), and his own techniques of repetition and differentiation (based on his continued development of concepts of z-axis repetition and discontinuous fragmentation), all within the instrumental combinations and colors of Birtwistle's orchestration techniques.

The result could be seen as a viewing of composer's work through a "Birtwistle filter", or, conversely, the essence of Birtwistle's orchestrational work through the filter of the composer's own music. Either way, the resulting work sounds, stylistically, nothing like the music of Birtwistle. This confronts more intently than any of the composer's other works the issues of authorial control, compositional content, compositional identity, and authenticity while producing a piece that is at once both the composer's and *not* the composer's, both Birtwistle's and *not* Birtwistle's, a work that is both an autonomous work and a one that can only be valued in consideration of its exterior relationships. It is a work that is not only not *about* Birtwistle rather a *presentation* of him, but also a work that is not about the *composer* rather a presentation of *him*.

The use of a compositionally predetermined framework for instrumental combinations proved to be extremely successful. The composer assumed various, but not all, performance techniques from the Birtwistle score, such as pizzicato in the strings or mutes in the brass. He limited his use of mutes to that of straight mutes, rather than the combination of straight and harmon mutes indicated in the Birtwistle score (the author would suggest this is an obvious throwback to Berio). He also treated the function of the various simultaneous voices of the content much differently, maintaining

his approach of a plurality of motives, with no foreground-middleground-background weighting, and no *Haupt-* or *Nebenstimmen*. Furthermore, his own piece does not assimilate the segregated *cantus vs. continuum* functions within the Birtwistle piece. It merely appropriates the instrumental combinations as they exist on the page.

Another difference between the composer's appropriation of the Birtwistle combinations and Birtwistle's combinations themselves is that of the assignment of a certain number of motives to various instruments or instrumental combinations. The number of simultaneous motives generated by the algorithm for any given phrase in the composer's piece seldom matched the number of motives in the corresponding bar of the Birtwistle. In instances in which there were fewer motives in the composer's score than in the Birtwistle, the composer either chose one instrumental combination from the Birtwistle, leaving the rest of the instruments out, or divided the motives up evenly amongst the instruments employed by Birtwistle in the corresponding measure, applying his own orchestrational skills and knowledge to ensure that a proper balance and color would be obtained. This latter technique resulted in a specific sound that is very particular to the work *Wistling Dixie*, namely one of grand, homophonic *tutti* passages, which do not occur in the Birtwistle at all.

The score and MIDI mockup

Wistling Dixie has not been performed. A copy of the score can be found in Appendix B.9 on p. 306. The MIDI mockup using the Sibelius Essential Sounds sample library does do the work justice, despite the fact that it does not present the muted brass sounds. A copy of the MIDI mockup can be found on the accompanying audio CD.

6

Discussion and Suggestions for Further Work

The results of the composer's endeavors over the past four years have been very fruitful. Both successes and weaknesses within the approaches taken and works created have contributed towards an ability to assess the works in a contemporary context and to reveal indications for future paths, whether based on minor refinement or major redirection.

6.1 Contemporary Relevance and Position

The works have successfully pooled influences and techniques from historical and contemporary artists and thinkers in the process of creating an individual approach to structure and repetition. The contemporary desire to reinstitute linearity into compositions has been achieved through the incorporation of underlying harmonic sequences that have local direction but no long-term arcs, without compromising the composer's desire for emotive rather than emotional content and his taste for and fascination with rapidly

alternating, disjunct, discontinuous forms. This places his works squarely in a contemporary context with regard to their relevance to the sociological, philosophical, and artistic currents of the day.

The simultaneous desire for linearity, discontinuity, and pluralist presentation certainly reflects the contemporary condition. The Information Age's constant throwing up of new, faster, more extensively *network*-based forms of communication, information dispersion, and information retrieval is at the same time exhausting and liberating. The average person in Western society today is bombarded in an extremely discontinuous manner by information received through numerous email accounts, profiles on numerous social networking sites, cell phone text messages, RSS feeds, special-interest internet and email forums, computer widgets for weather, news headlines and stock tickers, let alone the traditions of unsolicited advertising in physical postboxes, catalog subscriptions, paper-based post from employers, affiliated associations, public services, or the more standardized media of television and the telephone, or even meetings, appointments, and everyday drop-in visitors. The result is a condition of conflicting desires for a reprieve of this discontinuity through a return to *linearity* and an increased appetite for new sources of brief, disjunct headlines that guarantees one's position on the cutting-edge.

The composer's work reflects this current condition through its simultaneity of linearity (as implemented via meandering harmonic sequence), pluralist presence of divergent material, and fragmented, rapidly changing, non-developing, discontinuous structures.

His work also positions itself within the context of the discussion of modern vs. postmodern thought and their disparate attitudes towards meaning in music, the role of the author, authenticity, the search for Truth or formulas that provide ultimate solutions, and the limits of interpretation. It is safe to say that postmodernism has had its day, and the initial *hoopla* is over. The obligatory pendulum-swing and paradigm shift from the absolute, arborescently conceived impartation that characterized the modernists and structuralists to a complete dissolution of all conviction that an utterance can convey any specific meaning, as is often ascribed to postmodern thought, has fulfilled its function, and a return towards a more balanced but

now enlightened, differentiated view of these aspects of creative production is a welcomed trend. By embracing both modernist-structuralist and postmodernist-poststructuralist attitudes in his own work, the composer positions his work within a post-postmodern context that is progressive, constructive, and forward-looking, rather than reactionary. He does not find it necessary to adopt an *anti-postmodern* attitude, in a manner similar to the *anti-modernist* attitude it has been suggested was adopted by German composers Rihm, Manfred Trojahn (1949–), or Peter Ruzicka (1948–)⁹⁰.

The composer's use of equal-tempered pitch as a basis for melodically-based fragments as the material for his music also by no means rejects or seeks to reverse the "liberation" of pitch from the institutionalized constructions of musical function. It is not an embracing of "back to melody", or a rejection of the postmodernist approaches to non-pitch, non-melody, and non-harmony employed by postmodern composers such as Lachenmann and Ferneyhough. Instead, the composer embraces melody and equal-temperament as one of many possible constructions of sound, in a way even liberating it from its liberation, but with no dogmatic political, sociological, or pro-commercialist/ pro-capitalist platform. He admires and respects the work of Nono, Lachenmann and Ferneyhough, and Spahlinger (though he is not as attracted to their nearly fascistly dogmatic, commodity-based categorization and valuation of various styles of music). His use of disjunct structure resembles their underlying sentiment of discontinuity, not fully, but in part. It is even his intention to experiment with the use of extended performance techniques as the material for the empty structures produced by his algorithm in the future.

In short, the works presented in the course of this dissertation have succeeded in incorporating aspects of the contemporary condition, currents in thought and attitude, and an embodiment of divergent approaches from various stages along his historical lineage, effectively placing the composer, his attitudes, his techniques, and his pieces into a position of contemporary relevance and historical reference, all within works that are fresh in the specifics of their pitch, rhythm, and structural content, which maintain the interest of the listener, which express a the unique artistic personality of the composer, and which are enjoyable to listen to.

6.2 Future Directions

Against this backdrop, the works created and the approaches and techniques implemented to create them have also revealed a number of characteristics which can or should be modified or redesigned, on the one hand as a means of refining and improving on the techniques as they stand at the moment, or on the other hand for the sake of replacing them by pursuing new pathways that have been revealed through the composer's undertakings to date.

6.2.1 Implications for more diverse material

Two features that the composer sees as an exciting option for future work are related through their basis in stylistic material. The empty structures and motive patterns produced by the composer's algorithm can be filled with any kind of material. This has already been made evident through the composer's use of the very same algorithm and very same kind of underlying structures to create electroacoustic compositions, compositions for "real" instruments only, and works that combine the two, in particular with regard to rhythmic pulse and recognizable pitch content. The works composed to date reveal the potential for the algorithm to be used in generating structures for compositions, on the one hand, whose material consists of extended performance techniques, *à la* Lachenmann. On the other hand, they suggest that the same structures can be used for beat-based works (albeit with irregular metrical structures) that more closely resemble music from popular, electronica, or underground realms of musical style. The composer intends to pursue both of these directions at some stage in the future.

6.2.2 Fully automated generation of instrumental works

The algorithm's current state already automatically generates quasi-melodic pitch envelopes for tape compositions. These take the form of a sequence of pitches derived from the harmonies automatically generated by the routine. Another excitingly foreseeable direction that the algorithm's current state nearly demands be taken is that of fully automated pitch and rhythm generation for entirely instrumental compositions. As described in the section

on *Thriambos*, the Common Music programming environment already contains predefined shorthand functions that will translate traditional rhythmic durations and dynamic indications into numerical values (whereby e is an eighth-note, or 0.5, for example, and *mf* translates to an amplitude of 0.6 on a scale from 0.0 = silence to 1.0 = maximum volume). This feature, combined with the automatic harmony generation already contained within the algorithm, can clearly be implemented in such a manner that rhythmic motives and melodic contours can be predefined and repeated or differentiated by the algorithm automatically, in accordance with probability-based rules programmed by the composer. CM also currently supports a backend application called *FOMUS*, which translates MIDI note-names, as generated algorithmically by CM, into traditional music notation. The potential here is tremendous, but this is an extension to the algorithm that is still a ways off.

6.2.3 The switch to Grace

The author of Common Music, Rick Taube, has recently ceased development of his Lisp-based Common Music and has begun a new programming environment, moving to the more contemporary Scheme and SAL languages, called *Grace* (or *CM3*). He is developing the environment in conjunction with Todd Ingalls, a major figure in the world of the real-time sound production programming environment *SuperCollider*, a program with which the author of this dissertation has also worked extensively in the past and which he finds to be a very powerful real-time tool for electroacoustic composition. It is quite foreseeable that the composer will make the shift to *Grace* in the very near future, expanding his palette of algorithmic tools to include the *Grace-SuperCollider* interaction, opening up a plethora of new opportunities for real-time algorithmic sound and score generation.

6.3 Modifications and Improvements

The composer has also determined that a number of aspects of the current state of the algorithm still demand tweaking and development to become fully satisfactory. These include the routines that govern the automatic selection of intervals between inner and lower voices of the harmonic sequences

generated (in particular the low register, for the sake of wiser orchestration), and the absolutely essential inclusion of processes to determine orchestration and instrumental combination. The former is not an issue that need take much space here, since it is a matter of the implementation of a number of *if*-clauses and relatively straightforward probability tables, which the composer has already begun to undertake. The issue of instrumental combination, however, deserves a bit more specific attention.

6.3.1 Incorporation of rules for orchestration

In the process of using the “manual” technique of jumping around through the Schönberg score to impose instrumental combinations onto his orchestra piece, the composer was able to identify more clearly which specific attributes of Schönberg’s (or other composers’) orchestrational techniques he will have to analyze in order to produce probability tables and rules for incorporating this feature into his algorithm.

First of all, it became very clear that the orchestration contributed much more to the macro-structure and the perceived linearity of the work than originally assumed. For this reason, the composer has decided that his incorporation of orchestrational rules into his algorithm will be based on spans of several measures at a time, rather than one measure at a time. This will contribute, on the one hand, to the linearity of the work, which has been governed up to this point by the harmonic sequence only. As with the harmonic sequence, the orchestrational rules of the algorithm will not be intended to function as structural demarcation. Instead, the orchestration will progress with local direction, making use of the number of instruments playing and the registers of those instruments for gradual increase and decrease in the intensity of the work as it unfolds in time. It will not be used, however, to create a sensation of culmination or climax, and the algorithm will allow for solo passages or climactic passages to arrive at any point in the work, any number of times.

Secondly, initial planning of the method of analysis for the production of the probability tables revealed that the likelihood of any specific number of motives to occur in a given measure must first be analyzed. Then it will

be determined how many instruments are used to perform those motives. These are numbers that can be treated as ratios, such that any number of instruments can be selected for the automatic generation of the empty structure, and the algorithm will print out which instruments are playing which motives. This step will be much more complex, in that in order for it to be effective, a catalog will have to be made of the various instrumental combinations within certain pitch ranges (registers) and at certain dynamic levels.

The expansion of the algorithm to entail orchestration as attached to pitch levels will thus entail a complete reworking of the algorithm, such that the current algorithm becomes encapsulated within the new extension. In other words, the instrumental combinations must be chosen first, and the pitch ranges that they are attached to must then serve as the basis for the selection of pitches for the harmonies in each measure.

Each instrumental combination cataloged must also have a certain number of other possible combinations that it can lead to, potentially determined by a process such as a *Markov chain*. At the moment, the plan is for any of these individual instrumental combinations to be able to progress forwards or backwards in the chain. It will also be necessary to have any given instrumental combination lead to a certain number of consecutive instrumental combinations, maybe between 3 and 5, but definitely a random number, to ensure a certain degree of flow is achieved, much like the harmonic sequences function at the moment.

This undertaking will be quite extensive. A new catalog must be created for each ensemble of instruments the composer wishes to write for. One option, and the most extensive, is that analyses and probability tables will have to be made for every new ensemble, based on real combinations from other pieces. This would require that the composer create a new argument for the algorithm that would indicate which catalog the instrumentation probabilities are to be taken from. Another option is that the catalogs be modularized, such that possible instrumental combinations be cataloged for combinations of 2, 3, 4 instruments, etc., and if any of these 2, 3, or 4 instruments are members of an ensemble for which the composer is writing, those specific catalog entries can be accessed by the algorithm.

6.3.2 Macro-structure

This approach to implementing orchestration rules into the algorithm could potentially present one possible solution to the macro-structure issue of the algorithm. At present, the composer is not fully satisfied that the discontinuous structures created by the algorithm support works of more than 11 minutes in duration. The composer became very aware of the capacity for orchestration to greatly extend the capacity for duration, through aspects such as the number of instruments playing, the specific registers in which they are playing (and the resulting intensity), and the general registers made use of by the ensemble as a whole. All of these factors, for now, will be used as the first step towards rectifying the issue of macro-level structure in longer works.

7

Summary

The works presented here have been successful both in and of themselves as well as with regard to the artistic aims of the author as set out in the *Introduction*. He has achieved a music which exhibits an individual approach to structure and repetition, in great part through extending and combining earlier approaches of other composers and artists. He has reincorporated techniques of repetition into his own work and expanded the function of structure and repetition to extend beyond traditional motivic-thematic development, pushing the boundaries of comprehensibility through the use of disjunct, phrase-based melodic fragments and a large number of non-developing motives. His works incorporate both pluralistic, disjunct structures and a degree of underlying linearity, managing to avoid the grand narrative while maintaining emotive qualities that he values. His work sets down milestones for his own personal development while opening doors onto pathways for future development, and he has achieved this within a contemporarily relevant style and attitudinal context that embraces both the present, the recent past, and the less recent past with regards to sociological, linguistic, interpretative and artistic thought.

Notes

¹The author's use of these four categories is taken from John Cage's writings. Cage first mentions them in his "Defense of Satie" (In: Kostelanetz (1971)), but also describes them in "Composition as a Process: Indeterminacy" (In: Cage (1961), p. 35), where he writes: "structure[...] is the division of the whole into parts;[...] method[...] is the note-to-note procedure; form[...] is the expressive content, the morphology of the continuity;" in reference to *material* he identifies *frequency*, *duration*, *timbre* and *amplitude*.

²Cage's presentation of the *nine permanent emotions* of the Indian tradition formulate this more specifically, as will be discussed in more detail in the *Theory* section of this paper.

³The term *moment form* can be attributed to Stockhausen, as discussed in more detail in the *Background* and *Theory* sections of this paper.

⁴The term *fixed media* in electroacoustic composition has come to replace the term *tape*, and refers to any pre-rendered composition that is played back, either from tape, CD, hard drive or any other form of *fixed media*.

⁵Found at <http://www.lib.cam.ac.uk/Departments/Music/moderncomposers.html>. Last updated April 2009. Last accessed 24 Mar 2010.

⁶<http://www.harrassowitz.de>

⁷Rose Rosengard Subotnik writes, "Adorno's concept of structural listening, like all of his music criticism, was not only developed in a full and informed sympathy with Schoenberg's enterprise, but in fact can be read as a defense of Schoenberg." (Subotnik (1996a), p. 149).

⁸In his article "Postmodernism and Art Music in the German Debate" (In: Lohead and Auner (2002), p. 85), Tillman writes, "The idea of authenticity in musical modernism during the '50s and '60s was governed by Adorno's philosophy of music, as Danuser has pointed out," citing Danuser (1991), p. 57.

⁹In Stockhausen's own words: "Every present moment counts, as well as no moment at all; a given moment is not merely regarded as the consequence of the previous one and the prelude to the coming one, but as something individual, independent and centered in itself, capable of existing on its own. An instant does not need to be just a particle of measured duration. This concentration on the present moment—on every present moment—can make a vertical cut, as it were, across horizontal time perception..." (Stockhausen (1963), p. 199). Trans. B. Absetz in Heikinheimo (1972), pp. 120–21. Cited in Kramer (1978), p. 179.

¹⁰For a very interesting article depicting the relationship between Berio and Eco, and proposing not only a musical perception of text but a textual perception of music, see Mussnug (2008), pp. 81–97.

¹¹In the same article, Mussnug quotes a passage from Berio's *Remembering the Future*: "It can be useful for a composer to remember that the sound of a voice is always a quotation, always a gesture. The voice, whatever it does, even the simplest noise, is inescapably meaningful: it always triggers associations and it always carries within itself a model, whether natural or cultural." (Berio (2006), p. 50).

¹²(Feller, 2002), p. 250.

¹³Ibid. Feller takes the Foster quote from Foster (1983), p. xi.

¹⁴Subotnik refers to “what Adorno sees as the deceptions of falsehoods invariably fostered through social ideology in order to maintain the power of existing institutions”. She continues, “Conversely, the greater the distance of music from the logical paradigm, the greater its entrapment in the special interests served by the conventions of social ideology, and the smaller its claim to the essentially moral condition of aesthetic value.” (Subotnik (1996a), pp. 154–55).

¹⁵In the same article cited above, Feller writes, “Adorno differentiated types of music by their relationship to their status as a commodity, some accepting this fate, others rejecting. Both Lachenmann’s and Fernyough’s compositions reside within the latter type.” (p. 251)

¹⁶(Mauser, 1990), p. 375. This reference is found in Tillman (2002), p. 82.

¹⁷Lang writes, “Being a student of the Schönberg-school of sorts, repetition had been a banned thing for me for a long time, me aiming to achieve a continuous variety within my music, never saying things twice.” (Lang, 2002a)

¹⁸Kyle Gann describes *Totalism* as a music that “attract[s] rock audiences with its highly physical drum beat, while also engaging more sophisticated listeners through a background of great melodic and formal intricacy.” (Gann, 1993), quoted in (Taylor, 2002).

¹⁹See for example Eco’s *The Limits of Interpretation* (Eco, 1990).

²⁰(Davies, 1995), p. 34. Cited in: Ridley (2004), p. 22.

²¹(Ridley, 2004), p. 23.

²²(Wittgenstein, 1953), section 527. Cited in: Ridley (2004), p. 22.

²³(Ridley, 2004), p. 23.

²⁴(Ridley, 2004), p. 23.

²⁵Ibid., pp. 22–26.

²⁶The Oxford English Dictionary identifies the etymological source of the English word *sentiment* as the medieval Latin *sentimentum*, from Latin *sentire* “feel”. Its definition of “sentiment” includes “general feeling or opinion” and “a feeling or emotion”.

²⁷(Tillman, 2002), pp. 75–91. In his historical discussion of the origins and evolution of definition for the term “postmodern” in Germany, Tillman refers to several critics of the time, including primarily Danuser, Welsch and de la Motte-Haber. Here he refers to Motte-Haber (1987).

²⁸(Kramer, 2002), pp. 13–26.

²⁹(Danuser, 1988). Cited in Tillman (2002), p. 77.

³⁰(Kramer, 2002), pp. 16–17.

³¹(Hassan, 1987). Cited in Tillman (2002), p. 83.

³²(Williams, 2002), p. 228.

³³(Jencks, 1987), p. 34.

³⁴Ibid, p. 47.

³⁵(Gergen, 1991). Cited in: Kramer (2002), p. 19.

³⁶(Kramer, 2002), p. 18. The quotation at the end of the passage is attributed by Kramer to an anonymous reviewer of the given article.

³⁷(Lyotard, 1979), p. 7. Cited in the Introduction to Lochead and Auner (2002), p. 6.

³⁸For Stockhausen's approach to this, see his own description in Stockhausen (1963).

³⁹(Danuser, 1990). Cited in: Tillman (2002), p. 79.

⁴⁰(Subotnik, 1996b), pp. 148–176.

⁴¹Ibid, p. 148.

⁴²In the same article, Subotnik writes "Schoenberg and Adorno quite openly define structural listening as developmental listening," citing Schönberg's identification and significance of development in the works of J. S. Bach in *Style and Idea* (Schoenberg, 1946) and Adorno's article "Bach Defended Against His Devotees" (In: Adorno (1967)).

⁴³In the same article again, Subotnik writes on p. 156, "The notion of development represents. . . a continuation of structural concepts and values that originated in Viennese Classicism."

⁴⁴Ibid.

⁴⁵Webern asks, "How do I best achieve comprehensibility?—Through the use of repetition." (author's translation) (Webern (1960), p. 23).

⁴⁶For more specific discussion of spatiality in instrumental music see, for example, Hanocho-Roe (2003) and Boehmer (1997), in which the authors cite John Cage's *Silence* (Cage, 1961); or Morgan (1997), as cited in Kramer (1995), p. 176.

⁴⁷(Lang, 2002a) and (Lang, 2002b).

⁴⁸(Deleuze, 1994), pp. 19.

⁴⁹Ibid., p. 20.

⁵⁰(Saussure, 1916), p. 120; cited in: Derrida (1972b), p. 11.

⁵¹(Derrida, 1972b), p. 9.

⁵²(Subotnik, 1996b), pp. 148–176.

⁵³Ibid., p. 155.

⁵⁴Ibid., p. 159.

⁵⁵Ibid., p. 159.

⁵⁶(Boulez, 1963), p. 31. Cited in: Nesbitt (2004), p. 67.

⁵⁷Ibid.

⁵⁸(Nesbitt, 2004), p. 67.

⁵⁹Ibid.

⁶⁰This quote is taken from a letter from John Cage to Pierre Boulez dated 18 December 1950, as compiled in Nattiez (1990), p. 78.

⁶¹References to these influences are found in Pritchett (1993), p. 30 and p. 48 respectively.

⁶²(Bernstein, 2002), in: Nicholls (2002), p. 187; referring to Cage (1948b), in: Kostelanetz (1971), p. 34.

⁶³(Bernstein, 2002). In: Nicholls (2002), p. 187. Bernstein refers here to Cage (1949), in: Cage (1961), p. 62.

⁶⁴The author considers the obvious and intricate discussion of the linearity of time being a psychological construct, with its necessary consideration of at least Derrida's *trace*, its relationship to Heidegger's *Spür*, and the requisite background knowledge of Socrates-Plato-Aristotle, Descartes, Kant, Hegel, Peirce, Rousseau, Marx, Nietzsche, Levinas, Husserl etc. to be very important, but is allowing himself to work in slightly more general terms for the scope of this text.

⁶⁵See Osmond-Smith (1985) and Osmond-Smith (1991) for detailed discussions of what Osmond-Smith refers to as "fixed pitch fields" in Berio's harmonic language.

⁶⁶(Welsch, 1988), p. 10. Cited in: Tillman (2002), p. 76.

⁶⁷(Williams, 2002), p. 239.

⁶⁸This quote is taken from Bernstein's description of Cage's use of chance in (Bernstein, 2002), p. 210.

⁶⁹Descriptions of these can be found in Randal (1969); Rosenstiehl (1982), pp. 62, 195, 202, 205; Grout (1960), pp. 228, 310, 312. The Schirmer states that "All but two of Josquin's masses. . . make use of borrowed material. . .".

⁷⁰(Cyr, 1971), p. 296.

⁷¹(Morgan, 1978), p. 175. In the quoted article, Morgan is making a comparison between Ives and Mahler, and the quote refers to both men's treatment of quotation in their work.

⁷²(Ives, 1920), p. 51.

⁷³For a more in-depth discussion of this and the source of this use of the terms *arborescent* and *rhizome* see Deleuze and Guattari (1980), in particular the definitions set forth in the Introduction.

⁷⁴See for this point 16 of the list of postmodern characteristics compiled by Kramer, presented at the beginning of this chapter. See also Barthes (1968).

⁷⁵Kramer writes, "To see themselves on the cutting edge, such avant-gardists (and also early modernists like Schoenberg, Webern, and Stravinsky) had to accept history as linear progress. But recent postmodern composers have moved away from the dialectic between past and present that concerned these early avant-gardists and modernists and that continued to plague their mid-century descendants, such as Boulez, Stockhausen, Nono, Cage, Carter, and Babbitt." (Kramer (2002), p. 18).

⁷⁶See Jencks definition of *double-coding* in the article cited above and Kramer (2002), p. 18.

⁷⁷(Williams, 2002), p. 238.

⁷⁸(Pritchett, 1993), pp. 190–191.

⁷⁹(Danuser, 1988), p. 4. Cited in: Tillman (2002), p. 87.

⁸⁰(Heile, 2002). In: Lohead and Auner (2002), p. 289.

⁸¹See Barthes (1968).

⁸²Despite apparent similarities in spelling, the words *author* and *authentic* are etymologically unrelated. According to the New Oxford American Dictionary, *authentic* stems from the Greek *authentikos*, meaning "principal, genuine", while *author* stems from Latin *auctor*, from *augere*, meaning "increase, originate, promote". It states that the spelling of *author* with *th*

arose in the 15th century, and perhaps became established under the influence of *authentic*. It is interesting to note, in this context, that the original relationship between *author* and *augment* would suggest that the technique of appropriating a fragment and augmenting it is indeed still an act of authorship.

⁸³(Eco, 1983) Cited in: Jencks (1987), pp. 34–35.

⁸⁴(Subotnik, 1996a), p. 154. Subotnik takes the Adorno quotation from Adorno (1976), p. 197.

⁸⁵(Tillman, 2002), p. 85

⁸⁶Ibid.

⁸⁷(Subotnik, 1996a), p. 169.

⁸⁸See David Osmond-Smith as cited above.

⁸⁹The reference to this word is found in the New Oxford American Dictionary under the definition for *triumph*

⁹⁰See the *Theory* chapter of this dissertation for more detailed discussion of *anti-modernism* in Germany.

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A

Tables and charts from the construction of the algorithm

A.1 Oracle

A.1.1 Examples of the texts used in Oracle

It appears that all sources of information are unreliable. The deaf and the blind have additional difficulty in communication. Despite this, participants undertook risky experiments. A small group was despatched to the frontier town of Nihil. En route they reported seeing starving men, squatting on top of stone columns, calling out to them, warning them of inaccurate or incomplete information because the route they were taking was based only on theoretical data. The area where these persons were encountered is known to us as the Sea of Small Things.

The Sea of Small Things has no floor and no tide. Mariners, aboard luxury yachts, cruise constantly in search of land, spurred on by the presence of dust in the easterly breeze. Recent speculation proposes that the dust has been caused by the countless deaths of starving recluses. But it may well have been the remains of the group despatched to the frontier. There is much uncertainty about this. Nagging, gnawing doubt about the past, chews at their souls. Would it have been more delicious to die in the arms of a whore? What awaits the explorer of orifices?

Here is the message given to explorers; "Move on, moved by shifting tectonic plates or by the illusion of freewill. Be moved to tears by the Madonna's smile, a chronometer melting in the sun, the sagging of breasts in early morning light. The compass needle rotates in a frenzy of confusion, YOU will move on. Receive an

offer to go to Paris, next Wednesday, at two-thirty pm. Accept. You may think that one existence is as good as another but you are in charge of the tap that releases the Zyklon B”.

A.1.2 Sections, clips, and durations in the Oracle

<u>Dance01</u>	<u>Clearing01</u>	<u>Singers01</u>	<u>OracleA1e</u>	<u>Callback01</u>	<u>OracleB1e</u>	<u>2Callback01</u>	<u>OracleC1e</u>	<u>Dismiss01</u>	<u>Destruct01</u>	<u>Default 1</u>
46.000	54.000	64.000	54.240	18.000	55.960	18.000	53.080	40.000	25.000	40.000
<u>Dance02</u>	<u>Clearing02</u>	<u>Singers02</u>	<u>OracleA2e</u>	<u>Callback02</u>	<u>OracleB2e</u>	<u>2Callback02</u>	<u>OracleC2e</u>	<u>Dismiss02</u>	<u>Destruct02</u>	<u>Default 2</u>
51.880	40.000	65.000	42.560	18.000	54.560	18.000	61.960	40.000	22.000	40.000
<u>Dance03</u>	<u>Clearing03</u>	<u>Singers03</u>	<u>OracleA3e</u>	<u>Callback03</u>	<u>OracleB3e</u>	<u>2Callback03</u>	<u>OracleC3e</u>	<u>Dismiss03</u>	<u>Destruct03</u>	<u>Default 3</u>
47.000	51.000	65.560	60.880	18.000	62.240	18.000	53.280	40.000	22.000	40.000
		<u>Singers04</u>	<u>OracleA4e</u>	<u>Callback04</u>	<u>OracleB4e</u>	<u>2Callback04</u>	<u>OracleC4e</u>	<u>Dismiss04</u>	<u>Destruct04</u>	
		64.000	62.240	18.000	64.800	18.000	49.400	40.000	32.000	
			<u>OracleA5e</u>		<u>OracleB5e</u>		<u>OracleC5e</u>			
			60.520		60.840		54.320			
			<u>OracleA6e</u>		<u>OracleB6e</u>		<u>OracleC6e</u>			
			59.800		63.200		54.520			
			<u>OracleA7e</u>		<u>OracleB7e</u>		<u>OracleC7e</u>			
			38.400		50.880		56.400			
			<u>OracleA8e</u>		<u>OracleB8e</u>		<u>OracleC8e</u>			
			65.000		53.520		100.040			
			<u>OracleA1d</u>		<u>OracleB1d</u>		<u>OracleC1d</u>			
			56.200		59.360		54.040			
			<u>OracleA2d</u>		<u>OracleB2d</u>		<u>OracleC2d</u>			
			46.760		58.240		60.800			
			<u>OracleA3d</u>		<u>OracleB3d</u>		<u>OracleC3d</u>			
			53.240		63.400		52.280			
			<u>OracleA4d</u>		<u>OracleB4d</u>		<u>OracleC4d</u>			
			52.280		62.760		43.840			
			<u>OracleA5d</u>		<u>OracleB5d</u>		<u>OracleC5d</u>			
			54.320		52.480		44.800			
			<u>OracleA6d</u>		<u>OracleB6d</u>		<u>OracleC6d</u>			
			64.120		58.520		53.040			
			<u>OracleA7d</u>		<u>OracleB7d</u>		<u>OracleC7d</u>			
			40.250		39.920		49.400			
			<u>OracleA8d</u>		<u>OracleB8d</u>		<u>OracleC8d</u>			
			64.880		53.320		120.920			

Figure A.1: The structure and relative durations of the various clips that make up the Oracle sequences. (Durations listed in seconds)

A.1.3 Division of the Beckett text into 10 sections with indications of word-count and phrase-count (excerpt)

It's a winter night, where I was, where I'm going, remembered, imagined, no matter, believing in me, believing it's me, no, no need, so long as the others are there, where, in the world of the others, of the long mortal ways, under the sky, with a voice, no, no need, and the power to move, now and then, no need either, so long as the others move, the true others, but on earth, beyond all doubt on earth, [79/25]

for as long as it takes to die again, wake again, long enough for things to change here, for something to change, to make possible a deeper birth, or resurrection in and out of this murmur of memory and dream. A winter night, without moon or stars, but light, he sees his body, all the front, part of the front, what makes them light, [64/13]

this impossible night, this impossible body, it's me in him remembering, remembering the true night, dreaming of the night without morning, and how will he manage tomorrow, to endure tomorrow, the dawning, then the day, the same as he managed yesterday, to endure yesterday. Oh I know, it's not me, not yet, it's a veteran, injured to days and nights, but he forgets, he thinks of me, more than is wise, and it's a far cry to morning, perhaps it has time never to dawn at last. That's what he says, with his voice soon to leave him, perhaps tonight, and he says, How light it is, [107/26]

how shall I manage tomorrow, how did I manage yesterday, pah it's the end, it's a far cry to morning, and who's this speaking in me, and who's this disowning me, as though I had taken his place, usurped his life, that old shame that kept me from living, the shame of my living that kept me from living, and so on, muttering, the old inanities, his chin on his heart, his arms dangling, [74/15]

sagging at the knees, in the night. Will they succeed in slipping me into him, the memory and dream of me, into him still living, amn't I there already, [29/6]

A.1.4 Text, image, and sound motives in Oracle

<u>Wrds</u>	<u>Motives used</u>
4 It's a winter night,	1a
3 where I was,	2a, 3a
3 where I'm going,	2a, 3a, 4a
1 remembered,	5a
1 imagined,	5b
2 no matter,	6a
3 believing in me,	5c, 3b
3 believing it's me,	5c, 3b
1 no,	6b
2 no need,	6c
7 so long as the others are there,	7a, 8a, 2b
1 where,	2a
I 6 in the world of the others,	9a, 8a
5 of the long mortal ways,	7b, 9b, 4b
3 under the sky,	1b, 1c
3 with a voice,	10a
1 no,	6b
2 no need,	6c
5 and the power to move,	11a
3 now and then,	12a
3 no need either,	6c
6 so long as the others move,	7a, 8a, 4c
3 the true others,	13a, 8a
3 but on earth,	9c
5 beyond all doubt on earth,	14a, 5d, 9c
9 for as long as it takes to die again,	7c, 15a, 12b
2 wake again,	15b, 12b
7 long enough for things to change here,	7d, 16a, 3c, 2c
4 for something to change,	3d, 16a
6 to make possible a deeper birth,	11b, 17a, 18a
12 or resurrection in and out of this murmur of memory and dream.	18b, 12c, 10b, 5e, 5f
II 3 A winter night,	1a
4 without moon or stars,	1d, 1e
2 but light,	1f
4 he sees his body,	19a, 20a
3 all the front,	21a, 22a
4 part of the front,	21b, 22a
4 what makes them light,	3e, 11c, 1f

Figure A.2: Segment of the list of shorthand I.D. for phrases and motives used in the Oracle

	Phrase ID	Wrds	Secs/Wd	Dur	StrtDec	StopDec	StpTm	Motives used
<u>DANCE01</u> <u>00:46.0/25</u>	I.1	4	0.582	2.328	0.000	2.328	00:02.33	1a
	I.2	3		1.746	2.328	4.074	00:04.07	2a, 3a
	I.3	3		1.746	4.074	5.820	00:05.82	2a, 3a, 4a
	I.4	1		0.582	5.820	6.402	00:06.40	5a
	I.5	1		0.582	6.402	6.984	00:06.98	5b
	I.6	2		1.164	6.984	8.148	00:08.15	6a
	I.7	3		1.746	8.148	9.894	00:09.89	5c, 3b
	I.8	3		1.746	9.894	11.640	00:11.64	5c, 3b
	I.9	1		0.582	11.640	12.222	00:12.22	6b
	I.10	2		1.164	12.222	13.386	00:13.39	6c
	I.11	7		4.074	13.386	17.460	00:17.46	7a, 8a, 2b
	I.12	1		0.582	17.460	18.042	00:18.04	2a
	I.13	6		3.492	18.042	21.534	00:21.53	9a, 8a
	I.14	5		2.910	21.534	24.444	00:24.44	7b, 9b, 4b
	I.15	3		1.746	24.444	26.190	00:26.19	1b, 1c
	I.16	3		1.746	26.190	27.936	00:27.94	10a
	I.17	1		0.582	27.936	28.518	00:28.52	6b
	I.18	2		1.164	28.518	29.682	00:29.68	6c
	I.19	5		2.910	29.682	32.592	00:32.59	11a
	I.20	3		1.746	32.592	34.338	00:34.34	12a
	I.21	3		1.746	34.338	36.084	00:36.08	6c
	I.22	6		3.492	36.084	39.576	00:39.58	7a, 8a, 4c
	I.23	3		1.746	39.576	41.322	00:41.32	11a, 8a
	I.24	3		1.746	41.322	43.068	00:43.07	9c
	I.25	5		2.910	43.068	45.978	00:45.98	12a, 5d, 9c
	Phrase ID	Wrds	Secs/Wd	Dur	StrtDec	StopDec	StpTm	Motives used
<u>DANCE02</u> <u>00:51.22/25</u>	I.1	4	0.657	2.628	0.000	2.628	00:02.63	1a
	I.2	3		1.971	2.628	4.599	00:04.60	2a, 3a
	I.3	3		1.971	4.599	6.570	00:06.57	2a, 3a, 4a
	I.4	1		0.657	6.570	7.227	00:07.23	5a
	I.5	1		0.657	7.227	7.884	00:07.88	5b
	I.6	2		1.314	7.884	9.198	00:09.20	6a
	I.7	3		1.971	9.198	11.169	00:11.17	5c, 3b
	I.8	3		1.971	11.169	13.140	00:13.14	5c, 3b
	I.9	1		0.657	13.140	13.797	00:13.80	6b
	I.10	2		1.314	13.797	15.111	00:15.11	6c
	I.11	7		4.599	15.111	19.710	00:19.71	7a, 8a, 2b
	I.12	1		0.657	19.710	20.367	00:20.37	2a
	I.13	6		3.942	20.367	24.309	00:24.31	9a, 8a
	I.14	5		3.285	24.309	27.594	00:27.59	7b, 9b, 4b
	I.15	3		1.971	27.594	29.565	00:29.57	1b, 1c
	I.16	3		1.971	29.565	31.536	00:31.54	10a
	I.17	1		0.657	31.536	32.193	00:32.19	6b
	I.18	2		1.314	32.193	33.507	00:33.51	6c
	I.19	5		3.285	33.507	36.792	00:36.79	11a
	I.20	3		1.971	36.792	38.763	00:38.76	12a
	I.21	3		1.971	38.763	40.734	00:40.73	6c
	I.22	6		3.942	40.734	44.676	00:44.68	7a, 8a, 4c
	I.23	3		1.971	44.676	46.647	00:46.65	11a, 8a
	I.24	3		1.971	46.647	48.618	00:48.62	9c
	I.25	5		3.285	48.618	51.903	00:51.90	12a, 5d, 9c

Figure A.3: Comparison of data for two electroacoustic clips of the same section with phrase ID, number of words, seconds per word, phrase duration, and start/stop times for each phrase

	Oracle Mot.	Text Mot.	Image Motive	Kind	Sound Motive
Dance01	1.1	(1)	White	Hand	AllpGmrScrCh1
	1.2	(2)	Green/White fuzz slashes	Hand	BerioHarpPluck
	1.3	(3)	Blur purple-black	movFF	windshWipersFrag1mono.aif
	1.4	(4)	Vertical haze turquoise	StillFF	purpHazBegXltrlWingBeg1_44k16b.aif
	1.5	(5)	Airplane console schematic white	StillFF	JetFlying
	1.6	(6)	Dancing couple legs red-white	movFF	AfroCubanGagakuMixes
	1.7	(7)	Sneaker sole white-green	StillFF	AfroCubanSportsMixes
	1.8	(8)	Splash-splotch green-blue-yellow	StillFF	oneWave
	1.9	(9)	Tiles	FX	PoolDivSwimRhy
	1.1	(10)	Black back/White bar	Hand	ChurchBellsConcertCali
	1.11	(11)	Dancing woman purple	movFF	DeepPurpleWaterSeg2
	1.12	(12)	Dancing mannequin	PhysM	droppingWoodenBallMon.aif
Clearing01	2.1	(7)	white ghost streaks	movFF	pulleyChainLongPullCrop.aiff
	2.2	(15)	Blur black-gold telescopes	movFF	collapseCrpFdNrm.aiff
	2.3	(12)	gadgets	PhysM	gadgetsCrpFd.aiff
	2.4	(16)	arise	(physM)	ariseCrpFd.aiff
	2.5	(11)	Black space	PhysM	windTunnelNoZFade.aiff
	2.6	(10)	tan ground	PhysM	tanGroundCrpFd.aiff
	2.7	(5)	Metal mannequin	PhysM	metalMannequinCrpFd.aiff
	2.8	(1)	vacuum cleaner	PhysM	vacuumCleanerCrpFd.aiff
	2.9	(18)	Blue rays/star dust	PhysM	oneSidedWindFaded.aif
	2.1	(17)	Moons	PhysM	whkWhkCrop.aiff
	2.11	(21)	floating/driftng	(physM)	floatDriftCrpFd.aiff
	2.12	(20)	white flash	Hand	longSlowFluteCrop.aiff
	2.13	(22)	bombers	PhysM	bombersCrpFd.aiff

Figure A.4: Example of the labeling and relationship between text, image, and sound motives in the *Oracle*

A.1.5 Granulation arguments and their definitions

<i>filename</i>	The name of the generated output file
<i>startTime</i>	The time-point in seconds at which the sound grain is placed in the generated output file; sounds may begin after a specified duration of silence
<i>granLen</i>	The length of the sound grain to be generated, in seconds. Default value: 1.0 seconds. Should the grain length be longer than the source sound file, or should the current grain being generated surpass the end of the source source sound file, the routine loops around to the beginning of the source soundfile, taking the remaining necessary number of samples from the beginning. This looping operation may occur any number of times in the generation of an output soundfile.
<i>ampScale</i>	The scaled amplitude of the sound grain to be generated, from 0.0=silent to 1.0 maximum volume. Default value = 1.0
<i>srt</i>	The sampling rate of the sound grain to be generated. 1.0=original playback speed, 0.5=half playback speed (octave lower), 2.0=double playback speed (octave higher). Any numerical value accepted. Default value = 1.0).
<i>granAmpEnv</i>	Volume curve (envelope) of the grain, determined by a string of any number of breakpoint pairs. The first number of each pair indicates the percentage of the grain duration by which the volume curve is to attain the value indicated by the second number. The volume numbers may be between 0.0 = silent to 1.0 = full volume. Default = (0 0.0 10 1.0 90 1.0 100 0.0). The default envelope ensures that all grains start and end at a zero-crossing (silence) with a gradual, linear fade-in and fade-out in order to avoid clicks and pops during playback caused by sudden jumps to non-zero sample values in the digital waveform.
<i>inputFileStart</i>	The time-point in the resulting audio file at which the grain is to begin playback. Default value = 0.0 (beginning of the output file).
<i>panDeg</i>	Static placement of the grain within a linear loudspeaker array. The values for this argument function within <i>mod</i> 360, since the original instrument was programmed for a circular, equidistant, multi-channel loudspeaker array. The result is that stereo panning is also scaled from 0 to 360, with 0 = hard Left and 360 = hard Right. This 360-degree modulus allows for easy transformation of any sound-file generation for <i>n</i> -channel loudspeaker arrays.

<i>distance</i>	The approximate virtual (perceived) distance of the sound from the listener. This value is passed to the given reverberation instrument (routine) chosen by the user, and functions only in conjunction with reverberation instruments that incorporate this value. (The Common Music port of the <i>freeverb</i> reverberation instrument by [CITATION OF PROGRAMMER] is the instrument used by this composer.) Default = 1.0, resulting in a sound which is perceived as being directly in front of the listener. The numbers roughly represent meters of virtual distance behind the loudspeaker. The effect is best generated in conjunction with the use of reverb, through the mix of the source signal with that of the reverberation signal generated.
<i>revAmt</i>	The amount of reverb applied to the soundfile generated. Default value = 0.0 (no reverb). Reverb values between 0.05 and 0.1 generally result in supportive reverb ambience, without overpowering the resulting sound or becoming too much of an "effect". Further reverb parameters are passed to the reverberation instrument when the final commands are given to the computer to generate the sound (such as decay time, etc.).

A.1.6 The granulation instrument

```
(definstrument genGran1f (filename startTime
                        &key
                        (granLen 1.0) ; seconds
                        (ampScale 1.0)
                        (srt 1.0)
                        (granAmpEnv '(0 0.0 10 1.0 90 1.0 100 0.0))
                        (inputFileStart 0.0) ;; seconds
                        (panDeg 0.0)
                        (distance 1.0)
                        (revAmt 0.0))
  (let* ((beg (floor (* startTime *srate*)))
         (end (+ beg (floor (* granLen *srate*))))
         (degVal panDeg)
         (nChns (mus-channels *output*))
         (inputStartSamp (floor (* inputFileStart *srate*)))
         (inputTtlNumSamps (sound-frames filename))
         (inputFileSeg (open-input filename :start inputStartSamp))
         (srcGen (make-src :input inputFileSeg :srate srt))
         (ampEnv (make-env :envelope granAmpEnv :scaler ampScale :duration granLen))
         (pos 0.0))
    (if (= nChns 2) (setf degVal (* (/ degVal 360.0) 90.0)))
    (let ((panner (make-locsig :degree degVal
                              :distance distance
                              :reverb revAmt)))
      (format t "~%Processing, please wait...")
      (run
       (loop for i from beg below end do
            (setf pos (mus-location srcGen))
            (if (>= pos inputTtlNumSamps)
                (setf (mus-location srcGen)
                      (mod (mus-location srcGen) inputTtlNumSamps)))
            (locsig panner i (* ampScale (src srcGen) (env ampEnv))))))
      (close-input inputFileSeg))))
```

A.1.7 *rhythmGrainer* arguments

<i>filename</i>	The name of the output file to be generated
<i>startTime</i>	The time-point in seconds from the beginning of the output file at which the grain sequence is to begin
<i>outFileDur</i>	The duration of the grain sequence in seconds

<i>nextTimeList</i>	A sequence of durations, in seconds (including decimal fractions of seconds), that is to become the rhythm of the output file. This sequence is entered as a set, enclosed in parentheses. The sequence itself may consist of durations of any value; i.e., they need not have a <i>periodic</i> relationship to one another. However, the sequence loops back to the first duration when the final duration has been used and is continually repeated for the duration of the value stated in the <i>outFileDur</i> (output file duration).
<i>rateEnv</i>	(<i>rate envelope</i>) This is a set of breakpoint pairs (an <i>envelope</i>), set in parentheses, which modulate the playback rate (<i>pitch</i>) of the grains over the course of the output file duration. The output file may, for example, start out at normal speed, go up in pitch, down in pitch, and back to normal any number of times over the course of the output duration. Values between breakpoints are generated by linear interpolation. The first value is a percentage (0 to 100) of the output file. Playback rate values are stated in decimal values, by which 1.0 = original playback, 0.5 = half the playback speed (octave lower), 2.0 = twice the playback speed (octave higher), etc. Any decimal value may be used. Default = (0 1.0 100 1.0) (original playback rate for the entirety of the output duration).
<i>pitchModDpthEnv</i>	(<i>pitch modulation depth envelope</i>) This argument allows for a random modification of the playback speed for each grain. The user states an absolute range from which the normal playback rate can be further modified in addition to the playback rate envelope. A value of 1.0 would indicate that the given grain may play back at any speed within an octave above or below the playback rate determined for that grain by the rate envelope; a value of 2.0 would allow the playback rate to be randomly chosen from within the range of decimal values spanning two octaves above and below the playback rate determined for that grain by the rate envelope. A value of 0.0833 would allow the playback rate to be randomly chosen from within the range of decimal values spanning one semitone above and below the playback rate determined for that grain by the rate envelope. A value of 0.0 results in no random modulation of the grain's playback speed. The use of an envelope for this argument allows the user to broaden or tighten the range for this modification over the course of the output file duration. The default value = (0 0.0 100 0.0) (no modulation for the entirety of the output duration).
<i>inpFilOffsetEnv</i>	(<i>input file offset envelope</i>) This optional argument, which also takes the form of a breakpoint envelope, allows the user to determine from where in the original source soundfile the grain is taken (the <i>offset</i> within the input file). The breakpoint envelope allows the user to move forwards or backwards through the file (values between the breakpoint values are generated by linear interpolation). The first number in each breakpoint pair represents the percentage, in time, of the output file; the second represents the position within the original source sound file from where the grain is taken. Thus, should the user wish to playback the entire source soundfile over the course of the output duration, the breakpoint envelope would be (0 0.0 100 1.0). Playing the entire file backwards would be achieved by (0 1.0 100 0.0), and playing from the middle point of the source sound file backwards to the beginning and then forwards through the entirety of the rest of the file over equal time segments would be indicated by (0 0.5 50 0.0 100 1.0). The default value is (0 0.0 1.0 100).
<i>inpOffsModEnv</i>	(<i>input file offset modulation envelope</i>). The input file offset modulation envelope functions similarly to the pitch modulation depth envelope. The values of this argument, also enclosed in a breakpoint pair set, determine the maximum span, in seconds, from which the computer may deviate from the offset determined by <i>inpFilOffsetEnv</i> when selecting a segment from the source sound file from which to create a grain. The value, as with the pitch depth modulation depth, is an absolute indicating the distance to either side of the basic offset. Hence, a value of 1.0 would indicate that the grain may be chosen at a random point somewhere between 1.0 second prior to and 1.0 second following the basic offset. The default value for this argument is (0 0.0 100 0.0).
<i>grnLenEnv</i>	(<i>grain length envelope</i>). This argument allows the user to determine that the duration of each consecutive grain is to lengthen and/or shorten over the course of the output file duration. It takes a sequence of breakpoint pairs, again from 0 to 100 percent and with decimal fractions indicating the duration in seconds. The durations between each breakpoint pair will here too be determined by linear interpolation. The default value is (0 0.1 100 0.1).
<i>grnLenModEnv</i>	(<i>grain length modulation envelope</i>). This envelope follows the same basic principle of the previous two modulation envelopes. This time, however, it is the duration that of the grain that is randomly modulated, through addition or subtraction of the indicated amount at that point in the envelope. The default value is (0 0.0 100 0.0).
<i>grainAmpEnv</i>	(<i>grain amplitude envelope</i>). This set of breakpoint pairs determines the volume curve of the individual grains. All grains of a given sequence are assigned the same volume curve. The breakpoint pairs again consist of a percentage number from 0 to 100, and the volume is represented on a scale from 0 = silence to 1.0 = maximum volume. Linear interpolation again applies. The default value is (0 0.0 10 1.0 90 1.0 100 0.0), a sequence of value pairs which causes the volume of each grain to reach its maximum of 1.0 after a duration of 10 percent of the total grain duration and begin returning to silence starting at a time-point 90 percent of the way through the grain.

<i>overallAmpEnv</i>	(<i>overall amplitude envelope</i>). In addition to the volume curve of the individual grains, the entire sequence is also passed through a volume curve indicated by breakpoint pairs. The same approach applies as described above, but is now applied to the entire output sound file. The default value is (0 1.0 100 1.0).
<i>degreeEnv</i>	This argument corresponds to the <i>panDeg</i> argument in the basic instrument. It instructs the computer to place the sound at a specified location within a 360-degree periphery. The default value is (0 180 100 180), a location that would cause the sound to be located exactly in the middle of a stereo loudspeaker array.
<i>panModEnv</i>	(<i>pan modulation envelope</i>). Like the other modulation envelopes, this argument instructs the computer to modify the specified panorama placement by adding or subtracting a random value (in degrees) to the panorama placement specified by the degree envelope. It creates a sound whose location is scattered by a stated breadth, with the base degree at the center of that scatter. The default value is (0 0 100 0).
<i>distanceEnv</i>	The distance envelope argument allows the user to modify the perceived distance of a sound from the listener over the course of the output file duration. The second number of each breakpoint pair roughly indicates the number of meters between the listener and the perceived sound source. The default value is (0 1.0 100 1.0).
<i>revAmtEnv</i>	(<i>reverb amount envelope</i>). This final argument enables the addition of a modifiable degree of reverb to the final sound. The intensity of the reverb can be changed over time through the breakpoint pairs for this argument. The default value is (0 0.01 100 0.01) (minimal reverberation with no modification over time).

A.1.8 Segment of the *rhythmGrainer* function

```
(defun rhythmGrainerId (filename startTime outFileDur nextTimeList ampScale
&key
(rateEnv '(0 1.0 100 1.0))
(pitchModDpthEnv '(0 0.0 100 0.0)) ; multiply this value to receive values above,
; divide to receive values below --
; this number represents percent of an octave;
; 1.0 is a full octave on either side of the given rate,
; 2.0 is two octaves, 0.5 is a half octave, 0.0 is no modulation

(inpFilOffsetEnv '(0 0.0 100 1.0)) ; location within the file in seconds
(inpOffsModEnv '(0 0.0 100 0.0)) ; value in seconds of max offset mod
; to either side of the basic offset

(grnLenEnv '(0 0.1 100 0.1))
(grnModEnv '(0 0.0 100 0.0)) ; in seconds

(grainAmpEnv '(0 0.0 10 1.0 90 1.0 100 0.0))
(overallAmpEnv '(0 1.0 100 1.0))

(degreeEnv '(0 180 100 180))
(panModEnv '(0 0 100 0)) ; value between 0 and 360
; --breadth of scatter (unschaeferfe) from the base degree,
; with the base degree in the center

(distanceEnv '(0 1.0 100 1.0))
(revAmtEnv '(0 0.01 100 0.01)))

(let* ((file filename)
(strt startTime)
(outDur outFileDur)
(outFilDurAdjust (- outDur strt))

(cumDur 0.0)
(finalDur 0.0)
(lastGran 0.0)
(loopCntr 0)
(envScaleOffset 0.0)

(rateMakEnv (make-env :envelope rateEnv :duration 1.0))
(rateEnvVal 0.0)
(pchModMakeEnv (make-env :envelope pitchModDpthEnv :duration 1.0))
(pchModEnvVal 0.0)
(pchModEnvValPlusOne 0.0)
(pchModUpper 0.0)
(pchModLower 0.0)
(pchModSpan 0.0)
(pchModSpanRand 0.0)
(newAdjustedRate 0.0)

(inpOffsMakEnv (make-env :envelope inpFilOffsetEnv :duration 1.0))
(inpOffsEnvVal 0.0)
(inpOffsModMakeEnv (make-env :envelope inpOffsModEnv :duration 1.0))
(inpOffsModEnvVal 0.0)
(inpOffsModVal 0.0)
(adjustedInpOffs 0.0)

(nextTimeList nextTimeList)
(nextTimeListLen (length nextTimeList))
(nextTimeListIndex 0)
(nextTime 0.0))
```

A.1.9 Examples of algorithmic motive functions

```
(defun basicPing (str)
  (smGrnEnv5 "berktangPluckMorFed.aiff" str (+ str 0.68) 0.9
    :rateEnv '(0 1.0 100 1.0) :pitchModDepthEnv '(0 0.0 100 0.0)
    :inpFilOffsetEnv '(0 6.592 100 7.291) :inpOffsModEnv '(0 0.0 100 0.0)
    :grnLenEnv '(0 0.669 100 0.669) :grnLenModEnv '(0 0.0 100 0.0)
    :nextTimeLenEnv '(0 0.669 100 0.669) :ritLenModEnv '(0 0.0 100 0.0)
    :degreeEnv '(0 180 90 180) :panModEnv '(0 0.0 90 0.0)
    :distanceEnv '(0 1.0 100 1.0) :revAmtEnv '(0 0.01 100 0.01)
    :overallAmpEnv '(0 1.0 100 1.0)))

(defun dance01mot001a (str end ampScale)
  (smGrnEnv5 "dhopi2.aiff" str end (* 0.07 ampScale)
    :rateEnv '(0 5.7 100 5.7) :pitchModDepthEnv '(0 0.05 100 0.05)
    :inpFilOffsetEnv '(0 0.0 100 0.1) :inpOffsModEnv '(0 0.0 100 0.0)
    :grnLenEnv '(0 0.69 100 0.69) :grnLenModEnv '(0 0.0 100 0.0)
    :nextTimeLenEnv '(0 0.0369 100 0.0369) :ritLenModEnv '(0 0.1 100 0.10)
    :degreeEnv '(0 180 90 180.0) :panModEnv '(0 10.0 90 359.0)
    :distanceEnv '(0 1.0 100 1.0) :revAmtEnv '(0 10.01 100 10.01)
    :overallAmpEnv '(0 0.0 25 1.0 75 1.5 100 1.0)))

(defun clearing02mot001a (str end ampScale)
  (smGrnEnv5 "GasPumpMono.aiff" str end (* 0.3 ampScale)
    :rateEnv '(0 5.7 100 5.7) :pitchModDepthEnv '(0 0.05 100 0.05)
    :inpFilOffsetEnv '(0 0.0 100 0.1) :inpOffsModEnv '(0 0.0 100 0.0)
    :grnLenEnv '(0 0.69 100 0.69) :grnLenModEnv '(0 0.0 100 0.0)
    :nextTimeLenEnv '(0 0.0369 100 0.0369) :ritLenModEnv '(0 0.1 100 0.10)
    :degreeEnv '(0 180 90 180.0) :panModEnv '(0 10.0 90 359.0)
    :distanceEnv '(0 1.0 100 1.0) :revAmtEnv '(0 10.01 100 10.01)
    :overallAmpEnv '(0 0.0 25 1.0 100 1.0)))

(defun singers02mot001f (str end ampScale)
  (smGrnEnv5 "waterDropsCaveNRgnnCrp.aiff" str end (* 0.45 ampScale)
    :rateEnv '(0 13.3 100 13.3) :pitchModDepthEnv '(0 0.05 100 0.05)
    :inpFilOffsetEnv '(0 0.0 100 3.880) :inpOffsModEnv '(0 0.0 100 0.0)
    :grnLenEnv '(0 0.69 100 0.69) :grnLenModEnv '(0 0.0 100 0.0)
    :nextTimeLenEnv '(0 0.0369 100 0.0369) :ritLenModEnv '(0 0.1 100 0.10)
    :degreeEnv '(0 180 90 180.0) :panModEnv '(0 360.0 90 359.0)
    :distanceEnv '(0 1.0 100 1.0) :revAmtEnv '(0 10.01 100 10.01)
    :overallAmpEnv '(0 0.0 5 1.0 100 1.0)))
```

A.1.10 Segment of a score script for the Oracle

```
(with-sound (:channels 2 :srate 44100
  :output "dance01_augFormEds_01_stereo.aiff"
  :scaled-to 0.95
  :reverb freverb :decay-time 2.0
  :statistics t :play nil)

; I.1 - 1a
(dance01mot001a 0.0 2.329 0.95)
(dance01mot002a 0.0 2.329 0.95)

; I.2 - 2a, 3a
(dance01mot002a 2.329 4.076 0.95)
(dance01mot003a 2.329 4.076 0.95)

; I.3 - 2a, 3a, 4a
(dance01mot002a 4.076 5.823 0.95)
(dance01mot003a 4.076 5.823 0.95)
(dance01mot004a 4.076 5.823 0.95)
(dance01mot006a 4.076 5.823 0.95)

; I.4 - 5a
(dance01mot005a 5.823 6.405 0.95)
(dance01mot006a 5.823 6.988 0.8)

; I.5 - 5b
(dance01mot005b 6.405 6.988 0.8)

; I.6 - 6a
(dance01mot006a 6.988 11.646 0.7)

; I.7 - 5c, 3b
(dance01mot005c 8.152 9.899 0.8)
(dance01mot003b 8.152 9.899 0.8)
(dance01mot006b 8.152 9.899 0.8)

; I.8 - 5c, 3b
(dance01mot005c 9.899 11.646 0.9)
(dance01mot003b 9.899 11.646 0.9)
(dance01mot006c 9.899 11.646 0.9)

; I.9 - 6b
(dance01mot006b 11.646 13.393 0.95)

; I.10 - 6c
(dance01mot006c 12.228 13.393 0.95)
```

A.1.11 Example of a Modalys script

```

;;; make objects
(defvar my-plate)
(setq my-plate (make-object 'rect-plate
  (modes 240)
  (length0 .35)
  (length1 .35)
  (thickness .11)
  (density 2300)
  (young 6.2e10)
  (freq-loss .0235)
  (const-loss 1.75)))

(defvar my-hammer)
(setq my-hammer (make-object 'bi-two-mass
  (small-mass 0.05)
  (large-mass 1000.5)
  (stiffness0 100)
  (stiffness1 150)))

;;; make strike connection
(defvar my-plate-hit)
(setq my-plate-hit (make-access my-plate (const .67 .37) 'normal))
(defvar my-hammer-hit)
(setq my-hammer-hit (make-access my-hammer (const 1.7) 'trans0))

(make-connection 'strike my-plate-hit 0 my-hammer-hit 0.1)

;;; make position connection to push hammer
(defvar my-hammer-mov)
(setq my-hammer-mov (make-access my-hammer (const 0) 'trans0))

(make-connection 'position my-hammer-mov
  (make-controller 'envelope 1
    (list (list 0.00 .1)
          (list 0.05 -.0001)
          (list 0.10 .1))))

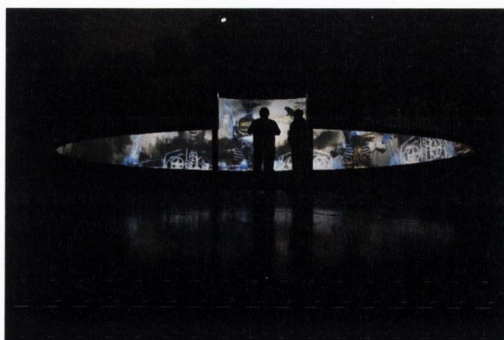
;;; make listening point on plate
(defvar my-plate-out)
(setq my-plate-out (make-access my-plate (const .2 .1) 'normal))

(make-point-output my-plate-out)

;;; arrange the plot, run the synthesis and play the sound
(run 5)
(play)

```

A.1.12 Documentary photo of the *Oracle* installation



A.2 Flying Instants

```
(defun 001a (str end ampScale)
  (smGrnEnv5 "bubbleBurstCmpFd.aiff" str end (* 0.20 ampScale)
    :rateEnv '(0 5.7 100 5.7) :pitchModDpthEnv '(0 0.05 100 0.05)
    :inpFilOffsetEnv '(0 0.0 100 4.496) :inpOffsModEnv '(0 0.0 100 0.0)
    :grnLenEnv '(0 0.69 100 0.69) :grnLenModEnv '(0 0.0 100 0.0)
    :nextTimeLenEnv '(0 0.0369 100 0.0369) :ntLenModEnv '(0 0.1 100 0.10)
    :degreeEnv '(0 180 90 180.0) :panModEnv '(0 10.0 90 359.0)
    :distanceEnv '(0 1.0 100 1.0) :revAmtEnv '(0 10.01 100 10.01)
    :overallAmpEnv '(0 0.0 25 1.0 75 1.5 100 1.0)))

(defun 001b (str end ampScale)
  (smGrnEnv5 "bubbleBurstCmpFd.aiff" str end (* 0.17 ampScale)
    :rateEnv '(0 3.17 100 3.17) :pitchModDpthEnv '(0 0.05 100 0.05)
    :inpFilOffsetEnv '(0 0.0 100 4.496) :inpOffsModEnv '(0 0.0 100 0.0)
    :grnLenEnv '(0 0.69 100 0.69) :grnLenModEnv '(0 0.0 100 0.0)
    :nextTimeLenEnv '(0 0.0369 100 0.0369) :ntLenModEnv '(0 0.1 100 0.10)
    :degreeEnv '(0 90 90 90.0) :panModEnv '(0 10.0 90 180.0)
    :distanceEnv '(0 1.0 100 1.0) :revAmtEnv '(0 10.01 100 10.01)
    :overallAmpEnv '(0 0.0 25 1.0 75 1.5 100 1.0)))

(defun 001c (str end ampScale)
  (smGrnEnv5 "bubbleBurstCmpFd.aiff" str end (* 0.55 ampScale)
    :rateEnv '(0 0.17 100 0.17) :pitchModDpthEnv '(0 0.05 100 0.05)
    :inpFilOffsetEnv '(0 0.0 100 4.496) :inpOffsModEnv '(0 0.0 100 0.0)
    :grnLenEnv '(0 0.69 100 0.69) :grnLenModEnv '(0 0.0 100 0.0)
    :nextTimeLenEnv '(0 0.0369 100 0.0369) :ntLenModEnv '(0 0.1 100 0.10)
    :degreeEnv '(0 270 90 270.0) :panModEnv '(0 10.0 90 180.0)
    :distanceEnv '(0 1.0 100 1.0) :revAmtEnv '(0 10.01 100 10.01)
    :overallAmpEnv '(0 0.0 25 1.0 75 1.5 100 1.0)))

(defun 001d (str end ampScale)
  (smGrnEnv5 "bubbleBurstCmpFd.aiff" str end (* 0.50 ampScale)
    :rateEnv '(0 1.7 100 1.7) :pitchModDpthEnv '(0 0.05 100 0.05)
    :inpFilOffsetEnv '(0 0.0 100 4.496) :inpOffsModEnv '(0 0.0 100 0.0)
    :grnLenEnv '(0 0.69 100 0.69) :grnLenModEnv '(0 0.0 100 0.0)
    :nextTimeLenEnv '(0 0.0369 100 0.0369) :ntLenModEnv '(0 0.1 100 0.10)
    :degreeEnv '(0 180 90 180.0) :panModEnv '(0 360.0 90 360.0)
    :distanceEnv '(0 1.0 100 1.0) :revAmtEnv '(0 2.01 100 2.01)
    :overallAmpEnv '(0 1.0 100 1.0)))
```

Figure A.5: Examples of the algorithmic motive functions for *Flying Instants*

A.3 Words Like Smoke

A.3.1 Analysis tables for the first version of the algorithm

Phrase ID	Phrase motives Beckett	Number	Phrase motives – limit to 3	Number
26	7c, 15a, 12b	3	7c, 15a, 12b	3
27	15b, 12b	2	15b, 12b	2
28	7d, 16a, 5c, 10b	4	7d, 16a, 10b	3
29	5f, 16a	2	5f, 16a	2
30	11b, 17a, 18a	3	11b, 17a, 18a	3
31	18b, 12c, 10b, 5e, 5f	5	18b, 12c, 10b	3
32	1a	1	1a	1
33	1d, 1c	2	1d, 1c	2
34	1f	1	1f	1
35	11b, 20a	2	11b, 20a	2
36	21a, 22a	2	21a, 22a	2
37	21b, 22a	2	21b, 22a	2
38	5e, 11c, 1f	3	5e, 11c, 1f	3

Figure A.6: Segment of the list for the number of motives per phrase in the Beckett and the limitation to three motives per phrase in the string trio

Phrase motives – restrict to 3	Number	Phrase motives – restrict to 3	Number	Sorted	Total	%	Sorted	Total	%
1a	1	20d, 31a	2	1			3		
2a, 3a	2	39a, 20c	2	1			3		
2a, 3a, 4a	3	1g	1	1			3		
5a	1	11f, 40a, 41a	3	1			3		
5b	1	5e, 5f, 3b	3	1			3		
6a	1	41a, 3g, 18d	3	1			3		
5c, 3b	2	3a, 40a, 12d	3	1			3		
5c, 3b	2	3a, 7m	2	1			3		
6b	1	42a, 12b	2	1			3		
6c	1	3k, 12g, 43a	3	1			3		
7a, 8a, 2b	3	44a, 15d	2	1			3		
2a	1	15e, 15d, 12c	3	1			3		
9a, 8a	2	3k, 10f, 12e	3	1			3		
7b, 9b, 4b	3	20a, 10g, 15d	3	1			3		
1b, 1c	2	10h, 15d	2	1			3		
10a	1	3k, 10i, 10j	3	1			3		
6b	1	20c, 10i	2	1			3		
6c	1	3k, 10d	2	1	34	0.2345	3		
11a	1	3l, 3k, 10k	3	1			3		
12a	1	10l	1	1			3		
6c	1	20a	1	1			3		
7a, 8a, 4c	3	15e	1	1			3		
11a, 8a	2	20f, 15d	2	1			3		
9c	1	39b	1	1			3		
12a, 5d, 9c	3	42a	1	1			3		
7c, 15a, 12b	3	15a, 15e, 32b	3	1			3		
15b, 12b	2	32c	1	1			3		
7d, 16a, 10b	3	32d, 3n	2	1			3		
5f, 16a	2	21c, 25c	2	1			3		
11b, 17a, 18a	3	3j, 46a, 8a	3	1			3		
18b, 12c, 10b	3	21c, 25d, 18f	3	1			3		
1a	1	47a, 21a, 15a	3	1			3		
1d, 1c	2	10j	1	1			3		
1f	1	47a, 48a, 15a	3	1			3	67	0.4621
11b, 20a	2	49a, 3g	2	2			3		
21a, 22a	2	32e, 3p, 18g	3	2			3		
21b, 22a	2	19b, 52a	2	2			3		
5e, 11c, 1f	3	51a, 3p, 18g	3	2			3		
3c, 11d, 1g	3	18g, 12e	2	2			3		
3d, 11d, 20a	3	19b	1	2			3		
3b, 3d, 5e	3	10m, 52b, 18g	3	2			3		
11d, 7c, 1g	3	49b, 52a, 56a	3	2			3		
11e, 1g, 23a	3	49a, 46b, 31b	3	2			3		
24a, 11e, 23b	3	32e	1	2			3		
25a, 23b	2	51a, 56a, 46c	3	2			3		
23c	1	3e, 46d	2	2			3		
1h	1	3e, 3o	2	2			3		
26a, 11e, 23d	3	56a	1	2			3		
25a, 23d	2	58a, 10a, 12e	3	2			3		
3a, 7f	2	12f	1	2			3		
3f, 3b	2	56a, 3j, 9c	3	2			3		
3e	1	18h, 58a, 32e	3	2			3		
27a	1	59a, 2c, 60a	3	2			3		
25b, 1h, 1g	3	59a, 60b, 20i	3	2			3		
3e, 7g	2	62a, 63a, 10q	3	2			3		
3e, 11e, 3b	3	13f, 20j, 18i	3	2			3		
3c, 7d	2	63a, 4e, 65a	3	2	44	0.3034	3		
3d, 23a	2	3j, 66a, 10r	3	2			3		
28a, 23e, 23f	3	10s, 46e, 20j	3	2			3		
3g, 3e, 10c	3	21e, 4f	2	2			3		
10a, 7h, 5d	3	21a, 20k, 9c	3	2			3		
3g, 23g	2	46f, 49c, 67a	3	2			3		
3e, 10c	2	19c, 19d, 19e	3	2			3		
24b, 1f	2	68a, 21a, 69a	3	2			3		
31a, 29a, 23b	3	21d, 32f, 15d	3	2			3		
31a, 29a, 23d	3	21d, 7q, 7h	3	2			3		
32a, 31a	2	21d, 18j, 10q	3	2			3		
7k, 23a	2			2				145	1.0000
20d, 10d, 20c	3			2					
20d, 31a, 20c	3			2					
32a, 31a, 33a	3			2					
33a, 110d	2			2					
31a, 35a, 36a	3			2					
35a, 10c, 36a	3			2					
7l	1			2					
10c	1			2					
31a, 35a	2			2					
20b, 20c	2			2					

Figure A.7: Number of motives per phrase (limited to 3), sorted and divided by the total (145) to determine percentage

PhraseNo.	NumWords	Sorted/Ascend	Instances	%	PhraseNo.	NumWords	Sorted/Ascend	Instances	%
1	4	1			86	4	5		
2	3	1			87	5	5		
3	3	1			88	6	5		
4	1	1			89	6	5		
5	1	1			90	12	5		
6	2	1			91	6	5		
7	3	1			92	5	5		
8	3	1	14	0.0966	93	2	5		
9	1	1			94	4	5	17	0.1172
10	2	1			95	4	5		
11	7	1			96	2	5		
12	1	1			97	4	5		
13	6	1			98	1	5		
14	5	1			99	1	5		
15	3	2			100	3	5		
16	3	2			101	3	5		
17	1	2			102	1	5		
18	2	2			103	1	6		
19	5	2			104	8	6		
20	3	2	11	0.0759	105	3	6		
21	3	2			106	4	6		
22	6	2			107	4	6		
23	3	2			108	6	6		
24	3	2			109	11	6		
25	5	2			110	5	6		
26	9	3			111	1	6		
27	2	3			112	5	6	19	0.1310
28	7	3			113	2	6		
29	4	3			114	3	6		
30	6	3			115	4	6		
31	12	3			116	5	6		
32	3	3			117	4	6		
33	4	3			118	1	6		
34	2	3			119	8	6		
35	4	3			120	9	6		
36	3	3			121	11	6		
37	4	3			122	1	7		
38	4	3			123	6	7		
39	3	3			124	4	7	6	0.0414
40	3	3			125	4	7		
41	5	3			126	1	7		
42	4	3	32	0.2207	127	5	7		
43	6	3			128	3	8		
44	6	3			129	4	8		
45	3	3			130	18	8	6	0.0414
46	2	3			131	6	8		
47	3	3			132	9	8		
48	6	3			133	8	8		
49	3	3			134	7	9		
50	3	3			135	6	9		
51	3	3			136	4	9	5	0.0345
52	2	3			137	5	9		
53	3	3			138	6	9		
54	5	3			139	9	10	2	0.0138
55	3	3			140	10	10		
56	4	3			141	4	11	2	0.0138
57	4	3			142	8	11		
58	7	4			143	6	12	2	0.0138
59	9	4			144	6	12		
60	4	4			145	5	18	1	0.0069
61	7	4						145	1.0000
62	2	4			662	662			
63	3	4							
64	4	4							
65	5	4							
66	5	4							
67	4	4							
68	6	4							
69	6	4							
70	5	4							
71	7	4							
72	3	4	28	0.1931					
73	8	4							
74	10	4							
75	3	4							
76	1	4							
77	3	4							
78	5	4							
79	3	4							
80	4	4							
81	3	4							
82	8	4							
83	6	4							
84	4	4							
85	4	4							

Figure A.8: Derivation of phrase-length probabilities from numbers and percentages of words per phrase in the Beckett

Phrase	Motives	NewMot ID	NumNewMots	TotNumMots	%	Phrase	Motives	NewMot ID	NumNewMots	TotNumMots	%
0	1a	1	1	1	1.0000	73	30a, 10e, 31a				0.0769
1	2a, 3a	2,3	2	2	1.0000	74	7l				0.0769
2	2a, 3a, 4a	4	1	3	0.3333	75	10e				0.0769
3	5a	5	1	1	1.0000	76	27a, 30a	32	1	13	0.0769
4	5b				0.5000	77	17b, 17c				0.0769
5	6a	6	1	2	0.5000	78	17d, 27a				0.0769
6	5c, 3b				0.2222	79	32a, 17c				0.0769
7	5c, 3b				0.2222	80	1g				0.5000
8	6b	7,8	2	9	0.2222	81	11f, 33a, 34a	33,34	2	4	0.5000
9	6c				0.2222	82	5e, 5f, 3b				0.0769
10	7a, 8a, 2b				0.2222	83	34a, 3g, 16d				0.0769
11	2a				0.3333	84	3a, 33a, 12d	35	1	13	0.0769
12	9a, 8a	9	1	3	0.3333	85	3a, 7m				0.0769
13	7b, 9b, 4b				0.1667	86	35a, 12b				0.0769
14	1b, 1c	10	1	6	0.1667	87	3k, 12g, 36a	36	1	3	0.3333
15	10a				0.1667	88	37a, 13d	37	1	2	0.5000
16	6b				0.3333	89	13e, 13d, 12e				0.0256
17	6c	11	1	3	0.3333	90	3k, 10f, 12e				0.0256
18	11a				0.3333	91	17a, 10g, 13d				0.0256
19	12a	12	1	1	1.0000	92	10h, 13d				0.0256
20	6c				0.0769	93	3k, 10i, 10j				0.0256
21	7a, 8a, 4c				0.0769	94	17c, 10i				0.0256
22	11a, 8a				0.0769	95	3k, 10d				0.0256
23	9c	13	1	13	0.0769	96	3l, 3k, 10k				0.0256
24	12a, 5d, 9c				0.0769	97	10l				0.0256
25	7c, 13a, 12b				0.0769	98	17a	38	1	39	0.0256
26	13b, 12b				0.2000	99	13e				0.0256
27	7d, 14a, 10b	14	1	5	0.2000	100	17f, 13d				0.0256
28	5f, 14a				0.4000	101	32b				0.0256
29	11b, 15a, 16a	15,16	2	5	0.4000	102	35a				0.0256
30	10b, 12c, 10b				0.1111	103	13a, 13e, 28b				0.0256
31	1a				0.1111	104	28c				0.0256
32	1d, 1e	17	1	9	0.1111	105	28d, 3n				0.0256
33	1f				0.1111	106	18c, 22c				0.0256
34	11b, 17a				0.1111	107	3j, 38a, 8a				0.0256
35	18a, 19a	18,19	2	2	1.0000	108	18c, 22d, 16f				0.1667
36	18b, 19a				0.0500	109	39a, 18a, 13a	39	1	6	0.1667
37	5e, 11c, 1f				0.0500	110	10j				0.2500
38	3c, 11d, 1g				0.0500	111	39a, 40a, 13a	40	1	4	0.2500
39	3d, 11d, 17a	20	1	20	0.0500	112	41a, 3g	41	1	2	0.5000
40	3b, 3d, 5e				0.0500	113	28e, 3p, 16g	42	1	5	0.2000
41	11d, 7c, 1g				0.0500	114	19b, 42a				0.2000
42	11c, 1g, 20a				0.0500	115	43a, 3p, 16g	43	1	3	0.3333
43	21a, 11c, 20b	21	1	3	0.3333	116	16g, 12e				0.1111
44	22a, 20b	22	1	2	0.5000	117	19b				0.1111
45	20c				0.2000	118	10m, 42b, 16g	44	1	9	0.1111
46	1h	23	1	5	0.2000	119	41b, 42a, 44a				0.1111
47	25a, 11e, 20d				0.2000	120	41a, 38b, 27b				0.0667
48	22a, 20d				0.1250	121	28c				0.0667
49	3a, 7f				0.1250	122	43a, 44a, 38c				0.0667
50	3f, 3b	24	1	8	0.1250	123	3e, 38d	45	1	15	0.0667
51	3e				0.1250	124	3e, 3o				0.0667
52	24a				0.1250	125	44a				0.0667
53	22b, 1h, 1g				0.0667	126	45a, 10o, 12e				0.0667
54	3e, 7g				0.0667	127	12f				0.2000
55	3e, 11c, 3b				0.0667	128	44a, 3j, 9c				0.2000
56	3c, 7d	25	1	15	0.0667	129	16h, 45a, 28e	46,47	2	10	0.2000
57	3d, 20a				0.0667	130	46a, 2c, 47a				0.2000
58	25a, 20e, 20f				0.0667	131	46a, 47b, 17i				0.3333
59	3g, 3e, 10c				0.1333	132	48a, 49a, 10q	48,49	2	6	0.3333
60	10a, 7h, 5d				0.1333	133	13f, 17j, 16i				0.1667
61	3g, 20g				0.1333	134	49a, 4e, 50a	50	1	6	0.1667
62	3e, 10c	26,27	2	15	0.1333	135	3j, 51a, 10r	51	1	3	0.3333
63	21b, 1f				0.1333	136	10s, 38e, 17j				0.0909
64	27a, 26a, 20b				0.1333	137	18c, 4f				0.0909
65	27a, 26a, 20d				0.2000	138	18a, 17k, 9c	52	1	11	0.0909
66	28a, 27a	28	1	5	0.2000	139	38f, 41c, 52a				0.0909
67	7k, 20a				0.0909	140	19c, 19d, 19e				0.3333
68	17d, 10d, 17c				0.0909	141	53a, 18a, 54a	53,54	2	6	0.3333
69	17d, 27a, 17c	29	1	11	0.0909	142	18d, 28f, 13d				0.0000
70	28a, 27a, 29a				0.0909	143	18d, 7q, 7h	x	x	9	0.0000
71	29a, 11d				0.4000	144	18d, 16j, 10q				0.0000
72	27a, 30a, 31a	30,31	2	5	0.4000						

Figure A.9: Tables to determine the chance of a new motive occurring in a given group of phrases

Phrase	Motives	Absolute Span Between Highest and Lowest Motive	Sorted	Instances	%	Phrase	Motives	Absolute Span Between Highest and Lowest Motive	Sorted	Instances	%
0	1a	0	0			73	30a, 10c, 31a	21	6		
1	2a, 3a	1	0			74	7l	0	6		
2	2a, 3a, 4a	2	0			75	10e	0	6	5	0.0345
3	5a	0	0			76	27a, 30a	3	6		
4	5b	0	0			77	17b, 17c	0	6		
5	6a	0	0			78	17d, 27a	10	7		
6	5c, 3b	2	0			79	32a, 17e	15	7		
7	5c, 3b	2	0			80	1g	0	7		
8	6b	0	0			81	11f, 33a, 34a	23	7		
9	6c	0	0			82	5c, 5f, 3b	2	7		
10	7a, 8a, 2b	5	0			83	34a, 3g, 16d	31	7	11	0.0759
11	2a	0	0			84	3a, 33a, 12d	30	7		
12	9a, 8a	1	0			85	3a, 7m	3	7		
13	7b, 9b, 4b	5	0			86	35a, 12b	23	7		
14	1b, 1c	0	0			87	3k, 12g, 36a	33	7		
15	10a	0	0			88	37a, 13d	24	7		
16	6b	0	0			89	13c, 13d, 12e	1	8	2	0.0138
17	6c	0	0			90	3k, 10f, 12e	9	8		
18	11a	0	0			91	17a, 10g, 13d	7	9		
19	12a	0	0	39	0.2690	92	10h, 13d	3	9	3	0.0207
20	6c	0	0			93	3k, 10i, 10j	7	9		
21	7a, 8a, 4c	4	0			94	17c, 10i	7	10		
22	11a, 8a	3	0			95	3k, 10d	7	10		
23	9c	0	0			96	3l, 3k, 10k	28	10	6	0.0414
24	12a, 5d, 9c	7	0			97	10l	0	10		
25	7c, 13a, 12b	6	0			98	17a	0	10		
26	13b, 12b	1	0			99	13c	0	10		
27	7d, 14a, 10b	7	0			100	17f, 13d	4	11	1	0.0069
28	5f, 14a	9	0			101	32b	0	12	1	0.0069
29	11b, 15a, 16a	5	0			102	35a	0	13	1	0.0069
30	16b, 12c, 10b	6	0			103	13a, 13c, 28b	15	14		
31	1a	0	0			104	28c	0	14		
32	1d, 1e	0	0			105	28d, 3n	25	14	4	0.0276
33	1f	0	0			106	18c, 22c	4	14		
34	11b, 17a	6	0			107	3j, 38a, 8a	25	15		
35	18a, 19a	1	0			108	18c, 22d, 16f	6	15	3	0.0207
36	18b, 19a	1	0			109	39a, 18a, 13a	26	15		
37	5e, 11c, 1f	10	0			110	10j	0	17		
38	3c, 11d, 1g	10	0			111	39a, 40a, 13a	27	17	2	0.0138
39	3d, 11d, 17a	14	1			112	41a, 3g	38	18	1	0.0069
40	3b, 3d, 5e	2	1			113	28e, 3p, 16g	25	19	1	0.0069
41	11d, 7e, 1g	10	1			114	19b, 42a	23	20	1	0.0069
42	11c, 1g, 20a	19	1	7	0.0483	115	43a, 3p, 16g	40	21		
43	21a, 11c, 20b	10	1			116	16g, 12c	4	21	2	0.0138
44	22a, 20b	2	1			117	19b	0	23		
45	20c	0	1			118	10m, 42b, 16g	32	23	3	0.0207
46	1h	0	2			119	41b, 42a, 44a	3	23		
47	23a, 11e, 20d	12	2			120	41a, 38b, 27b	14	24	1	0.0069
48	22a, 20d	2	2			121	28e	0	25		
49	3a, 7f	4	2	6	0.0414	122	43a, 44a, 38c	6	25	3	0.0207
50	3f, 3b	0	2			123	3e, 38d	35	25		
51	3e	0	2			124	3e, 3o	0	26	1	0.0069
52	24a	0	3			125	44a	44	27	1	0.0069
53	22b, 1h, 1g	21	3			126	45a, 10c, 12c	33	28	2	0.0138
54	3e, 7g	4	3			127	12f	0	28		
55	3e, 11e, 3b	8	3			128	44a, 3j, 9c	41	29	1	0.0069
56	3c, 7d	3	3	8	0.0552	129	16h, 45a, 28e	29	30		
57	3d, 20a	17	3			130	46a, 2c, 47a	45	30	2	0.0138
58	25a, 20e, 20f	5	3			131	46a, 47b, 17i	30	31	1	0.0069
59	3g, 3e, 10c	7	3			132	48a, 49a, 10q	39	32	1	0.0069
60	10a, 7h, 5d	5	4			133	13f, 17j, 16i	4	33		
61	3g, 20g	17	4			134	49a, 4e, 50a	46	33	2	0.0138
62	3e, 10c	7	4			135	3j, 51a, 10r	48	35	1	0.0069
63	21b, 1f	20	4			136	10s, 38c, 17j	28	36	1	0.0069
64	27a, 26a, 20b	7	4	8	0.0552	137	18c, 4f	14	38	1	0.0069
65	27a, 26a, 20d	7	4			138	18a, 17k, 9c	9	39	1	0.0069
66	28a, 27a	1	4			139	38f, 41c, 52a	14	40	1	0.0069
67	7k, 20a	13	4			140	19c, 19d, 19e	0	41	1	0.0069
68	17d, 10d, 17c	7	5			141	53a, 18a, 54a	36	44	1	0.0069
69	17d, 27a, 17c	10	5			142	18d, 28f, 13d	15	45	1	0.0069
70	28a, 27a, 29a	2	5	5	0.0345	143	18d, 7q, 7h	11	46	1	0.0069
71	29a, 11d	18	5			144	18d, 16j, 10q	8	48	1	0.0069
72	27a, 30a, 31a	4	5							145	1.0000

Figure A.10: Analysis of the span between the highest and lowest numbered motives of any given phrase

Phrase	Motives	Absolute Span			Phrase	Motives	Absolute Span		
		Between Highest Possible and Actual Highest Motive	Sorted	Instances			%	Between Highest Possible and Actual Highest Motive	Sorted
0	1a	0	0		74	7l	24	3	
1	2a, 3a	0	0		75	10e	21	3	2 0.0138
2	2a, 3a, 4a	0	0		76	27a, 30a	1	4	
3	5a	0	0		77	17b, 17c	14	4	
4	5b	0	0		78	17d, 27a	4	4	6 0.0414
5	6a	0	0		79	32a, 17e	0	4	
6	5c, 3b	1	0		80	1g	31	4	
7	5c, 3b	1	0		81	11f, 33a, 34a	0	4	
8	6b	0	0		82	5e, 5f, 3b	29	5	2 0.0138
9	6c	0	0		83	34a, 3g, 16d	0	5	
10	7a, 8a, 2b	0	0		84	3a, 35a, 12d	1	6	2 0.0138
11	2a	6	0		85	3a, 7m	27	6	
12	9a, 8a	0	0		86	35a, 12b	0	8	
13	7b, 9b, 4b	0	0		87	3k, 12g, 36a	0	8	
14	1b, 1c	8	0		88	37a, 13d	0	8	5 0.0345
15	10a	0	0		89	13e, 13d, 12e	24	8	
16	6b	4	0		90	3k, 10f, 12e	25	8	
17	6c	4	0		91	17a, 10g, 13d	20	9	
18	11a	0	0		92	10h, 13d	24	9	3 0.0207
19	12a	0	0		93	3k, 10i, 10j	27	9	
20	6c	6	0		94	17c, 10i	20	11	2 0.0138
21	7a, 8a, 4c	4	0		95	3k, 10d	27	11	
22	11a, 8a	1	0		96	3l, 3k, 10k	27	13	
23	9c	3	0		97	10l	27	13	3 0.0207
24	12a, 5d, 9c	0	0		98	17a	20	13	
25	7c, 13a, 12b	0	0		99	13e	24	14	2 0.0138
26	13b, 12b	0	0		100	17f, 13d	20	14	
27	7d, 14a, 10b	0	0		101	32b	5	15	
28	5f, 14a	0	0		102	35a	2	15	
29	11b, 15a, 16a	0	0		103	15a, 15c, 28b	9	15	
30	16b, 12c, 10b	0	0	61 0.4207	104	28c	9	15	7 0.0483
31	1a	15	0		105	28d, 5n	9	15	
32	1d, 1e	15	0		106	18c, 22c	15	15	
33	1f	15	0		107	3j, 38a, 8a	0	15	
34	11b, 17a	0	0		108	18c, 22d, 16f	16	16	
35	18a, 19a	0	0		109	39a, 18a, 13a	0	16	3 0.0207
36	18b, 19a	0	0		110	10j	29	16	
37	5e, 11c, 1f	8	0		111	39a, 40a, 13a	0	17	2 0.0138
38	3c, 11d, 1g	8	0		112	41a, 3g	0	17	
39	3d, 11d, 17a	2	0		113	28c, 3p, 16g	13	19	2 0.0138
40	3b, 3d, 5e	14	0		114	19b, 42a	0	19	
41	11d, 7e, 1g	8	0		115	43a, 3p, 16g	0	20	
42	11c, 1g, 20a	0	0		116	16g, 12e	27	20	
43	21a, 11e, 20b	0	0		117	19b	24	20	5 0.0345
44	22a, 20b	0	0		118	10m, 42b, 16g	1	20	
45	20c	2	0		119	41b, 42a, 44a	0	20	
46	1h	21	0		120	41a, 38b, 27b	3	21	2 0.0138
47	23a, 11e, 20d	0	0		121	28e	16	21	
48	22a, 20d	1	0		122	43a, 44a, 38c	0	24	
49	3a, 7f	16	0		123	3c, 38d	6	24	
50	3f, 3b	20	0		124	3e, 3o	41	24	5 0.0345
51	3e	20	0		125	44a	0	24	
52	24a	0	0		126	45a, 10o, 12e	0	24	
53	22b, 1h, 1g	2	0		127	12f	33	25	1 0.0069
54	3e, 7g	17	0		128	44a, 3j, 9e	1	26	1 0.0069
55	3e, 11e, 3b	13	0		129	16h, 45a, 28e	0	27	
56	3c, 7d	17	0		130	46a, 2c, 47a	0	27	
57	3d, 20a	4	0		131	46a, 47b, 17i	0	27	
58	25a, 20e, 20f	0	0		132	48a, 49a, 10q	0	27	6 0.0414
59	3g, 3c, 10c	15	0		133	13f, 17j, 16i	32	27	
60	10a, 7h, 5d	15	0		134	49a, 4e, 50a	0	27	
61	3g, 20g	5	1		135	3j, 51a, 10r	0	29	1 0.0069
62	3c, 10c	15	1		136	10s, 38e, 17j	13	31	1 0.0069
63	21b, 1f	4	1		137	18e, 4f	33	32	1 0.0069
64	27a, 26a, 20b	0	1		138	18a, 17k, 9c	33	33	
65	27a, 26a, 20d	0	1	8 0.0552	139	38f, 41c, 52a	0	33	
66	28a, 27a	0	1		140	19c, 19d, 19e	33	33	4 0.0276
67	7k, 20a	8	1		141	53a, 18a, 54a	0	33	
68	17d, 10d, 17c	11	1		142	18d, 28f, 13d	26	36	2 0.0138
69	17d, 27a, 17c	1	2		143	18d, 7q, 7h	36	36	
70	28a, 27a, 29a	0	2		144	18d, 16j, 10q	36	41	1 0.0069
71	29a, 11d	0	2	5 0.0345				145 1.0000	
72	27a, 30a, 31a	0	2						
73	30a, 10e, 31a	0	2						

Figure A.11: Analysis of the span between the highest possible and highest actual numbered motives of any given phrase

A.3.2 Translation of analyses into probability functions as variables in the algorithm

```
(define phraseLen-tabl
  (make-ptable `(
    (1 0.0966)
    (2 0.0759)
    (3 0.2207)
    (4 0.1931)
    (5 0.1172)
    (6 0.1310)
    (7 0.0414)
    (8 0.0414)
    (9 0.0345)
    (10 0.0138)
    (11 0.0138)
    (12 0.0138)
    (18 0.0069))))
```

Figure A.12: Beckett phrase-length probabilities as a function

```
(define density-tabl
  (make-ptable `(
    (0 ,silenceRatio)
    (1 0.2345)
    (2 0.3034)
    (3 0.4621))))
```

Figure A.13: Words per phrase probabilities function. The 0 takes the value of *silenceRatio* to determine the probability of a bar of only rest.

```
(define chanceOfNewMotiveList '(0 1.0000 1 0.5000 2 0.3333 3 1.0000 4 0.5000 5 0.5000 6
0.2000 7 0.2000 8 0.2000 9 0.2000 10 0.2000 11 0.5000 12 0.5000 13 0.1667 14 0.1667 15
0.1667 16 0.3333 17 0.3333 18 0.3333 19 1.0000 20 0.0769 21 0.0769 22 0.0769 23 0.0769 24
0.0769 25 0.0769 26 0.5000 27 0.3333 28 0.2000 29 0.2000 30 0.1111 31 0.1111 32 0.1111 33
0.1111 34 0.1111 35 1.0000 36 0.0500 37 0.0500 38 0.0500 39 0.0500 40 0.0500 41 0.0500 42
0.0500 43 0.3333 44 0.5000 45 0.2000 46 0.2000 47 0.2000 48 0.1250 49 0.1250 50 0.1250 51
0.1250 52 0.1250 53 0.0667 54 0.0667 55 0.0667 56 0.0667 57 0.0667 58 0.0667 59 0.1333 60
0.1333 61 0.1333 62 0.1333 63 0.1333 64 0.1333 65 0.2000 66 0.2000 67 0.0909 68 0.0909 69
0.0909 70 0.0909 71 0.4000 72 0.4000 73 0.1000 74 0.1000 75 0.1000 76 0.1000 77 0.1000 78
0.1000 79 0.1000 80 0.5000 81 0.5000 82 0.0769 83 0.0769 84 0.0769 85 0.0769 86 0.0769 87
0.3333 88 0.5000 89 0.0256 90 0.0256 91 0.0256 92 0.0256 93 0.0256 94 0.0256 95 0.0256 96
0.0256 97 0.0256 98 0.0256 99 0.0256 100 0.0256 101 0.0256 102 0.0256 103 0.0256 104 0.0256
105 0.0256 106 0.0256 107 0.0256 108 0.1667 109 0.1667 110 0.2500 111 0.2500 112 0.5000 113
0.2000 114 0.2000 115 0.3333 116 0.1667 117 0.1667 118 0.1667 119 0.1667 120 0.0667 121
0.0667 122 0.0667 123 0.0667 124 0.0667 125 0.0667 126 0.0667 127 0.2000 128 0.2000 129
0.2000 130 0.2000 131 0.3333 132 0.3333 133 0.1667 134 0.1667 135 0.3333 136 0.0909 137
0.0909 138 0.0909 139 0.0909 140 0.3333 141 0.3333 142 0.0000 143 0.0000 144 0.0000))
```

Figure A.14: Probability function for the chance of a new motive.

```
(define diffHighestPossibleActualHighest-tabl
  (make-ptable '(0 0.4207) (1 0.0552) (2 0.0345) (3 0.0138) (4 0.0414) (5 0.0138) (6
0.0138) (7 0.0345) (8 0.0207) (9 0.0138) (10 0.0207) (11 0.0138) (12 0.0483) (13 0.0207)
(14 0.0138) (15 0.0138) (16 0.0345) (17 0.0138) (18 0.0345) (19 0.0069) (20 0.0069) (21
0.0414) (22 0.0069) (23 0.0069) (24 0.0069) (25 0.0276) (26 0.0138) (27 0.0069))))

(define absoluteSpanBetweenHighestAndLowestMotive-tabl
  (make-ptable '(0 0.269) (1 0.0483) (2 0.0414) (3 0.0552) (4 0.0552) (5 0.0345) (6
0.0345) (7 0.0759) (8 0.0138) (9 0.0207) (10 0.0414) (11 0.0069) (12 0.0069) (13 0.0069)
(14 0.0276) (15 0.0207) (16 0.0138) (17 0.0069) (18 0.0069) (19 0.0069) (20 0.0138) (21
0.0207) (22 0.0069) (23 0.0207) (24 0.0069) (25 0.0069) (26 0.0138) (27 0.0069) (28
0.0138) (29 0.0069) (30 0.0069) (31 0.0138) (32 0.0069) (33 0.0069) (34 0.0069) (35
0.0069) (36 0.0069) (37 0.0069) (38 0.0069) (39 0.0069) (40 0.0069) (41 0.0069))))
```

Figure A.15: Motive-span probability functions.

A.3.3 Harmonic analysis of Bernhard Lang D/W2

The image displays a handwritten musical score for Bernhard Lang's piece 'D/W2'. The score is organized into eight systems, each consisting of a musical staff and a line of harmonic analysis labels. The measures are numbered sequentially from 1 to 104. The labels use letters (T, D, S, O, SP, TP, SS, SG) and symbols (/, #) to denote specific harmonic or rhythmic events. Some measures contain multiple notes, and some labels include accidentals like sharps (#).

1 2 3 4 5 6 7 8
A T D T D T S T S O T D T S O/T D/T T D T T

10 11 12 13 14 15 16 17 18 19 20 21
T SP D T D T S T S T T T D T/D T/D T/D S T D

22 23 24 25 26 27 28 29 30 31 32 33
T SS(D) T/D SS(D) T/D SS(D) T T/D D/SP T O T O T S SS T D T TP/SG TP/SG

34 35 36 37 38 39 40 41 42 43 44 45
T D T T SS(D) T/D SS(D)/T D S T T/D S D S T T T T T D T

46 47 48 49 50 51 52 53 54 55 56 57
T SP T/D S S T/D T T S T T/D T/D T/D T/D T/D D T O

58 59 60 61 62 63 64 65 66 67 68 69
S T S T T D S D D T T/D D T/D T D T T S T T/D O

70 71 72 73 74 75 76 77 78 79 80 81 82
S/D D T D D D Y S TG/TP/D T T T T TG/TP T/D T T/D T

83 84 85 86 87 88 89 90 91 92
T T T/D T/D T/D S T T S D ZD/D S/D ZD/D S/D ZD/S/SS ZD/S/T/D T/D ZD/S/D S

93 94 95 96 97 98 99 100 101 102 103 104
T T T S T T TP/D S S T S S S S T D T/D T

A.3. WORDS LIKE SMOKE

105 106 107 108 109 110 111 112 113 114

SSIT/GG TGSP chr-D chr-D T TGSP T T/D TGSP chr-D T T/S T S T/D SS DR D T TGSP T/S T/S

115 116 117 118 119 120 121 122 123 124 125

TGSP T T D T D T D T T T T T T T/S T/S

126 127 128 129 130 131 132 133 134 135

SRT SS SS SChr-T SS SChr-T SS SChr-D T/D SChr-D T/SS T/SS D T/SS T SS S SS SSS SS

136 137 138 139 140 141 142 143 144 145 146 147

TGSP T/D TGSP S/SS TGSP SS S/D TGSP/D TGSP/D TGSP/D S/D T ST TGSP/D T ST T/D T/D T ST

148 149 150 151 152 153 154 155 156 157 158

T D TGSP TGSP D TGSP D TGSP TGSP D TGSP SS TP/S D T/D TP/S chr-D S TP/S/D D T D T T/D

159 160 161 162 163 164 165 166 167 168 169 170

T S T S SR ZDDSS T T T/D S S S TG/SP TG/SP S T/D S S/D T T/D S/D Tchr-D

171 172 173 174 175 176 177 178 179 180 181 182 183

T/D S T T/D T/D T/D T/D T/D T/D chr-T/S T SS T/D chr-T/S T/D D S/D T/D

184 185 186 187 188 189 190 191 192 193 194 195

T/D T/D S D S/D T SS Tchr-D S T D/S T/D T/S T/S D T D D/T D D/T

196 197 198 199 200 201 202 203 204 205 206 207 208

D/T D D D T/D SS T/D T/D S T S/D T D/T D/SP TP/S/D T TP/S/D T TP/S/D chr-D TGSP/D

209

D T

A.3.4 Analysis tables of Bernhard Lang

Phrase	Harms	Num	Phrase	Harms	Num	Phrase	Harms	Num
1	A, E	2	71	A-C-E	1	141	E-F-B	1
2	A, E	2	72	B, B-D	2	142	E-F-B	1
3	A, D-A, A, D-A, E	5	73	B-D	1	143	D-E-F-B	1
4	A, E	2	74	A, A-D	1	144	A-E, D-A-E	2
5	A, D	2	75	C-Fs-B	1	145	F-A-B-E, A-E, D-A-E	3
6	E-A-B	1	76	A-C	1	146	A-B-E, A-B	2
7	E-A-B	1	77	A-C, A	2	147	A-E, D-A-E	2
8	A, E, A	3	78	A-C	1	148	A-E	1
9	A	1	79	C	1	149	E-B, F-A, F-A-C	3
10	A	1	80	A-B, A-C	2	150	E-B, F-A	2
11	F-A, B-A	2	81	A-B, A-C	2	151	E-B, F-A, F-A-C	3
12	A-E, E	2	82	A-C	1	152	E-B, F-A, G, G-C, F-A-D	5
13	A, D	2	83	A-C-Cs	1	153	E-G-B, Cs-G-A, C-D-F	3
14	A-C, A-D	2	84	A-C-Cs	1	154	Ef-E-Bf	1
15	A-C	1	85	A-B-Cs, A-B-D, A-B-C	3	155	D-F, C-D-F-B	2
16	A	1	86	D-A, A-C, A	3	156	B	1
17	A-E, B	2	87	D-A, E-B	2	157	(A4) (E5)	2
18	A-B	1	88	Cs-B, D-A-B	2	158	A, A-B	2
19	A-B	1	89	Cs-B, D-A-B	2	159	A, A-D	2
20	A-B, A-D	2	90	Cs-D-B-G	1	160	A, A-D	2
21	A, B-D-E	2	91	Cs-D-A-B, E-A-B	2	161	A-Fs, Ds-Gs-G, A	3
22	A, G-B	2	92	Cs-D-B, D-A	2	162	A-C-E	1
23	A-B, G-B	2	93	Cs-E-A	1	163	F, A-D	2
24	A-B, G-B	2	94	Cs-E-A	1	164	F-D, F-A-D	2
25	A	1	95	Cs-E, D-A	2	165	F-A	1
26	A-B, F-A-B	2	96	A-E	1	166	F, A-D	2
27	A, E	2	97	A-E	1	167	A-B	1
28	A, B-D	2	98	Fs-A-E	1	168	A-D	1
29	A, A-D	2	99	D-A	1	169	D-E	1
30	D-G	1	100	D-A, A-C	2	170	A, A-Ds, D-Fs-A-B, Bf-Ef-A	3
31	A, B-D, Cs-A	3	101	A-D, D-A	2	171	A-B-Ds, A-D	2
32	Fs-A-Bb	1	102	A-D	1	172	A	1
33	Fs-A-Bb	1	103	A, E	2	173	A-B-Ds	1
34	A-C, B	2	104	E-A, A	2	174	A-B-Ds	1
35	A	1	105	G-A-F, F-A, Ef-G	3	175	A-B-Ds	1
36	A, G-B	2	106	Ef	1	176	A-B-Ds	1
37	A-B, G-B-E-A	2	107	A, F-A, A	3	177	A-B-Ds	1
38	B-E, A-D, A	3	108	A-B, F-A	2	178	A-B-Ds	1
39	A-B, D	2	109	Ef-Bf	1	179	A-B, G-Af	2
40	B-D-E, A-D, A	3	110	A, A-D-E	2	180	A, G	2
41	A	1	111	A, A-D	2	181	A-B-Ds, G-Af-D	2
42	A	1	112	A-B, G-B-D, B-F	3	182	A-Ds, E	2
43	A	1	113	B, A	2	183	A-D-Ef, B	2
44	A, B-D	2	114	A-Fs, A-B-Fs, A-D-E	3	184	A-B	1
45	A	1	115	F-Af	1	185	A-B-E, A-D	2
46	A-E, F-A-C	2	116	A, E-A, B-E	3	186	A-D, D-A-Bf	2
47	A-B-D, A-D-F, F-A-B-D	3	117	A, E-B	2	187	A, G-B-D	2
48	A-B	1	118	A, B	2	188	Ef-A-C, D	2
49	A, A-Df, A-D	3	119	A	1	189	A-E, D-E, A-D-E	3
50	A	1	120	A	1	190	A-D-E	1
51	B-A	1	121	A	1	191	A-D-E	1
52	B-A	1	122	B, E-A	2	192	E	1
53	B-A	1	123	E-A	1	193	A-E	1
54	B-A	1	124	E-A-C, D-E-A	2	194	E-B, E-A-B	2
55	B-E-A, E-B	2	125	A-D-E	1	195	E-B, E-A-B	2
56	A-E, B	2	126	G-A-B, G-Bf, G, D-Af-Ef	4	196	E-A-B	1
57	B	1	127	G-Bf, D-Af-Ef	2	197	E	1
58	A-D, A-E	2	128	G-Bf, D-Bf-Ef	2	198	E-B	1
59	A-D, A-E	2	129	A-B-E, D-B-Ef	2	199	D-E-G-B	1
60	A, E-B	2	130	G-A-B-Ef-E	1	200	Cs-D-E-B	1
61	A-D, B-E	2	131	G-A-B, Ef-E-B	2	201	A-B-Ds	1
62	E-B	1	132	G-A, A-Ef, G	3	202	A-Ds-E, A-D	2
63	A-E, A-B-E	2	133	D-F, G-D	2	203	A, D-A-B	2
64	B-E	1	134	G-D-F	1	204	A	1
65	A-B-D	1	135	G-D-F-G	1	205	Ds-A-Cs, Ds-F-A	2
66	A, B-D, A	3	136	E-F, A-E-G	2	206	Fs-As, A	2
67	A-E, A-D	2	137	E-F, D-F-G	2	207	Fs-As, A	2
68	A	1	138	F-A, G	2	208	F-Fs-B, Ef-E-Bf, F-Gs-A	3
69	A-B, E	2	139	D-F-A-B	1	209	Gs, A	2
70	D-A-B, E	2	140	E-F-B	1			

Figure A.16: Analysis of the number of consecutive harmonies in each phrase of the Lang

A.3.5 Programming code excerpts from the algorithm

```
(define numHarmsInPhraseProbabilityTabl
  (make-ptable '((1 0.4258)(2 0.4498)(3 0.1100)(4 0.0048)(5 0.0096))))
```

Figure A.18: Number of harmonies per measure as a probability table assigned to a variable in the algorithm

```
(define deadRepHarmsList '((A) (E) (A) (E) (A) (D A) (A) (D A) (E) (A) (E) (A) (D) (E A B)
  (E A B) (A) (E) (A) (A) (A) (F A) (B A) (A E) (E) (A) (D) (A C) (A D) (A C) (A) (A E) (B) (A)
  (A) (B D) (A) (A D) (A) (B D E) (A) (G B) (A B) (G B) (A B) (G B) (A) (A B) (F A B) (A) (E)
  (G B E A) (B E) (A D) (A) (A B) (D) (B D E) (A D) (A) (A) (A) (A) (A) (B D) (A) (A E) (F A)
  C) (A B D) (A D F) (F A B D) (A B) (A) (A D f) (A D) (A) (B A) (B A) (B A) (B A) (B E A) (E
  B) (A E) (B) (B) (A D) (A E) (A D) (A E) (A) (E B) (A D) (B E) (E B) (A E) (A B E) (B E) (A
  B D) (A) (B D) (A) (A E) (A D) (A) (A B) (E) (D A B) (E) (A C E) (B) (B D) (B D) (A) (A D)
  (C F s B) (A C) (A C) (A) (A C) (C) (A B) (A C) (A B) (A C) (A C) (A C C s) (A C C s) (A B C s)
  (A B D) (A B C) (D A) (A C) (A) (D A) (E B) (C s B) (D A B) (C s B) (D A B) (C s D B G) (C s D A
  B) (E A B) (C s D B) (D A) (C s E A) (C s E A) (C s E) (D A) (A E) (A E) (F s A E) (D A) (D A) (A
  C) (A D) (D A) (A D) (A) (E) (E A) (A) (G A F) (F A) (E f G) (E f) (A) (F A) (A) (A B) (F A)
  (E f B f) (A) (A D E) (A) (A D) (A B) (G B D) (B F) (B) (A) (A F s) (A B F s) (A D E) (F A f) (A)
  (E A) (B E) (A) (E B) (A) (B) (A) (A) (A) (B) (E A) (E A) (E A C) (D E A) (A D E) (G A B) (G
  B f) (G) (D A f E f) (G B f) (D A f E f) (G B f) (D B f E f) (A B E) (D B E f) (G A B E f E) (G A B)
  (E f E B) (G A) (A E f) (G) (D F) (G D) (G D F) (G D F G) (E F) (A E G) (E F) (D F G) (F A)
  (G) (D F A B) (E F B) (E F B) (E F B) (D E F B) (A E) (D A E) (F A B E) (A E) (D A E) (A B
  E) (A B) (A E) (D A E) (A E) (E B) (F A) (F A C) (E B) (F A) (E B) (F A) (F A C) (E B) (F A)
  (G) (G C) (F A D) (E G B) (C s G A) (C D F) (E f E B f) (D F) (C D F B) (B) (A) (E B) (A) (A B)
  (A) (A D) (A) (A D) (A F s) (D s G s G) (A) (A C E) (F) (A D) (F D) (F A D) (F A) (F) (A D) (A
  B) (A D) (D E) (A) (A D s) (D F s A B) (B f E f A) (A B D s) (A D) (A) (A B D s) (A B D s) (A B D s)
  (A B D s) (A B D s) (A B D s) (A B) (G A f) (A) (G) (A B D s) (G A f D) (A D s) (E) (A D E f) (B) (A
  B) (A B E) (A D) (A D) (D A B f) (A) (G B D) (E f A C) (D) (A E) (D E) (A D E) (A D E) (A D E)
  (E) (A E) (E B) (E A B) (E B) (E A B) (E A B) (E) (E B) (D E G B) (C s D E B) (A B D s) (A D s
  E) (A D) (A) (D A B) (A) (D s A C s) (D s F A) (F s A s) (A) (F s A s) (A) (F F s B) (E f E B f) (F G s
  A) (G s) (A))
```

Figure A.19: List of consecutive harmonies from the Lang defined as a variable for the Markov-like generation of harmonic progression.

```
(define (rawListNotes->keynums rawList)
  (loop for i in rawList collect
    (keynum i)))

(define (make-ptable data)
  (let ((total (loop for d in data sum (second d)))
        (sum 0))
    ;; total holds sum of weights in data
    (loop for d in data
      for v = (first d) ; outcome to return
      for w = (second d) ; relative weight
      do (set! sum (+ sum w))
      ;; collect outcome and normalized probability
      collect (list v (/ sum total)))))

(define (pran table)
  ;; return outcome in table according
  ;; to its weighted probability
  (let ((x (random 1.0)))
    ;; x is uniform number < 1.
    (loop for d in table
      for p = (second d)
      when (< x p) ; x in this segment.
      return (first d))))
```

Figure A.20: The three dependencies of the 1st version of the algorithm.

A.3.6 The arguments of the algorithm for *Words Like Smoke* and their meanings

<i>targetDuration</i>	This takes the form of a integer or floating-point number that indicates the length of the piece in minutes.
<i>pulseBasis</i>	This is the basis for the number of pulses in each measure. This value determines the relative duration of each measure. One pulse corresponds to one word in the original text that served as the source for the corresponding probability table. A pulse basis of 1.0 indicates that the pulse is to be based on quarters; 0.5 indicates that it is to be based on eighths, etc.
<i>tempoUnit</i>	The tempo unit and pulse basis are indicated separately and may be assigned different values. While the pulse basis determines the relative length of each given measure based on a standard duration (quarter, eighth etc.), the tempo unit indicates the durational value that is used in conjunction with the metronome mark in order to determine the tempo of the work. Both parameters use the same correspondence between 1.0 = quarter, 0.5 = eighth, 2.0 = half etc. Thus, the relative lengths of a structure's measures may be based in eighths, while the tempo marking could still be set as quarter = 60, for example.
<i>metronomeMark</i>	This is the metronome marking as ascribed to the tempo unit.
<i>silenceRatio</i>	The name of this variable is slightly misleading. The value given represents the probability that any given measure consist of only rest. Since the measures that are generated vary in length, this value does not determine the absolute amount of silence in the work, but rather the percentage of silent measures.
<i>numInsts</i>	This parameter value indicates the number of instruments in the ensemble for which the structure is being generated. In this first version of the algorithm, each instrument should be capable of performing a separate motive. Thus if 9 instruments are assigned to this value, the algorithm will generate structures in which any number between 0 and 9 instruments will play in any given bar, and any number from 1 to 9 motives may be performed by those instruments. (In the latest version of the algorithm, this parameter value indicates the maximum number of simultaneous motives, regardless of the number of instruments. This approach allows for doublings and couplings in the orchestral technique and allows the user to strive for more clarity in the work by, for instance, indicating that there will only ever be a maximum of three or four simultaneous motives, even in a work for large ensemble or orchestra, for example).
<i>startingHarm</i>	In this first version of the algorithm, this value must be a harmony, spelled in letter names, that is contained within the list of harmonies defined prior to running the algorithm.

A.3.7 A segment of the algorithm for *Words Like Smoke*

```
(define numHarmsInPhraseProbabilityTabl
  (make-table '((1 0.4258)(2 0.4498)(3 0.1100)(4 0.0048)(5 0.0096))))

(set! currentPhraseLen (prn phraseLen-tabl))
(loop for i from 0 while (< (+ currentTime (* currentPhraseLen timeIncrement)) (* targetDuration 60)) do
  (set! phraseLengthList (append phraseLengthList '(,currentPhraseLen)))
  (set! totalPulseCount (+ totalPulseCount currentPhraseLen))
  (set! beginTime currentTime)
  (set! durationsSecsList (append durationsSecsList '(,(* currentPhraseLen timeIncrement))))
  (set! currentTime (+ currentTime (list-ref durationsSecsList i)))
  (set! currentTimeDec (/ currentTime 60))
  (set! currentPhraseLen (prn phraseLen-tabl)))

(set! beginTime 0)
(set! currentTime 0)
(let ((numVoices 0)
      (currentNewMotiveChance 0.0)
      (newMotiveMarker 0)
      (currentActualHighestMotive 0)
      (motiveSpan 0)
      (lowestPossiblePhraseMotive 0))
  (loop for i from 0 below (length phraseLengthList) do
    (format t "Phrase Number: ~s%" (+ 1 i))
    (format t "~TphraseLength: ~s pulses~%" (list-ref phraseLengthList i))
    (format t "~Tduration: ca. ~s seconds~%" (/ (round (list-ref durationsSecsList i) .01) 100.0))
    (set! beginTime currentTime)
    (set! currentTime (+ currentTime (list-ref durationsSecsList i)))
    (set! currentTimeDec (/ currentTime 60))
    (set! currentTimeSecondsSeg (round (* (- currentTimeDec (floor currentTimeDec)) 60)))
    (set! currentTimeSecondsSegTens (floor currentTimeSecondsSeg 10))
    (set! currentTimeSecondsSegUnits (floor (- currentTimeSecondsSeg (* currentTimeSecondsSegTens 10)))
    (format t "~TtimeAtBegOfPhrase: ~s secs (ca. ~s~s~s~s)~%"
      (/ (round beginTime .01) 100.0)
      (floor (/ beginTime 60))
      (floor (round (* (- (/ beginTime 60) (floor (/ beginTime 60))) 60)) 10)
    )
```

A.3.8 Example of the algorithm's output

Pulse Basis: quarter note
Tempo Unit: quarter note
Metronome Mark: 84

Phrase Number: 1
phraseLength: 12 pulses
duration: ca. 8.57 seconds
timeAtBegOfPhrase: 0.0 secs (ca. 0:00")
timeAtEndOfPhrase: 8.57 secs (ca. 0:09")
number of simultaneous instruments in the phrase: 2
chance of a new motive in any of the voices: 1.0
new motive in the phrase? YES
actual highest motive in the phrase: 1
span between actual highest motive and lowest possible in the phrase: 0
lowest possible motive in the phrase: 1
instrument no 1: NEW MOTIVE 1
instrument no 2: motive 1
currentHighestPossibleMotive: 1
number of consecutive harmonies in the phrase: 2
harmonies: (A4) (D4 A4 B4)

Phrase Number: 2
phraseLength: 18 pulses
duration: ca. 12.86 seconds
timeAtBegOfPhrase: 8.57 secs (ca. 0:09")
timeAtEndOfPhrase: 21.43 secs (ca. 0:21")
number of simultaneous instruments in the phrase: 0
currentHighestPossibleMotive: 1
number of consecutive harmonies in the phrase: 1
harmonies: (D4 A4 B4)

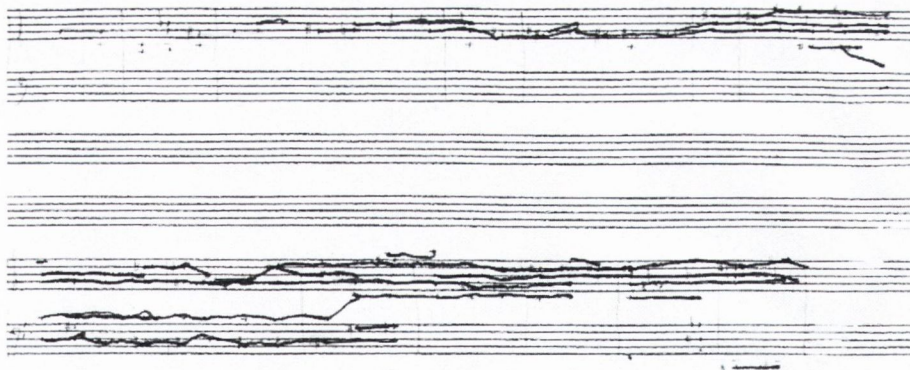
Phrase Number: 3
phraseLength: 3 pulses
duration: ca. 2.14 seconds
timeAtBegOfPhrase: 21.43 secs (ca. 0:21")
timeAtEndOfPhrase: 23.57 secs (ca. 0:24")
number of simultaneous instruments in the phrase: 3
chance of a new motive in any of the voices: 0.35894614
new motive in the phrase? NO
actual highest motive in the phrase: 1
span between actual highest motive and lowest possible in the phrase: 0
lowest possible motive in the phrase: 1
instrument no 1: motive 1
instrument no 2: motive 1
instrument no 3: motive 1
currentHighestPossibleMotive: 1
number of consecutive harmonies in the phrase: 1
harmonies: (D4 A4 B4)

A.4 Second Version of the algorithm

A.4.1 Keyboard reduction of the Berio passage



A.4.2 Determination of polyphonic lines in the Berio



A.4.3 Analysis tables for the Berio

MelFrag	Intvl	MelFrag	Intvl	MelFrag	Intvl	MelFrag	Intvl	MelFrag	Intvl	MelFrag	Intvl
G		C		B		C		F		B	
G	0	C	0	B	0	C	0	F	0	B	0
C		C		A	-2	F		F		B	
C	0	C	0	B	2	Ef	-2	G	2	B	0
A	0	C	0	B	0	D		G	0	G	
A	0	C	0	B	0	D	0	Af		F	-2
C	3	C	0	B	0	Ef	1	F	-3	F	0
G		C		Bf	-1	Ef	0	F	0	F	0
Fs	-1	C	0	Bf	0	Af		Ds		F	0
G	1	C	0	Bf	0	Af		Ds	0	F	0
G	0	C	0	A	-1	B	3	Ds	0	D	
B		C		Bf	1	B	0	D	-1	D	0
B	0	C	0	Bf	0	D	3	D	0	E	
Gs		C		Bf	0	D	0	D	0	E	0
G	-1	C	0	Bf	0	Ds	-1	D	0	E	0
B		C		G	-3	Ef	0	D	0	E	0
Bf	-1	C	0	G	0	F		Ds	1	E	0
Bf	0	C	0	G	0	E	-1	Ds	0	E	0
Bf	0	C	0	G	0	E	0	E	1	E	0
G		Ds		G	0	E	0	E	0	Cs	
Fs	-1	Ds	0	G	0	Af	4	Ds	-1	Cs	0
Fs	0	A	-4	Fs	-1	A	1	Ds	0	Cs	0
G	1	A	0	Fs	0	Bf	1	Ds	0	C	
Fs	-1	Ds	6	Fs	0	A	-1	Ds	0	C	0
Fs	0	B	-4	G	1	Af	-1	Ds	0	C	0
Fs	0	B	0	G	0	Bf		Ds	0		
G	1	D		G	0	Bf	0	Ds	0		
G	0	D	0	G	0	Bf	0	Ds	0		
G	0	D	0	Gs	1	C		C			
G	0	Cs	-1	Gs	0	C	0	C	0		
G	0	Cs	0	Gs	0	C	0	C	0		
Gs	1	Cs	0	G	-1	C	0	Cs			
G	-1	D	1	Gs	1	C	0	Cs	0		
G	0	Cs	-1	Gs	0	C	0	Gs			
G	0	Cs	0	Gs	0	C	0	Gs	0		
G	0	Cs	0	Gs	0	F		Gs	0		
Gs	1	D	1	Gs	0	F	0	Gs	0		
Gs	0	D	0	Gs	0	Bf		E			
G	-1	E		G	-1	Bf	0	Ef	-1		
G	0	E	0	G	0	Bf	0	Ef	0		
G	0	E	0	G	0	Bf	0	Df	-2		
G	0	E	0	G	0	Bf	0	Fs	5		
G	0	E	0	Fs	-1	Af	-2	Fs	0		
G	0	E	0	Fs	0	Bf	2	Fs	0		
Fs	-1	D	-2	G	1	Bf	0	Fs	0		
Fs	0	Ds	1	G	0	Bf	0	Fs	0		
G	1	Ds	0	A	2	Bf	0	F	-1		
G	0	Ds	0	G	-2	Bf	0	E	-1		
Gs		Ds		G	0	B		C			
B	3	E	1	G	0	B	0	C	0		
G		F	1	G	0	B	0	C	0		
B	4	E	-1	G		B	0	C	0		
B	0	Fs	2	G	0	Bf	-1	C	0		
B	0	D	-3	G	0	B	1	C	0		
Bf	-1	D	0	G	0	B	0	C	0		
Bf	0	E	2	Af	1	B	0	C	0		
B	1	Gs		G	-1	B	0	C	0		
B	0	Gs	0	G	0	B	0	C	0		
B	0	A		G	0	B	0	A			
B	0	A	0	F	-2	B	0	A	0		
B	0			F	0	B	0	A	0		
Ds				F	0	B	0	A	0		
Ds	0			Ef	-2	E		A	0		
Fs	3			Fs	3	D	-2	A	0		
Fs	0			F		Ef		Bf			
Fs	0			E	-1	Ef	0	Bf	0		
Fs	0			C		C	-3	B	1		
E	-2			C	0	C	0	B	0		
E	0			C	0	C	0	Bf	-1		
Cs				Cs		C	0	Bf	0		
Cs	0			Cs	0	Bf	-2	Bf	0		
				Af	-2	Bf	0	Bf	0		
				A	1	A	1	Bf	0		

Figure A.21: Analysis of the interval content of the Berio.

Intvl	Num	%	Intvl	Num	%	Intvl	Num	%
-4	2	0.0063	0	228	0.7125	1		
-4						1		
-3						1		
-3	4	0.0125				1		
-3						1		
-3						1		
-2						1		
-2						1		
-2						1		
-2						1		
-2						1		
-2	13	0.0406				1	26	0.0813
-2						1		
-2						1		
-2						1		
-2						1		
-2						1		
-2						1		
-1						1		
-1						1		
-1						1		
-1						1		
-1						1		
-1						1		
-1						1		
-1						1		
-1						1		
-1						1		
-1						2		
-1						2		
-1						2		
-1						2	6	0.0188
-1						2		
-1						2		
-1						2		
-1						3		
-1						3		
-1	31	0.0969				3	6	0.0188
-1						3		
-1						3		
-1						3		
-1						4	2	0.0063
-1						4		
-1						5	1	0.0031
-1						6	1	0.0031
-1						-2	320	1.0000
-1								
-1								
-1								
-1								
-1								
-1								

Figure A.22: Sorting of the interval list and determination of percentages. (The 228 instances of the 0 interval have been reduced to one cell for the sake of space.)

Chord	NumVox	Diff	Chord	NumVox	Diff
G	1		A-DS-AF-C-G-BF-F	7	2
C-G	2	1	CS-G-BF-DS-E	5	-2
A-C	2	0	CS-AF-A-FS	4	-1
A-C-BF	3	1	G-BF-D	3	-1
C-FS	2	-1	C-F-G-BF-D-A	6	3
G	1	-1	D-C-EF-G-BF-E	6	0
G-B	2	1	D-F-BF	3	-3
B	1	-1	AF-EF-F-G	4	1
GS	1	0	F-AF-EF-C-F-G-BF-FS	8	4
G-B	2	1	E-B-EF-BF	4	-4
BF	1	-1	E-B-C-FS-G-BF-E	7	3
G-BF	2	1	BF-E-D-G	4	-3
C-G-BF	3	1	AF-D-C-E-G	5	1
FS	1	-2	A-B-DS-C-D-FS-G	7	2
FS-GS	2	1	F-BF-EF-C-FS	5	-2
G-B	2	0	F-G-A-C-FS-BF	6	1
FS	1	-1	AF-EF-C-FS-BF-B	6	0
C-FS	2	1	F-C-G-BF-B	5	-1
FS-GS	2	0	F-A-EF-C-FS-G-BF-B-E	9	4
G-B-DS	3	1	C-FS-G-BF	4	-5
G-B-DS	3	0	C-FS-G-AF-BF	5	1
G-B-FS	3	0	C-F-GS-BF-B	5	0
CS-G-BF-FS	4	1	AF-BF-C-EF-G-GS-BF-B	8	3
C-CS-G-BF-FS	5	1	F-AF-A-G-GS-BF-B-DS	8	0
D-C-GS-B-E	5	0	F-G-BF-B-DS-C	6	-2
D-C-G-B-E	5	0	G-GS-BF-B-DS-C	6	0
D-GS-C-G-B	5	0	CS-G-GS-B-C	5	-1
CS-C-G-B-DS	5	0	CS-EF-G-GS-B-D	6	1
CS-C-GS-DS	4	-1	C-EF-G-GS-B-D	6	0
D-C-GS-A-B	5	1	C-DF-GS-A-B-D-F	7	1
CS-C-G-A	4	-1	C-FS-GS-B-D	5	-2
CS-C-G-DS-E	5	1	C-FS-G-D	4	-1
CS-C-G-B-E	5	0	C-FS-G-A-DS	5	1
CS-C-G-B-E	5	0	C-FS-G-A-BF-DS	6	1
D-GS-C-G-B-E	6	1	C-FS-A-BF-E	5	-1
D-GS-C-G-E-FS-A	7	1	C-E-FS-A-BF-B-C-CS-D-DS-E	11	6
C-G-B-E-A	5	-2	CS-C-E-FS-G-A-B-DS	8	-3
C-FS-B-E	4	-1	C-G-A-BF-B-DS-E-F-G-B	10	2
C-FS-A-D	4	0	G-DS-E-F-B	5	-5
C-G-B-DS	4	0	D-A-DS-E-F-B	6	1
C-G-B-DS-F	5	1	D-G-BF-DS-E-F-B	7	1
B-DS-E	3	-2	C-CS-G-BF-DS-E-F	7	0
F-C-G-B-DS	5	2	C-CS-G-BF-DS-E-F	7	0
C-FS-G-BF-E	5	0	C-CS-D-E-F-G-AF-A-BF-B-C-D-DS-E	14	7

Figure A.23: Analysis of the difference in number of voices between consecutive chords in the Berio

Int	Num	AbsInt	Int	Num	AbsInt	SortNum	%	SortNum	%
-10	1	10	1		1	1		4	
-9	1	9	1		1	1		4	
-7		7	1		1	1		4	
-7		7	1		1	1		4	
-7		7	1		1	1		4	
-7	8	7	1		1	1		4	
-7		7	1	13	1	1		4	15
-7		7	1		1	1		4	
-7		7	1		1	1		4	
-7		7	1		1	1		4	
-6		6	1		1	1	22	4	
-6		6	1		1	1		4	
-6		6	1		1	1		4	
-6		6	2		2	1		4	
-6	10	6	2		2	1		4	
-6		6	2	6	2	1		5	
-6		6	2		2	1		5	4
-6		6	2		2	1		5	
-6		6	3		3	1		6	
-5		5	3		3	1		6	
-5	2	5	3	6	3	1		6	
-4		4	3		3	2		6	
-4		4	3		3	2		6	
-4		4	3		3	2		6	
-4	6	4	4		4	2		6	13
-4		4	4		4	2		6	
-4		4	4		4	2		6	
-3		3	4		4	2		6	
-3		3	4	9	4	2		6	
-3		3	4		4	2	17	6	
-3	7	3	4		4	2		6	
-3		3	4		4	2		7	
-3		3	4		4	2		7	
-3		3	5		5	2		7	
-2		2	5	2	5	2		7	
-2		2	6		6	2		7	
-2		2	6	3	6	2		7	10
-2		2	6		6	2		7	
-2		2	7		7	3		7	
-2	11	2	7	2	7	3		7	
-2		2	8	1	8	3		7	
-2		2	10	1	10	3		8	1
-2		2	11	2	11	3		9	1
-2		2	11		11	3		10	
-2		2		100		3	13	10	2
-1		1				3		11	2
-1		1				3		11	
-1		1				3			100
-1		1				3			
-1	9	1				3			
-1		1				3			
-1		1				3			
-1		1				3			
-1		1				3			

Figure A.26: Sorting and percentage calculations of intervals of entry for new voices. All values have been converted to positive for a greater pool.

Phrase	NumHarms	NumHarms	Instances	%
1	1	1		
2	2	1		
3	3	1		
4	7	1		
5	2	1		
6	5	1		
7	1	1	14	0.3415
8	5	1		
9	4	1		
10	4	1		
11	3	1		
12	3	1		
13	3	1		
14	3	1		
15	2	2		
16	2	2		
17	1	2		
18	2	2		
19	3	2		
20	2	2		
21	2	2		
22	1	2	15	0.3659
23	3	2		
24	2	2		
25	2	2		
26	2	2		
27	1	2		
28	2	2		
29	2	2		
30	1	3		
31	1	3		
32	2	3		
33	1	3	7	0.1707
34	1	3		
35	1	3		
36	1	3		
37	1	4	2	0.0488
38	2	4		
39	2	5	2	0.0488
40	1	5		
41	1	6	1	0.0244
			41	1.0000

Figure A.28: Analysis and percentages for the number of consecutive harmonies in a given phrase of the Berio.

Phrase	Motives	Num	Phrase	Motives	Num	Phrase	Motives	Num
1	1a	1	51	3f, 5b	2	101	20f, 15d	2
2	2a, 3a	2	52	3e	1	102	39b	1
3	2a, 3a, 4a	3	53	27a	1	103	42a	1
4	5a	1	54	25b, 1h, 1g	3	104	15a, 3k, 15e, 32b	4
5	5b	1	55	3e, 7g	2	105	32c	1
6	6a	1	56	3e, 11e, 5b	3	106	32d, 3n	2
7	5c, 3b	2	57	3c, 7d	2	107	21c, 25c	2
8	5c, 3b	2	58	3d, 23a	2	108	3j, 46a, 8a	3
9	6b	1	59	28a, 23e, 3e, 23f, 3f	5	109	21c, 25d, 15a, 3b, 18f, 3g	6
10	6c	1	60	3g, 3e, 10c	3	110	47a, 21a, 15a	3
11	7a, 8a, 2b	3	61	10a, 7h, 5d, 3d	4	111	10j	1
12	2a	1	62	3g, 23g	2	112	47a, 48a, 3n, 15a	4
13	9a, 8a	2	63	3e, 10c	2	113	49a, 3g	2
14	7b, 9b, 4b	3	64	24b, 1f	2	114	32e, 3p, 18g	3
15	1b, 1c	2	65	31a, 20b, 29a, 23b	4	115	19b, 52a	2
16	10a	1	66	31a, 20b, 29a, 23d	4	116	51a, 3p, 18g	3
17	6b	1	67	32a, 31a	2	117	18g, 12e	2
18	6c	1	68	7k, 23a	2	118	19b	1
19	11a	1	69	20d, 10d, 20c	3	119	3e, 10m, 52b, 18g	4
20	12a	1	70	20d, 31a, 20c	3	120	49b, 10n, 52a, 3b, 56a, 3g	6
21	6c	1	71	32a, 31a, 33a	3	121	18g, 49a, 46b, 20g, 31b, 20h	6
22	7a, 8a, 4c	3	72	33a, 110d	2	122	32e	1
23	11a, 8a	2	73	31a, 35a, 36a, 10e	4	123	51a, 56a, 46c	3
24	9c	1	74	35a, 10e, 36a, 10e	4	124	3e, 46d	2
25	12a, 5d, 9c	3	75	7l	1	125	3e, 3o	2
26	7c, 15a, 12b	3	76	10e	1	126	56a	1
27	15b, 12b	2	77	31a, 35a	2	127	3a, 58a, 10o, 12e	4
28	7d, 16a, 5c, 10b	4	78	20b, 20c	2	128	12f	1
29	5f, 16a	2	79	20d, 31a	2	129	56a, 3j, 9c	3
30	11b, 17a, 18a	3	80	39a, 20e	2	130	3p, 15f, 18h, 58a, 3b, 7o, 32e, (58a), 18e	8
31	18b, 12c, 10b, 5e, 5f	5	81	1g	1	131	59a, 2c, 60a	3
32	1a	1	82	11f, 40a, 41a, 3b, 5g	5	132	7b, 59a, 60b, 13c, 20i	5
33	1d, 1e	2	83	5e, 5f, 3b	3	133	10p, 62a, 3g, 63a, 10q	5
34	1f	1	84	41a, 3g, 18d	3	134	13f, 3q, 20j, 18i	4
35	11b, 20a	2	85	3a, 40a, 12d	3	135	3q, 63a, 4e, 65a	4
36	21a, 22a	2	86	3a, 7m	2	136	3j, 66a, 10r	3
37	21b, 22a	2	87	42a, 12b	2	137	10s, 46e, 20j	3
38	5e, 11c, 1f	3	88	3k, 12g, 43a	3	138	21e, 4f	2
39	3c, 11d, 1g	3	89	44a, 15d	2	139	21a, 20k, 9c, 7p	4
40	3d, 11d, 20a	3	90	7n, 15e, 15d, 12e	4	140	15c, 46f, 3q, 49c, 67a	5
41	3b, 3d, 5e	3	91	3k, 10f, 12e	3	141	19c, 19d, 19e	3
42	11d, 7e, 1g	3	92	20a, 10g, 15d	3	142	3e, 68a, 21a, 69a	4
43	11e, 1g, 23a	3	93	10h, 15d	2	143	21d, 7q, 32f, 15d	4
44	24a, 3e, 11e, 23b	4	94	3k, 10i, 10j	3	144	21d, 7q, 7h	3
45	25a, 23b	2	95	20c, 10i	2	145	21d, 7q, 18j, 10q	4
46	25c	1	96	3k, 10d	2			
47	1h	1	97	3l, 3k, 10k	3			
48	26a, 11e, 23d	3	98	10l	1			
49	25a, 23d	2	99	20a	1			
50	3a, 7f	2	100	15e	1			

Figure A.29: New analysis of the number of motives each phrase of the Beckett.

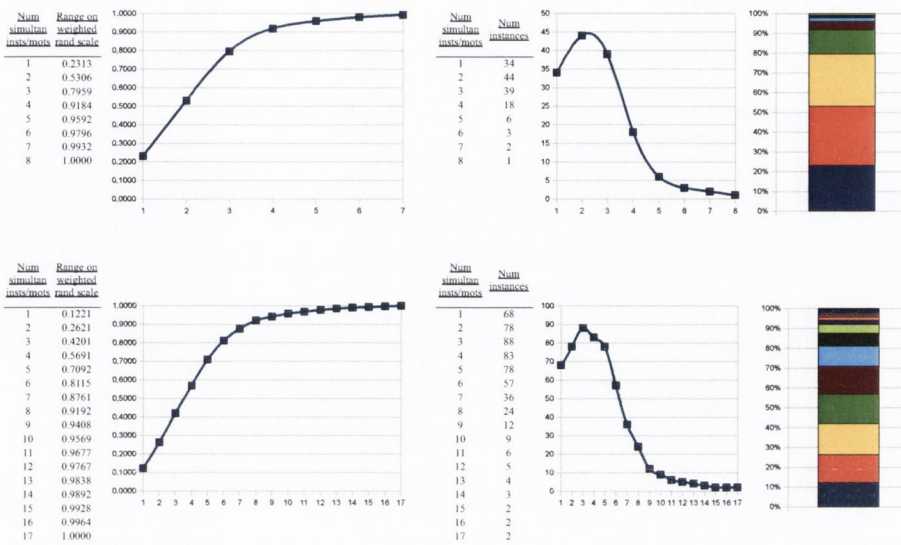


Figure A.31: Same curve maintained for number of simultaneous instruments/motives regardless of number of instruments chosen.

A.4.4 Translation of analysis tables into variables

```
(define melodicMotionTable
  (make-ptable '((-4 0.0063)
                (-3 0.0125)
                (-2 0.0406)
                (-1 0.0969)
                (0 0.7125)
                (1 0.0813)
                (2 0.0188)
                (3 0.0188)
                (4 0.0063)
                (5 0.0031)
                (6 0.0031))))
```

Figure A.32: Translation of the melodic interval analysis into a probability table, assigned to a variable in the algorithm

```
(define subtractNumNotesTable
  (make-ptable '((5 2) (4 1) (3 3) (2 7) (1 14))))

(define addNumNotesTable
  (make-ptable '((1 26) (2 4) (3 3) (4 2) (6 1) (7 1))))
```

Figure A.33: Translation of the analysis of the difference in the number of notes in two consecutive chords into a probability table, assigned to a variable in the algorithm

```
(define newNoteIntervalTabl
  (make-ptable '((1 22) (2 17) (3 13) (4 15) (5 4) (6 13) (7 10) (8 1)
    (9 1) (10 2) (11 2))))
```

Figure A.34: Translation of the analysis of the interval at which new voices enter into a probability table, assigned to a variable in the algorithm

```
(define numHarmsInPhraseProbabilityTabl
  (make-ptable '((1 14) (2 15) (3 7) (4 2) (5 2) (6 1))))
```

Figure A.35: Translation of the analysis of the number of consecutive harmonies in a given phrase into a probability table, assigned to a variable in the algorithm

```
(define density-tabl
  (make-ptable '((1 34) (2 44) (3 39) (4 18) (5 6) (6 3) (7 2) (8 1))))
```

Figure A.36: Translation of the new analysis of the number of motives in each phrase of the Beckett into a probability table, assigned to a variable in the algorithm

A.4.5 Running the algorithm

```
(define (keynums->notenames chord)
  (loop for i in chord collect
    (note i)))

(define (chordPlayer2 harm dur)
  (process for note in harm
    output (new midi :time (now) :keynum note :duration dur)))

(define (chance? prob)
  (< (random 1.0) prob))
```

Figure A.37: New dependencies for the algorithm.

```
(harmMotsStructBerio
;targetduration (mins)
3
;pulsebasis
0.5
;tempounit
0.5
;metronomemark
96
;numinsts
7
;strtpchlst
'(67)
;amount of silence
.11)

(harmMotsStructBerio 3 0.5 0.5 96 7 '(67) .11)

(events (harmMotsStructBerio 17 0.5 0.5 84 7 '(67) .17)
"/Users/username/folder/filename.midi")
```

Figure A.38: Examples of an instantiation of the algorithm. The first two examples are without MIDI output of the harmonic progression. Lines beginning with a semi-colon are comment lines, facilitating the user's overview of the meanings of the values being entered. Without the comment lines the above appears as shown in the second example. The third call is an example of running the algorithm with MIDI output.

Pulse Basis: 1.0
Tempo Unit: 1.0
Metronome Mark: 72

Phrase Number: 1
phraseLength: 2 pulses
duration: ca. 1.67 seconds
timeAtBegOfPhrase: 0.0 secs (ca. 0:00")
timeAtEndOfPhrase: 1.67 secs (ca. 0:02")
number of simultaneous instruments in the phrase: 14
chance of a new motive in any of the voices: 1.0
new motive in the phrase? YES
actual highest motive in the phrase: 1
span between actual highest motive and lowest possible in the phrase: 0
lowest possible motive in the phrase: 1
instrument no 1: motive 1
instrument no 2: motive 1
instrument no 3: motive 1
instrument no 4: motive 1
instrument no 5: motive 1
instrument no 6: motive 1
instrument no 7: motive 1
instrument no 8: NEW MOTIVE 1
instrument no 9: motive 1
instrument no 10: motive 1
instrument no 11: motive 1
instrument no 12: motive 1
instrument no 13: motive 1
instrument no 14: motive 1
number of consecutive harmonies in the phrase: 1
harmonies: (G4)
currentHighestPossibleMotive: 1

Phrase Number: 2
phraseLength: 2 pulses
duration: ca. 1.67 seconds
timeAtBegOfPhrase: 1.67 secs (ca. 0:02")
timeAtEndOfPhrase: 3.33 secs (ca. 0:03")
number of simultaneous instruments in the phrase: 0
currentHighestPossibleMotive: 1

Phrase Number: 3
phraseLength: 4 pulses
duration: ca. 3.33 seconds
timeAtBegOfPhrase: 3.33 secs (ca. 0:03")
timeAtEndOfPhrase: 6.67 secs (ca. 0:07")
number of simultaneous instruments in the phrase: 24
chance of a new motive in any of the voices: 0.4791625
new motive in the phrase? YES
actual highest motive in the phrase: 2
span between actual highest motive and lowest possible in the phrase: 0
lowest possible motive in the phrase: 2
instrument no 1: motive 2
instrument no 2: motive 2
instrument no 3: motive 2
instrument no 4: motive 2
instrument no 5: motive 2
instrument no 6: motive 2
instrument no 7: motive 2
instrument no 8: motive 2
instrument no 9: motive 2

instrument no 10: motive 2
instrument no 11: motive 2
instrument no 12: motive 2
instrument no 13: motive 2
instrument no 14: motive 2
instrument no 15: motive 2
instrument no 16: motive 2
instrument no 17: motive 2
instrument no 18: motive 2
instrument no 19: motive 2
instrument no 20: motive 2
instrument no 21: NEW MOTIVE 2
instrument no 22: motive 2
instrument no 23: motive 2
instrument no 24: motive 2
number of consecutive harmonies in the phrase: 2
harmonies: (FS4 G4) (G4)
currentHighestPossibleMotive: 2

Phrase Number: 4
phraseLength: 1 pulses
duration: ca. 0.83 seconds
timeAtBegOfPhrase: 6.67 secs (ca. 0:07")
timeAtEndOfPhrase: 7.5 secs (ca. 0:08")
number of simultaneous instruments in the phrase: 10
chance of a new motive in any of the voices: 0.38539374
new motive in the phrase? NO
actual highest motive in the phrase: 1
span between actual highest motive and lowest possible in the phrase: 0
lowest possible motive in the phrase: 1
instrument no 1: motive 1
instrument no 2: motive 1
instrument no 3: motive 1
instrument no 4: motive 1
instrument no 5: motive 1
instrument no 6: motive 1
instrument no 7: motive 1
instrument no 8: motive 1
instrument no 9: motive 1
instrument no 10: motive 1
number of consecutive harmonies in the phrase: 2
harmonies: (G4) (BF4)
currentHighestPossibleMotive: 2

Phrase Number: 5
phraseLength: 5 pulses
duration: ca. 4.17 seconds
timeAtBegOfPhrase: 7.5 secs (ca. 0:08")
timeAtEndOfPhrase: 11.67 secs (ca. 0:12")
number of simultaneous instruments in the phrase: 21
chance of a new motive in any of the voices: 0.499975
new motive in the phrase? YES
actual highest motive in the phrase: 3
span between actual highest motive and lowest possible in the phrase: 0
lowest possible motive in the phrase: 3
instrument no 1: motive 3
instrument no 2: motive 3
instrument no 3: motive 3
instrument no 4: motive 3
instrument no 5: motive 3
instrument no 6: motive 3

Figure A.39: Example of the algorithm's output of empty structure for the orchestra piece.

A.5 Thriambos

A.5.1 Thriambos programming examples

```
;; soundfilelist
(define sndFileLst '(("trb2NaiffXPND.aiff" a4 0.9) ; inst 2
                    ("trb3NaiffXPND.aiff" e3 4.4) ; inst 3
                    ("trb4NaiffXPND.aiff" a4 1.2) ; inst 4
                    ("trb5NC.aiff" ds4 3.0) ; inst 5
                    ("trb14NaiffXPND.aiff" bf4 1.9) ; inst 6
                    ("trb15NaiffXPND.aiff" f4 4.8) ; inst 7
                    ("trb13NC.aiff" a3 2.1) ; inst 8
                    ("trb9NaiffXPND.aiff" as2 6.9))) ; inst 9
```

Figure A.40: Example of the sound list now required for the algorithm

```
;; automaticPitchEnvelopeMaker
(define (freqRat note1 note2)
  (loop for i from 0 below (length note2)
        collect (* (/ i (length note2)) 100)
        collect (/ (hertz (list-ref note2 i)) (hertz note1))))
```

Figure A.41: The new automatic pitch-envelope making function *freqRat*.

```
;; automaticPitchEnvelopeMaker
(define (freqRat note1 note2)
  (loop for i from 0 below (length note2)
        collect (* (/ i (length note2)) 100)
        collect (/ (hertz (list-ref note2 i)) (hertz note1))))
```

Figure A.42: The new automatic pitch-envelope making function *freqRat*.

```
(defun mot1 (inst strt end pchEnv ampScale)
  (let ((file "")
        (origPch 0)
        (fileDur 0))
    (set! file (list-ref (list-ref sndFileLst (- inst 2)) 0))
    (set! origPch (list-ref (list-ref sndFileLst (- inst 2)) 1))
    (set! fileDur (list-ref (list-ref sndFileLst (- inst 2)) 2))
    (smGrnEnv5 file strt end (* 0.45 ampScale)
               :rateEnv (freqRat origPch pchEnv) :pitchModDpthEnv '(0 0.0 50 0.0 100 0.0)
               :inpFilOffsetEnv '(0 0.0 100 ,fileDur) :inpOffsModEnv '(0 0.0 100 0.0)
               :grnLenEnv '(0 0.7 100 0.7) :grnLenModEnv '(0 0.0 100 0.0)
               :nextTimeLenEnv '(0 0.005 100 0.005) :ntLenModEnv '(0 0.05 100 0.05)
               :degreeEnv `(0 ,(*/ 360 8) (- inst 1)) 90 ,(*/ 360 8) (- inst 1))) :panModEnv '(0 0 100 360)
               :distanceEnv '(0 1.0 80 1.0) :revAmtEnv '(0 0.01 90 0.01)
               :overallAmpEnv (rhythDynEnvMakr '(q e ts ts ts s e. s s s s)
                                               '(ff niente mf mf mf mf niente niente f f niente))))
```

Figure A.43: An example of an algorithmic motive function using the new *freqRat*.

```

;; rhythmToTimeEnvelopeMaker
(define (rhythToTm rhythEnv)
  (let ((fullTm '())
        (querSum 0)
        (percRat 0)
        (tms '())
        (j 0))
    (set! fullTm (loop for i in rhythEnv collect
                      (rhythm i)))
    (loop for i in fullTm do
          (set! querSum (+ querSum i)))
    (set! percRat (/ 100 querSum))
    (set! tms (loop for i in fullTm collect
                   (* percRat i)))
    (loop for i in tms do
          (set! j (+ j i))
          collect j)))

;; rhythEnvPlusDynToTimEnvMaker
(define (rhythDynEnvMakr rhythEnv dynEnv)
  (let ((tms (rhythToTm rhythEnv)))
    (loop for i from 0 below (length tms)
          collect (list-ref tms i)
                  collect (amplitude (list-ref dynEnv i)))))

```

Figure A.44: The *rhythmToTimeEnvelopeMaker* and *rhythEnvPlusDynToTimEnvMaker* functions.

A.6 Interminable Delirium

A.6.1 Programming code excerpts from *Interminable Delirium*

```

(define (harmMotsStructBerio targetDuration pulseBasis tempoUnit metronomeMark numInsts
  strtPchList silence uppermostPch lowermostPch maxNumVox)

```

Figure A.45: The new arguments *uppermostPch*, *lowermostPch*, and *maxNumVox*.

```

(events (harmMotsStructBerio
  ;targetduration (mins)
  11
  ;pulsebasis
  1.0
  ;tempounit
  1.0
  ;metronomemark
  48
  ;numinsts
  6
  ;strtpchlst
  '(67)
  ;amount of silence
  .17
  ;uppermost pitch
  (keynum 'a4)
  ;lowermost pitch
  (keynum 'c2)
  ; maximum number of voices in a chord
  8
  ) "/Users/seanreed/Documents/compositionsProjects/newICCPiece/newICCPiece.midi" :versioning t :play nil)

```

Figure A.46: Example of running the algorithm with its new arguments.

A.7 More Than Is Wise

```
(define
  (harmMotsStructBerio targetDuration pulseBasis tempoUnit metronomeMark numInsts
    strtPchList silence uppermostPch lowermostPch maxNumVox overlapChance overlapNumPhrases
    outFileNames)
```

Figure A.47: New argument *fileNameOut*.

```
(events (harmMotsStructBerio
; targetDuration (mins)
; 5.0
; pulsebasis
; 1.0
; tempounit
; 1.0
; metronomemark
; 60
; numinsts
; 6
; strtPchList
; '(60)
; amount of silence
; 0.07
; uppermost pitch
; (keynum 'a6)
; lowermost pitch
; (keynum 'c2)
; maximum number of voices in a chord
; 6
; overlapChance
; .333
; overlapNumPhrases
; (+ 1 (random 2))
; fileNameOut
; "schJuly2009_1_b_lisp"
; "schJuly2009_1_b_midi"
; :versioning t
; :play nil)
```

Figure A.48: Running the algorithm with the new argument.

A.8 Imperishable Raptures

```
(defun mot1 (inst strt end pchEnv ampScale)
  (let ((file ""))
    (origPch 0)
    (fileDur 0))
  (set! file (list-ref (list-ref sndFileList (- inst (+ numAcousticInsts 1))) 0))
  (set! origPch (list-ref (list-ref sndFileList (- inst (+ numAcousticInsts 1))) 1))
  (set! fileDur (list-ref (list-ref sndFileList (- inst (+ numAcousticInsts 1))) 2))
  (smGrnEnv5 file strt end (* 0.45 ampScale))
  :rateEnv (freqAt origPch pchEnv) :pitchModDpthEnv '(0 0 0 50 0 100 0 0)
  :inpFltOffsetEnv '(0 0 0 100 ,(* 0.75 fileDur)) :inpOffsModEnv '(0 0 0 100 0 0)
  :grnLenEnv '(0 0 7 100 0 7) :grnLenModEnv '(0 0 0 100 0 0)
  :nextTimeLenEnv '(0 0 005 100 0 005) :mLenModEnv '(0 0 05 100 0 05)
  :degreeEnv '(0 ,(* (/ 360 numTotalInsts) (- inst (+ numAcousticInsts 1)))
    90 ,(* (/ 360 numTotalInsts) (- inst (+ numAcousticInsts 1))))
  :panModEnv '(0 0 100 360)
  :distanceEnv '(0 1.0 80 1.0) :revAmtEnv '(0 0 01 90 0 01)
  :overallAmpEnv (rhythDynEnvMakr '(q)
    '(f))))

(defun mot2 (inst strt end pchEnv ampScale)
  (let ((file ""))
    (origPch 0)
    (fileDur 0))
  (set! file (list-ref (list-ref sndFileList (- inst (+ numAcousticInsts 1))) 0))
  (set! origPch (list-ref (list-ref sndFileList (- inst (+ numAcousticInsts 1))) 1))
  (set! fileDur (list-ref (list-ref sndFileList (- inst (+ numAcousticInsts 1))) 2))
  (smGrnEnv5 file strt end (* 0.95 ampScale))
  :rateEnv (freqAt origPch pchEnv) :pitchModDpthEnv '(0 0 0 50 0 1 100 0 0)
  :inpFltOffsetEnv '(0 0 02 100 ,(* 0.95 fileDur)) :inpOffsModEnv '(0 0 0 100 0 0)
  :grnLenEnv '(0 0 13 100 0 13) :grnLenModEnv '(0 0 01 100 0 01)
  :nextTimeLenEnv '(0 0 11 100 0 11) :mLenModEnv '(0 0 01 100 0 01)
  :degreeEnv '(0 ,(* (/ 360 numTotalInsts) (- inst (+ numAcousticInsts 1)))
    90 ,(* (/ 360 numTotalInsts) (- inst (+ numAcousticInsts 1))))
  :panModEnv '(0 0 100 360)
  :distanceEnv '(0 1.0 80 1.0) :revAmtEnv '(0 0 01 90 0 01)
  :overallAmpEnv (rhythDynEnvMakr '(q)
    '(f))))
```

Figure A.49: Examples of the algorithmic motive functions for *Imperishable Raptures*.

A.9 *Wistling Dixie*

A.9.1 *Wistling Dixie* programming code excerpts

```
(define phraseLen-tab1  
  (make-ptable '((2 0.0759) (3 0.2207) (4 0.1931) (5 0.1172) (6 0.1310) (7 0.0414))))
```

Figure A.50: The shorter list of probable phrase lengths for *Wistling Dixie*.

B

Scores

B.1 ...all is noise...

...all is noise...

FULL SCORE (in C)

Sean Reed

(composed 2005 - 2006)

$\text{♩} = 60$

Temple Blocks

Piano

Violin

Violoncello

Contrabass

TB

Pno

Vln

Vlc

Cb

f *ff* *f* *f* *ff* *f* *f* *ff* *f*

p *mf* *ff* *mp* *mf* *p* *mf* *ff* *mp* *mf* *p* *mf* *ff* *mp* *mf*

Violin I (Vln I), Violin II (Vln II), Viola (Vla), Piano (Pno), Double Bass (Dbl)

Violin I (Vln I), Violin II (Vln II), Viola (Vla), Piano (Pno), Double Bass (Dbl)

7

Musical score for measures 7-8. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The key signature has three sharps (F#, C#, G#) and the time signature is 3/4. The dynamics for each instrument are: TB (ff, mp, pp, mf), Pno (ff, mp, pp, mf), Vln (ff, mp, pp, mf), Vlc (ff, mp, pp, mf), and Cb (ff, mp, pp, mf). Measure 7 contains sixteenth-note patterns in the upper staves and eighth-note patterns in the lower staves. Measure 8 features a triplet of eighth notes in the upper staves and a triplet of eighth notes in the lower staves.

9

Musical score for measures 9-12. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The key signature has three sharps (F#, C#, G#) and the time signature is 3/4. The dynamics for each instrument are: TB (p, mf, p, ff), Pno (p, mf, p, ff), Vln (p, mf, p, ff), Vlc (p, mf, p, ff), and Cb (p, mf, p, ff). Measure 9 contains sixteenth-note patterns in the upper staves and eighth-note patterns in the lower staves. Measure 10 features a triplet of eighth notes in the upper staves and a triplet of eighth notes in the lower staves. Measure 11 contains sixteenth-note patterns in the upper staves and eighth-note patterns in the lower staves. Measure 12 features a triplet of eighth notes in the upper staves and a triplet of eighth notes in the lower staves.

4

11

Score for measures 11-12. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The key signature is one sharp (F#) and the time signature is 3/4. The music features complex rhythmic patterns with many sixteenth and thirty-second notes. Dynamic markings include *pp*, *mf*, *p*, *f*, and *mf*. Fingerings and slurs are indicated throughout the staves.

13

Score for measures 13-14. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The key signature changes to two flats (Bb, Eb) and the time signature remains 3/4. The music continues with complex rhythmic patterns. Dynamic markings include *f*, *ff*, *f*, *p*, *mf*, and *p*. Fingerings and slurs are indicated throughout the staves.

15

Score for measures 15-16. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The TB part has dynamics *mp*, *p*, *mf*, *p*, and *f*. The Pno part has dynamics *mp*, *mf*, *p*, and *f*. The Vln part has dynamics *mp*, *mf*, *p*, and *f*. The Vlc part has dynamics *p*, *mp*, *mf*, *p*, and *mp*. The Cb part has dynamics *mp*, *mf*, *p*, and *f*. The music features various articulations such as slurs, accents, and triplets.

17

Score for measures 17-18. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The TB part has dynamics *mp*, *p*, *mf*, *p*, and *f*. The Pno part has dynamics *p*, *mf*, *p*, and *f*. The Vln part has dynamics *mp*, *pp*, *mf*, *p*, and *f*. The Vlc part has dynamics *pp*, *mf*, *p*, and *f*. The Cb part has dynamics *mp*, *pp*, *mf*, *p*, and *f*. The music features various articulations such as slurs, accents, and triplets.

6

19

Score for measures 19-20. The score includes five staves: TB (Tuba), Pno (Piano), Vln (Violin), Vlc (Viola), and Cb (Cello). The TB part features a rhythmic pattern of eighth notes with dynamic markings *p*, *f*, and *p*. The Pno part has a complex texture with chords and arpeggios. The Vln part has a melodic line with dynamics *p*, *f*, and *p*. The Vlc part has a melodic line with dynamics *mf*, *p*, *f*, and *p*. The Cb part has a melodic line with dynamics *p*, *f*, and *p*.

21

Score for measures 21-22. The score includes five staves: TB (Tuba), Pno (Piano), Vln (Violin), Vlc (Viola), and Cb (Cello). The TB part features a rhythmic pattern of eighth notes with dynamic markings *mf*, *pp*, and *f*. The Pno part has a complex texture with chords and arpeggios, including sixteenth-note patterns in the right hand. The Vln part has a melodic line with dynamics *mf*, *pp*, and *f*. The Vlc part has a melodic line with dynamics *mf*, *pp*, and *f*. The Cb part has a melodic line with dynamics *mf*, *pp*, and *f*.

23

Score for measures 23-24. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The TB part features a melodic line with dynamics *pp*, *mf*, *p*, *f*, and *p*. The Pno part has a complex texture with dynamics *pp*, *mf*, *p*, *f*, and *p*. The Vln part has dynamics *pp*, *mf*, *p*, *f*, and *p*. The Vlc part has dynamics *pp*, *mf*, *p*, *f*, and *p*. The Cb part has dynamics *pp*, *mf*, *p*, *f*, and *p*. There are various musical notations including slurs, ties, and articulation marks.

25

Score for measures 25-26. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The TB part features a melodic line with dynamics *mf*, *p*, and *f*. The Pno part has a complex texture with dynamics *mf*, *p*, and *f*. The Vln part has dynamics *mf*, *p*, and *f*. The Vlc part has dynamics *mf* and *f*. The Cb part has dynamics *mf*, *p*, and *f*. There are various musical notations including slurs, ties, and articulation marks.

8

Musical score for measures 27-28. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). Measure 27 features a dense texture with sixteenth-note patterns in the strings and piano, and a melodic line in the trombone. Dynamic markings include *ff*, *mf*, and *f*. Measure 28 continues the texture with similar dynamics. Rehearsal marks 11 and 12 are present.

Musical score for measures 29-30. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). Measure 29 features a dense texture with sixteenth-note patterns in the strings and piano, and a melodic line in the trombone. Dynamic markings include *p*, *f*, and *ff*. Measure 30 continues the texture with similar dynamics. Rehearsal mark 12 is present.

31

31

mf mp mf

Pno

Vln mf

Vlc mf

Cb mf

33

33

f pp Sua

Pno f pp mf

Vln f pp mf

Vlc f pp mf

Cb f pp mf

10

35

Score for measures 35-36. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The TB part features a melodic line with dynamics *mf*, *p*, *mf*, and *p*, including a triplet in measure 36. The Pno part has a complex accompaniment with dynamics *p*, *mf*, and *p*. The Vln part has a melodic line with dynamics *p*, *mf*, and *p*, including a triplet in measure 36. The Vlc part has a melodic line with dynamics *p*, *mf*, and *p*, including a triplet in measure 36. The Cb part has a melodic line with dynamics *p*, *mf*, and *p*.

37

Score for measures 37-40. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The TB part features a melodic line with dynamics *f*, *p*, *ff*, *mf*, and *p*, including a triplet in measure 37. The Pno part has a complex accompaniment with dynamics *f*, *p*, *ff*, *mf*, and *p*. The Vln part has a melodic line with dynamics *f*, *p*, *ff*, *mf*, and *p*, including a triplet in measure 37. The Vlc part has a melodic line with dynamics *f*, *p*, *ff*, *mf*, and *p*, including a triplet in measure 37. The Cb part has a melodic line with dynamics *f*, *p*, *ff*, *mf*, and *p*.

39

Score for measures 39-40. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The key signature has one sharp (F#) and the time signature is 3/4. Measure 39 features a dynamic of *f* (forte) across all parts. Measure 40 features a dynamic of *p* (piano) in the Pno, Vln, and Vlc parts, and *f* (forte) in the TB and Cb parts. Fingerings and articulations are indicated throughout.

41

Score for measures 41-42. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The key signature has one sharp (F#) and the time signature is 3/4. Measure 41 features a dynamic of *p* (piano) in the Pno, Vln, and Vlc parts, and *mf* (mezzo-forte) in the TB and Cb parts. Measure 42 features a dynamic of *ff* (fortissimo) in all parts. Fingerings and articulations are indicated throughout.

12

43

Score for measures 43-44. The score includes parts for TB (Tuba), Pno (Piano), Vln (Violin), Vlc (Viola), and Cb (Cello). The TB part features a complex rhythmic pattern with a 5-measure rest and a 6-measure rest, marked with *p* and *pp*. The Pno part has a 5-measure rest, marked with *p* and *pp*. The Vln part has a 3-measure rest, marked with *p* and *pp*. The Vlc and Cb parts have 3-measure rests, marked with *p* and *pp*. The key signature is B-flat major, and the time signature is 3/4.

45

Score for measures 45-46. The score includes parts for TB, Pno, Vln, Vlc, and Cb. The TB part has a 7-measure rest, marked with *mp*, *f*, *p*, *mf*, and *f*. The Pno part has a 9-measure rest, marked with *mp*, *f*, *p*, *mf*, and *f*. The Vln part has a 3-measure rest, marked with *mp*, *f*, *p*, *mf*, and *f*. The Vlc and Cb parts have 5-measure rests, marked with *mp*, *f*, *p*, *mf*, and *f*. The key signature is B-flat major, and the time signature is 3/4.

47

Score for measures 47-48. The score includes parts for TB, Pno, Vln, Vlc, and Cb. The key signature has one sharp (F#). The time signature is 7/8. The music features a complex rhythmic pattern with many eighth and sixteenth notes. Dynamics range from *p* to *mf*. The Pno part has a grand staff with both treble and bass clefs. The Vln, Vlc, and Cb parts have treble clefs. The TB part has a soprano clef. There are some slurs and accents throughout the passage.

49

Score for measures 49-50. The score includes parts for TB, Pno, Vln, Vlc, and Cb. The key signature has one sharp (F#). The time signature is 7/8. The music features a complex rhythmic pattern with many eighth and sixteenth notes. Dynamics range from *f* to *mp*. The Pno part has a grand staff with both treble and bass clefs. The Vln, Vlc, and Cb parts have treble clefs. The TB part has a soprano clef. There are some slurs and accents throughout the passage.

14

51

Score for measures 51-52. The score includes five staves: TB (Tuba), Pno (Piano), Vln (Violin), Vlc (Viola), and Cb (Cello). The music is in 7/8 time and features complex rhythmic patterns with many triplets. The dynamic marking *p* (piano) is present in all parts.

53

Score for measures 53-54. The score includes five staves: TB (Tuba), Pno (Piano), Vln (Violin), Vlc (Viola), and Cb (Cello). The music continues with complex rhythmic patterns and triplets. Dynamic markings include *f* (forte), *p* (piano), *mf* (mezzo-forte), and *ff* (fortissimo) across the different parts.

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59

Score for measures 59-60. The score includes parts for Tenor Bass (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The TB part features a rhythmic pattern of eighth notes with 'x' marks. The Pno part has a melodic line with dynamics *pp* and *p*. The Vln part has a melodic line with dynamics *pp* and *p*. The Vlc part has a melodic line with dynamics *pp* and *p*. The Cb part has a melodic line with dynamics *pp* and *p*. There are slurs and accents throughout the score.

61

Score for measures 61-62. The score includes parts for Tenor Bass (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The TB part features a rhythmic pattern of eighth notes with 'x' marks and dynamics *mf*. The Pno part has a melodic line with dynamics *pp* and *mf*. The Vln part has a melodic line with dynamics *pp* and *mf*. The Vlc part has a melodic line with dynamics *pp* and *mf*. The Cb part has a melodic line with dynamics *pp* and *mf*. There are slurs and accents throughout the score.

63

Score for measures 63-64. The score includes five staves: TB (Tuba), Pno (Piano), Vln (Violin), Vlc (Viola), and Cb (Cello). The music features dynamic markings of *p*, *mf*, *f*, *ff*, and *p*. The TB part has a triplet of eighth notes. The Pno part has a triplet of eighth notes in the right hand and a triplet of eighth notes in the left hand. The Vln part has a triplet of eighth notes. The Vlc part has a triplet of eighth notes. The Cb part has a triplet of eighth notes. The music is in 3/4 time and features a variety of rhythmic patterns and articulations.

65

Score for measures 65-66. The score includes five staves: TB (Tuba), Pno (Piano), Vln (Violin), Vlc (Viola), and Cb (Cello). The music features dynamic markings of *mf*, *p*, *mf*, *f*, and *ff*. The TB part has a triplet of eighth notes. The Pno part has a triplet of eighth notes in the right hand and a triplet of eighth notes in the left hand. The Vln part has a triplet of eighth notes. The Vlc part has a triplet of eighth notes. The Cb part has a triplet of eighth notes. The music is in 3/4 time and features a variety of rhythmic patterns and articulations.

18

67

67 68 69 70 71 72

6 10 12

TB Pno Vln Vcl Cb

p

Detailed description: This system of musical notation covers measures 67 to 72. It features five staves: Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vcl), and Contrabass (Cb). The TB staff contains a complex rhythmic pattern of sixteenth notes, with some notes marked with 'x'. The Pno staff has a treble and bass clef, with various chords and melodic lines. The Vln and Vcl staves show melodic lines with some slurs and accents. The Cb staff has a melodic line with some triplets. Dynamics include piano (*p*) and accents. Measure numbers 67, 68, 69, 70, 71, and 72 are indicated. Rehearsal marks 6, 10, and 12 are present above the TB staff. A '3' in a box is located at the end of the TB staff.

69

69 70 71 72

TB Pno Vln Vcl Cb

pp *f* *p* *f* *p*

pp *f* *mf* *p* *f*

pp *f* *mp* *p* *f*

pp *f* *mp* *p* *f*

pp *f* *mp* *p* *f*

Detailed description: This system of musical notation covers measures 69 to 74. It features five staves: Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vcl), and Contrabass (Cb). The TB staff has a melodic line with dynamics *pp*, *f*, *p*, *f*, and *p*. The Pno staff has a treble and bass clef with dynamics *pp*, *f*, *mf*, *p*, and *f*. The Vln and Vcl staves have melodic lines with dynamics *pp*, *f*, *mp*, *p*, and *f*. The Cb staff has a melodic line with dynamics *pp*, *f*, *mp*, *p*, and *f*. Dynamics are indicated throughout. Measure numbers 69, 70, 71, and 72 are indicated.

72

Score for measures 72-73. The score includes five staves: TB (Tenor Bass), Pno (Piano), Vln (Violin), Vlc (Viola), and Cb (Cello). The TB staff features a rhythmic pattern of eighth notes with 'x' marks, marked *pp* and *mp*. The Pno staff has a complex texture with arpeggiated chords, marked *p*, *mp*, and *pp*. The Vln and Vlc staves play melodic lines with slurs and triplets, marked *p* and *mp*. The Cb staff provides a bass line with slurs and triplets, marked *p* and *mp*.

74

Score for measures 74-75. The score includes five staves: TB, Pno, Vln, Vlc, and Cb. The TB staff continues with rhythmic patterns, marked *pp* and *p*. The Pno staff features arpeggiated figures and slurs, marked *p*. The Vln and Vlc staves play melodic lines with slurs and triplets, marked *pp* and *p*. The Cb staff provides a bass line with slurs and triplets, marked *pp* and *p*.

20

77

77

mf f mp f

Pno mf f mp f

Vln mf f mp f

Vlc mf f mp f

Cb mf f mp f

Detailed description: This system of music covers measures 77 to 80. The tuba (TB) part features a complex rhythmic pattern with a five-measure rest at the start of measure 77, followed by eighth notes and sixteenth notes. Dynamics are *mf*, *f*, *mp*, and *f*. The piano (Pno) part has a similar rhythmic structure with chords and triplets. Dynamics are *mf*, *f*, *mp*, and *f*. The violin (Vln) and viola (Vlc) parts play melodic lines with slurs and triplets. Dynamics are *mf*, *f*, *mp*, and *f*. The cello (Cb) part also features melodic lines with slurs and triplets. Dynamics are *mf*, *f*, *mp*, and *f*.

79

79

p f mp

Pno p f mp

Vln p f mp

Vlc p f mp

Cb p f mp

Detailed description: This system of music covers measures 79 to 82. The tuba (TB) part begins with a five-measure rest in measure 79, followed by eighth notes and sixteenth notes. Dynamics are *p*, *f*, and *mp*. The piano (Pno) part continues with chords and triplets. Dynamics are *p*, *f*, and *mp*. The violin (Vln) and viola (Vlc) parts play melodic lines with slurs and triplets. Dynamics are *p*, *f*, and *mp*. The cello (Cb) part also features melodic lines with slurs and triplets. Dynamics are *p*, *f*, and *mp*.

81

81

TB

Pno

Vln

Vlc

Cb

pp

p

pp

p

pp

pp

Detailed description: This system of musical notation covers measures 81 to 83. It features five staves: Tubular Bell (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The TB part consists of rhythmic patterns with some grace notes. The Pno part has a complex texture with triplets and dynamic markings of *pp* and *p*. The Vln and Vlc parts play melodic lines with triplets and dynamic markings of *pp* and *p*. The Cb part provides a bass line with triplets and dynamic markings of *pp* and *p*.

83

83

TB

Pno

Vln

Vlc

Cb

f

p

f

f

f

p

f

Detailed description: This system of musical notation covers measures 83 to 85. It features five staves: Tubular Bell (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The TB part has a rhythmic pattern with dynamic markings of *f* and *p*. The Pno part has a complex texture with triplets and dynamic markings of *f* and *p*. The Vln and Vlc parts play melodic lines with triplets and dynamic markings of *f* and *p*. The Cb part provides a bass line with triplets and dynamic markings of *p* and *f*.

Musical score for measures 83-85. The score is written for Oboe (Ob), Violin I (VI), Violin II (VIA), Piano (Pno), and Trombone (TB). The key signature is one sharp (F#) and the time signature is 4/4. The music features dynamic markings of *f* (forte) and *ff* (fortissimo), and articulation markings of *acc* (accents). The Oboe, Violin I, and Violin II parts have melodic lines with slurs and accents. The Piano part provides harmonic support with chords and moving lines. The Trombone part has a rhythmic pattern of eighth notes.

Musical score for measures 86-88. The score is written for Oboe (Ob), Violin I (VI), Violin II (VIA), Piano (Pno), and Trombone (TB). The key signature is one sharp (F#) and the time signature is 4/4. The music features dynamic markings of *f* (forte) and *ff* (fortissimo), and articulation markings of *acc* (accents). The Oboe, Violin I, and Violin II parts have melodic lines with slurs and accents. The Piano part provides harmonic support with chords and moving lines. The Trombone part has a rhythmic pattern of eighth notes.

90

TB *mf* *p* *f*
 Pno *mf* *p* *f*
 Vln *mf* *p* *f* *p*
 Vlc *mf* *p* *f*
 Cb *mf* *p* *f*

92

TB *p* *f* *pp*
 Pno *p* *mf* *f* *pp*
 Vln *mf* *f* *pp*
 Vlc *p* *mf* *f* *pp*
 Cb *p* *mf* *f* *pp*

24

94

94

11

pp *ff*

Pno

Vln

Vlc

Cb

ff

ff

9 7 3 5 3

96

96

mp *pp* *mf*

Pno

Vln

Vlc

Cb

mp *pp* *mf*

3 5 6 10

98

Musical score for measures 98-99. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The music features complex rhythmic patterns with triplets and sixteenth notes. Dynamics range from *f* (forte) to *p* (piano) and *mf* (mezzo-forte). The piano part has a dense texture with sixteenth-note runs and chords. The strings play a rhythmic accompaniment with some melodic lines.

100

Musical score for measures 100-102. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The music continues with complex rhythmic patterns. Dynamics range from *f* (forte) to *pp* (pianissimo). The piano part features a very dense texture of sixteenth notes in the left hand and chords in the right hand. The strings continue their rhythmic accompaniment.

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106

Score for measures 106-108. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The TB part features a melodic line with dynamics *f*, *p*, *mp*, *f*, *mp*, and *p*. The Pno part has a complex texture with dynamics *f*, *p*, *mp*, *f*, and *mp*. The Vln part has dynamics *f*, *p*, *mp*, *f*, and *mp*. The Vlc part has dynamics *f*, *p*, *mp*, *f*, and *mp*. The Cb part has dynamics *f*, *p*, *mp*, *f*, and *mp*. The measures contain various musical notations including slurs, accents, and dynamic markings.

109

Score for measures 109-111. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The TB part features a melodic line with dynamics *mp*, *p*, *mp*, *p*, and *mf*. The Pno part has a complex texture with dynamics *p*, *mp*, *p*, and *mf*. The Vln part has dynamics *p*, *mp*, *p*, and *mf*. The Vlc part has dynamics *p*, *mf*, and *p*. The Cb part has dynamics *p*, *mp*, *p*, and *mf*. The measures contain various musical notations including slurs, accents, and dynamic markings.

28

111

Score for measures 111-112. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The key signature has two flats (B-flat and E-flat). The time signature is 7/8. Measure 111 features a dynamic range from *p* to *ff*. Measure 112 features a dynamic range from *p* to *mp*. The Pno part includes a sixteenth-note triplet in measure 111 and a sixteenth-note sextuplet in measure 112. The Vln part includes a triplet in measure 111. The Vlc and Cb parts include triplets in measure 112.

113

Score for measures 113-114. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The key signature has two flats (B-flat and E-flat). The time signature is 7/8. Measure 113 features a dynamic range from *f* to *pp*. Measure 114 features a dynamic range from *f* to *pp*. The Pno part includes a sixteenth-note triplet in measure 113 and a sixteenth-note triplet in measure 114. The Vln part includes a triplet in measure 113. The Vlc and Cb parts include triplets in measure 113.

Musical score for measures 115-120. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The music features dynamic markings of *mf*, *p*, and *f*. Measure numbers 7, 9, 10, and 12 are indicated above the staves. The piano part includes a 9-measure rest in measure 115 and a 12-measure rest in measure 116. The violin part includes a 10-measure rest in measure 115. The viola part includes a 7-measure rest in measure 115 and a 5-measure rest in measure 116. The cello part includes a 6-measure rest in measure 115 and a 3-measure rest in measure 116.

Musical score for measures 116-120. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The music features dynamic markings of *p* and *mp*. Measure numbers 3 and 7 are indicated above the staves. The piano part includes a 3-measure rest in measure 116 and a 7-measure rest in measure 117. The violin part includes a 3-measure rest in measure 116 and a 7-measure rest in measure 117. The viola part includes a 3-measure rest in measure 116 and a 7-measure rest in measure 117. The cello part includes a 3-measure rest in measure 116 and a 7-measure rest in measure 117.

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118

Musical score for measures 118-120. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). Dynamics range from *f* to *mf*. The score features complex rhythmic patterns and articulation marks.

120

Musical score for measures 120-124. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). Dynamics range from *pp* to *p*. The score features complex rhythmic patterns and articulation marks.

123

Score for measures 123-124. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The TB part features sixteenth-note patterns with accents and dynamic markings *mf* and *p*. The Pno part has a dense texture with ten-note runs in both hands, marked *mf* and *p*. The Vln part has a melodic line with accents and dynamic markings *mf* and *p*. The Vlc part has a melodic line with a triplet and dynamic markings *mf* and *p*. The Cb part has a melodic line with a triplet and dynamic markings *mf* and *p*.

125

Score for measures 125-126. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The TB part has a melodic line with accents and dynamic markings *f* and *p*. The Pno part has a melodic line with accents and dynamic markings *f* and *p*. The Vln part has a melodic line with accents and dynamic markings *f* and *p*. The Vlc part has a melodic line with accents and dynamic markings *f* and *p*. The Cb part has a melodic line with a triplet and dynamic markings *f* and *p*.

Musical score for measures 126-129. The score includes parts for Ctrb, VI, Vln, Pno, and Tuba. Dynamic markings include *ff*, *fu*, and *f*. The music features complex rhythmic patterns and articulation marks.

129

Musical score for measures 127-130. The score includes parts for Ctrb, VI, Vln, Pno, and Tuba. Dynamic markings include *ff*, *fu*, and *f*. The music features complex rhythmic patterns and articulation marks.

127

131

Score for measures 131-132. The instruments are TB, Pno, Vln, Vlc, and Cb. The TB part features a melodic line with accents and a dynamic marking of *p*. The Pno part consists of chords with triplets and a dynamic marking of *f*. The Vln part has a melodic line with triplets and a dynamic marking of *p*. The Vlc part has a rhythmic accompaniment with triplets and a dynamic marking of *f*. The Cb part has a melodic line with triplets and a dynamic marking of *f*.

133

Score for measures 133-134. The instruments are TB, Pno, Vln, Vlc, and Cb. The TB part features a melodic line with accents, a dynamic marking of *f*, and a quintuplet. The Pno part consists of chords with triplets and dynamic markings of *p* and *f*. The Vln part has a melodic line with triplets and dynamic markings of *p* and *f*. The Vlc part has a rhythmic accompaniment with triplets and dynamic markings of *f* and *p*. The Cb part has a melodic line with triplets and dynamic markings of *f* and *p*.

34

135

Score for measures 135-137. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The TB part features a rhythmic pattern of eighth notes with dynamic markings *mp*, *mf*, *f*, and *mp*. The Pno part has a complex texture with triplets and dynamic markings *mp*, *p*, *mf*, *f*, and *mp*. The Vln part has a fast sixteenth-note passage with dynamic markings *mp*, *p*, *mf*, *f*, and *mp*. The Vlc and Cb parts have a similar rhythmic pattern with dynamic markings *mp*, *p*, *mf*, *f*, and *mp*.

138

Score for measures 138-140. The score includes parts for Trombone (TB), Piano (Pno), Violin (Vln), Viola (Vlc), and Cello (Cb). The TB part has a complex rhythmic pattern with dynamic markings *pp* and *mp*. The Pno part has a complex texture with triplets and dynamic markings *pp* and *mp*. The Vln part has a fast sixteenth-note passage with dynamic markings *pp* and *mp*. The Vlc and Cb parts have a similar rhythmic pattern with dynamic markings *pp* and *mp*.

Musical score for measures 140-142, featuring five staves: TB (Trumpet B), Pno (Piano), Vln (Violin), Vlc (Viola), and Cb (Cello). The score is in 3/4 time and includes dynamic markings (*pp*, *mf*, *mp*) and articulation (trills, slurs, and triplets). Measure 140 shows a trill in the TB part, followed by a *mf* section. Measure 141 features a *mp* section with a sixteenth-note pattern in the Pno and Vln parts. Measure 142 concludes with a *pp* section. The Pno part includes a sixteenth-note pattern in the right hand and a triplet in the left hand. The Vln and Vlc parts feature a sixteenth-note pattern in the right hand and a triplet in the left hand. The Cb part features a sixteenth-note pattern in the right hand and a triplet in the left hand.

B.2 Flying Instants

```
(with-sound (:channels 2
            :header-type mus-aiff
            :data-format mus-b24int
            :srate 48000
            :output "becket3sndTst48k24bStereo.aiff"
            :scaled-to 0.95
            :reverb freeverb :decay-time 2.0
            :statistics t :play nil)

;;
;;
;; SECTION I
;;
;;
;;

; I.1 - 1a
(001a 0.000 3.308 0.90)

; I.2 - 2a, 3a
(002a 3.308 5.789 0.85)
(003a 3.308 5.789 0.85)

; I.3 - 2a, 3a, 4a
(002a 5.789 8.270 0.85)
(003a 5.789 8.270 0.85)
(004a 5.789 8.270 0.85)

; I.4 - 5a
(005a 8.270 9.097 0.95)

; I.5 - 5b
(005b 9.097 9.924 0.95)

; I.6 - 6a
(006a 9.924 11.578 0.95)

; I.7 - 5c, 3b
(005c 11.578 14.059 0.95)
(003b 11.578 14.059 0.95)
```

Figure B.1: Segment of the script score for *Flying Instants*

B.3 Words Like Smoke

B.3.1 Score of Words Like Smoke

Words Like Smoke Sean Reed

$\text{♩} = 84$

Violin

Viola

Violoncello

Vln.

Vla.

Vc.

arco

pizz.

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2

11

Vln. *f* *ff* *p*

Vla. *f* 6 6 3 6 *ff* *p*

Vc. *f* 5 5 5 *ff* *p*

Detailed description: This system contains measures 11 and 12. Measure 11 is in 4/4 time. The Violin part features a series of sixteenth-note runs starting with a forte (*f*) dynamic, reaching fortissimo (*ff*) in the middle, and ending with a piano (*p*) dynamic. The Viola part has a similar texture with sixteenth-note runs, marked with dynamics *f*, *ff*, and *p*, and includes a triplet of sixteenth notes. The Violoncello part also has sixteenth-note runs, marked with dynamics *f*, *ff*, and *p*, and includes a triplet of sixteenth notes.

12

Vln. *f* *p* *mf* *f* *pizz.* *arco* *f* *p*

Vla. *f* 3 *p* *mf* *f* *pizz.* 3 *arco* *f* 3 *p*

Vc. *f* *p* *mf* *f* *pizz.*

Detailed description: This system contains measures 13 and 14. Measure 13 is in 3/4 time. The Violin part has dynamics *f*, *p*, *mf*, *f*, and includes a pizzicato (*pizz.*) section followed by an arco section with dynamics *f* and *p*. The Viola part has dynamics *f*, *p*, *mf*, *f*, and includes a triplet of sixteenth notes, a pizzicato (*pizz.*) section with a triplet, and an arco section with dynamics *f* and a triplet of sixteenth notes. The Violoncello part has dynamics *f*, *p*, *mf*, and *f*, and includes a pizzicato (*pizz.*) section.

15

Vln. *pizz.* *p*

Vla. *p* *pizz.*

Vc. *arco* *f* *p* *mf* *p* *f* *pizz.*

Detailed description: This system contains measures 15 and 16. Measure 15 is in 4/4 time. The Violin part is mostly silent, with a pizzicato (*pizz.*) section in measure 16 marked with a piano (*p*) dynamic. The Viola part is also mostly silent, with a pizzicato (*pizz.*) section in measure 16 marked with a piano (*p*) dynamic. The Violoncello part has dynamics *f*, *p*, *mf*, *p*, and *f*, and includes an arco section in measure 15 and a pizzicato (*pizz.*) section in measure 16.

18

Vln. -

Vla. -

Vc. *arco* *mp* *p*

Detailed description: This system contains measures 17 and 18. Measure 17 is in 4/4 time. The Violin and Viola parts are silent. The Violoncello part has dynamics *mp* and *p*, and includes an arco section in measure 17 and a triplet of sixteenth notes in measure 18.

19

Vln. arco *f* *p* 3

Vla. arco *f* 3 3 3 *p* 6

Vc. *f* *p* *mf* *p* *pizz.* *f*

21

Vln. *f* *p* *ff* *p* *pizz.* *f*

Vla. *f* 3 *p* *ff* *p* *f* *ff* *p*

Vc. *f* 5 *p* *ff* *p*

23

Vln. arco *p* *f* 3

Vla.

Vc. *p* *f* *p* *f* 3

25

Vln. *f* *pizz.* 3 *p*

Vla. *p* *pizz.*

Vc. *p*

4

26

Vln. *f* *f* *ff* *p*

Vla. *f* *f* *f* *f* *pizz.*

Vc. *f* *f* *f* *f*

30

Vln. *mp* *p*

Vla. *p* *pizz.*

Vc. *p*

32

Vln. *f* *p*

Vla. *pizz.* *f* *p*

Vc. *p*

34

Vln. *f* *mf* *f* *p*

Vla. *pizz.* *f* *p* *f* *p*

Vc. *f* *p* *ff* *p*

37

Vln. *mp* *p* *f* *p* *ff* *p*

Vla. *mp* 6 *p* *f* 3 *p* *ff* *p*

Vc. *mp* 5 *p* *f* 5 *p* *ff* *p*

40

Vln. *p* *f* *p* *f*

Vla. *pizz.* *p* 3 *f* *p* 3 *f* 3

Vc. *p* *f* *p* *f*

43

Vln. *mp* *p* *f* *p*

Vla. *p* *f* *p* *f* 3 *p*

Vc. *p* 3 *f* *p* 5 *f* 3 *p*

44

Vln. *p* *f* *p* 7:8 *f* 10:8

Vla. *p* 3 *f* *p* 5 *f* 3 *f*

Vc. *p* *f* *p* *f* 3 *p* *f* 3

6

47

Vln. *f* *p* *f* *f* *ff* *p*

Vla. *f* *p* *f* *f* *ff* *p*

Vc. *f* *ff* *f* *p* *ff* *p*

50

Vln. *f* *p* *ff* *p* *f* *mf* *f*

Vla. *f* *p* *ff* *p* *f* *p* *ff* *p*

Vc. *f* *p* *ff* *p* *f* *p* *ff* *p*

52

Vln. *f* *ff* *p*

Vla. *pp* *norm* *f*

Vc. *pp* *(norm.) pizz.* *p*

56

Vln. *f* *p*

Vla. *f* *p*

Vc. *p*

59 *sul pont.*
Vln. *pp*
Vla. *sul pont.*
Vc. *arco*
f *ff* *p*

61 *norm.*
Vln. *f* *p* *ff* *p* *f* *ff* *p*
Vla. *norm.*
f *p* *ff* *p* *f* *p* *ff* *p*
Vc. *f* *p* *ff* *p* *f* *p* *ff* *p*

63
Vln. *mp* *p*
Vla. *mp* *p*
Vc. *mp* *p*

65
Vln. *mf*
Vla. *mf*
Vc. *p* *f* *p* *f*

8

66

Vln. *f* *ff* *p* sul pont.
Vla. *pp* sul pont.
Vc. *pp*

Detailed description: This system covers measures 66 and 67. The Violin part (Vln.) starts with a forte (*f*) dynamic, followed by fortissimo (*ff*) and piano (*p*). It includes a trill in measure 67. The Viola (Vla.) and Violoncello (Vc.) parts are marked *pp* (pianissimo) and play sul ponticello (sul pont.).

68

Vln. *f* *p* *mf* *3* *p* *<f* pizz. arco *f*
Vla. *f* *p* *f* *p* *f* *3*
Vc. *f* *3* *p* *3* *6* *f* *3* *p* *3* *6* *f*

Detailed description: This system covers measures 68, 69, and 70. The Violin part (Vln.) has dynamics *f*, *p*, *mf*, and *p*, with a trill in measure 69. It switches from pizzicato (pizz.) to arco in measure 70. The Viola (Vla.) and Violoncello (Vc.) parts have dynamics *f* and *p*. The Vc. part includes triplet and sextuplet markings.

71

Vln. *f* *p* *ff* *p* sul pont. *pp*
Vla. *p* *<f* *p* *f*
Vc. *pp*

Detailed description: This system covers measures 71, 72, 73, and 74. The Violin part (Vln.) has dynamics *f*, *p*, *ff*, and *p*. It plays sul ponticello (sul pont.) in measures 73 and 74. The Viola (Vla.) has dynamics *p*, *f*, and *p*. The Violoncello (Vc.) part is marked *pp*.

75

Vln. norm. *p* *f*
Vla. *f* *p*
Vc. norm. *mf* *3* pizz. *p*

Detailed description: This system covers measures 75, 76, 77, and 78. The Violin part (Vln.) has dynamics *p* and *f*. The Viola (Vla.) has dynamics *f* and *p*. The Violoncello (Vc.) part has dynamics *mf* and *p*, with a triplet in measure 75 and pizzicato (pizz.) in measure 77.

77

Vln. $\frac{2}{4}$ $\frac{2}{4}$ $\frac{2}{4}$ $\frac{6}{4}$

Vla. $\frac{2}{4}$ $\frac{2}{4}$ $\frac{2}{4}$ $\frac{6}{4}$

Vc. $\frac{2}{4}$ $\frac{2}{4}$ $\frac{2}{4}$ $\frac{6}{4}$

p \leftarrow *f* *p* *f*

80

Vln. $\frac{6}{4}$ $\frac{6}{4}$ $\frac{6}{4}$ $\frac{6}{4}$

Vla. $\frac{6}{4}$ $\frac{6}{4}$ $\frac{6}{4}$ $\frac{6}{4}$

Vc. $\frac{6}{4}$ $\frac{6}{4}$ $\frac{6}{4}$ $\frac{6}{4}$

pizz. *p* *p* *p* *arco* *f*

arco *mp* *p* *f* *6*

84

Vln. $\frac{6}{4}$ $\frac{6}{4}$ $\frac{6}{4}$ $\frac{6}{4}$

Vla. $\frac{6}{4}$ $\frac{6}{4}$ $\frac{6}{4}$ $\frac{6}{4}$

Vc. $\frac{6}{4}$ $\frac{6}{4}$ $\frac{6}{4}$ $\frac{6}{4}$

pizz. *p* *p* *p* *arco* *p* \leftarrow *f*

86

Vln. $\frac{6}{4}$ $\frac{6}{4}$ $\frac{6}{4}$ $\frac{6}{4}$

Vla. $\frac{6}{4}$ $\frac{6}{4}$ $\frac{6}{4}$ $\frac{6}{4}$

Vc. $\frac{6}{4}$ $\frac{6}{4}$ $\frac{6}{4}$ $\frac{6}{4}$

f \leftarrow *p* *arco* *f* *3* *p* *mf* \leftarrow *p* *3* *p* *3* *p* *f*

10

88 *pizz.*

Vln. *p*

Vla. *p* *f* *p*

Vc. *mp*

Measures 88-89: Violin (Vln.) plays a melody with a *pizz.* marking and a *p* dynamic. Viola (Vla.) and Violoncello (Vc.) play accompaniment with dynamics *p*, *f*, and *p*. Triplet markings are present in measures 88 and 89.

89

Vln. *p*

Vla. *f* *ff*

Vc. *p*

Measures 89-90: Violin (Vln.) continues with a *p* dynamic. Viola (Vla.) has dynamics *f* and *ff*. Violoncello (Vc.) has a *p* dynamic. Measure 90 ends with a time signature change to 3/4.

91 *arco*

Vln. *f* *p* *ff* *p*

Vla. *f* *p* *ff* *p*

Vc. *f* *p* *ff* *p*

Measures 91-92: Violin (Vln.) plays *arco* with dynamics *f*, *p*, *ff*, and *p*. Viola (Vla.) and Violoncello (Vc.) also have dynamics *f*, *p*, *ff*, and *p*. Measure 92 ends with a time signature change to 7/4.

93

Vln. *f* *p* *ff* *p* *mp*

Vla. *f* *p* *ff* *p* *pizz.* *f* *arco*

Vc. *f* *p* *ff* *p* *mp*

Measures 93-96: Violin (Vln.) has dynamics *f*, *p*, *ff*, *p*, and *mp*. Viola (Vla.) has dynamics *f*, *p*, *ff*, *p*, *pizz.*, *f*, and *arco*. Violoncello (Vc.) has dynamics *f*, *p*, *ff*, *p*, and *mp*. Measure 96 ends with a time signature change to 8/4.

98

Vln. *mf* sul pont. *norm.*

Vla. *pp* *mp*

Vc. *p*

100

Vln. *f* *p*

Vla. *p* *p*

Vc. *mp* *p*

101

Vln. *p* *f* *p* *f*

Vla. *p* *f* *p* *f*

Vc. *p* *f* *p* *f*

102

Vln. *mf* *p* *f* *p* *f* *p* *ff* *p*

Vla. *p*

Vc. *p*

105

Vln. *f* *ff* *p*

Vla. *f* *ff* *p*

Vc. *f* *ff* *p*

Detailed description: This musical score page contains five systems of music for Violin (Vln.), Viola (Vla.), and Violoncello (Vc.). The first system (measures 98-100) is in 8/4 time. The violin part starts with a melody marked *mf* and *sul pont.*, followed by a *norm.* section. The viola and cello parts provide accompaniment with dynamics *pp* and *mp*. The second system (measures 100-101) is in 6/4 time, featuring a *f* dynamic in the violin and *p* in the viola and cello. The third system (measures 101-102) is in 10/4 time, with dynamic contrasts between *p* and *f*. The fourth system (measures 102-103) is in 12/4 time, showing a range of dynamics from *mf* to *ff*. The fifth system (measures 103-105) is in 3/4 time, with a *f* dynamic in the violin and *ff* in the viola and cello. The score includes various musical notations such as slurs, accents, and triplets.

12

108

Vln. *p* *f* *f* *p* *mf* *p* *f* *pizz.*

Vla. *f* *pizz.* *mf* *p* *f* *p* *f* *p*

Vc. *p*

Measures 108-112. Violin: *p* *f* *f* *p* *mf* *p* *f* *pizz.* Violin: *f* *pizz.* *mf* *p* *f* *p* *f* *p*. Viola: *f* *pizz.* *mf* *p* *f* *p* *f* *p*. Violoncello: *p*. Measure 108 has a 3-measure rest. Measure 112 has a 3-measure rest.

112

Vln. *arco* *mp* *p*

Vla. *f* *arco* *ff* *p*

Vc. *mp* *f* *p*

Measures 112-113. Violin: *arco* *mp* *p*. Viola: *f* *arco* *ff* *p*. Violoncello: *mp* *f* *p*. Measure 112 has a 6-measure rest. Measure 113 has a 3-measure rest.

113

Vln. *mp*

Vla. *mp*

Vc. *p*

Measures 113-116. Violin: *mp*. Viola: *mp*. Violoncello: *p*. Measure 113 has a 6-measure rest. Measure 114 has a 3-measure rest. Measure 115 has a 3-measure rest. Measure 116 has a 3-measure rest.

116

Vln. *mf* *pp* *pp*

Vla. *mf* *pp* *mf*

Vc. *pizz.* *pp* *arco* *mf* *pizz.*

Measures 116-120. Violin: *mf* *pp* *pp*. Viola: *mf* *pp* *mf*. Violoncello: *pizz.* *pp* *arco* *mf* *pizz.*. Measure 116 has a 3-measure rest. Measure 117 has a 3-measure rest. Measure 118 has a 3-measure rest. Measure 119 has a 3-measure rest. Measure 120 has a 3-measure rest.

119

Vln. *mp* *p* *f* *p*

Vla. *mp* *p*

Vc. *f* *ff* *p* *p*

Measures 119-120. Violin: *mp* (measures 119-120), *p* (measure 120), *f* (measure 120), *p* (measure 120). Viola: *mp* (measures 119-120), *p* (measure 120). Violoncello: *f* (measures 119-120), *ff* (measure 120), *p* (measure 120), *p* (measure 120). Triplet markings are present in measures 119 and 120.

121

Vln. *p* *f* *mf* *p* *f* *p* *f* *p* *ff* *p*

Vla. *pizz.* *p* *arco* *mf* *p* *f* *p* *f* *p* *f*

Vc. *f* *p* *mf* *p* *f* *p* *f* *p* *f*

Measures 121-124. Violin: *p* (121), *f* (121), *mf* (122), *p* (122), *f* (122), *p* (122), *f* (123), *p* (123), *f* (123), *p* (123), *ff* (124), *p* (124). Viola: *pizz.* (121), *p* (121), *arco* (122), *mf* (122), *p* (122), *f* (122), *p* (122), *f* (123), *p* (123), *f* (123), *p* (123). Violoncello: *f* (121), *p* (121), *mf* (122), *p* (122), *f* (122), *p* (122), *f* (123), *p* (123), *f* (123), *p* (123). Triplet markings are present in measures 121, 122, 123, and 124.

125

Vln. *p*

Vla. *f* *p* *ff* *p* *p*

Vc. *f* *p* *ff* *p* *p*

Measures 125-128. Violin: *p* (measures 125-128). Viola: *f* (125), *p* (125), *ff* (125), *p* (125), *p* (126). Violoncello: *f* (125), *p* (125), *ff* (125), *p* (125), *p* (126). Triplet markings are present in measures 125, 126, 127, and 128.

129

Vln. *f* *ff* *p* *f* *p*

Vla. *mf* *mf* *mf*

Vc. *mf*

Measures 129-132. Violin: *f* (129), *ff* (129), *p* (129), *f* (130), *p* (130). Viola: *mf* (130), *mf* (130), *mf* (130). Violoncello: *mf* (130). Triplet markings are present in measures 129, 130, 131, and 132.

14

132

Vln. *f* *p* *f* *p* *<f>* *p* *<f>* *p*

Vla. *f* *p* *f* *p*

Vc. *f* *p* *f* *p*

135

Vln. *pp*

Vla. *pp* *mp*

Vc. *p* *f* *p* *f*

139

Vln. *mp* *p*

Vla. *mp*

Vc. *pizz.* *mp*

141

Vln. *mf* *p*

Vla. *mf* *p*

Vc. *p*

143

Vln. *mf* *p* *f* *p* *<f* *p*

Vla. *sul pont.* *norm.*

Vc. *pp* *p* *f* *p* *f* *mf* 3

145

Vln. *pp*

Vla. *f* *p* *mf* *p* *<f* *pizz.* 3

Vc. *f* 3 *mf* 5 *p* *<f* *pizz.* 3

148

Vln. *mf* *p* *f* *p* *<f* *p* *ff*

Vla. *arco* *mf* 3 3 3 (pizz.)

Vc. *p*

151

Vln. *p* *f* *p* *f*

Vla. *p* *f* 3 3 *p* *f*

Vc. *p* *f* 3 3 *p* *f*

16

154

Vln. *f* *p* *mf* *5* *3* *f* pizz.

Vla. *p* arco *mp* *3* *p*

Vc. *p* *3* *f* *p* *mf* *p* *f* pizz.

Measures 154-155. Violin: *f* *p* *mf* *5* *3* *f* pizz. Viola: *p* arco *mp* *3* *p*. Violoncello: *p* *3* *f* *p* *mf* *p* *f* pizz.

156

Vln. arco *f* *3* *3* *3* *3* *p* *3* *3* *6*

Vla. *f* arco *3* *p*

Vc. *f* *p* *5* *5*

Measures 156-157. Violin: arco *f* *3* *3* *3* *3* *p* *3* *3* *6*. Viola: *f* arco *3* *p*. Violoncello: *f* *p* *5* *5*.

157

Vln. *mp* *p* *pp*

Vla. *mp* *6* *6* *3* *3* *p* *mp*

Vc. *mp* *5* *5* *3* *3* *3* *3* *p*

Measures 158-160. Violin: *mp* *p* *pp*. Viola: *mp* *6* *6* *3* *3* *p* *mp*. Violoncello: *mp* *5* *5* *3* *3* *3* *3* *p*.

160

Vln. *f* *p* *ff* *p*

Vla. *f* *ff* *3* *p* *mf* *3*

Vc. *f* *p* *ff* *p* *p*

Measures 161-163. Violin: *f* *p* *ff* *p*. Viola: *f* *ff* *3* *p* *mf* *3*. Violoncello: *f* *p* *ff* *p* *p*.

164

Vln. *p* *f* *p* *mf* *p* *f* pizz.

Vla. *p*

Vc. *f* *ff* *p*³

166 arco

Vln. *f* *p* *mf* *p* *f*

Vla. *f* *p* *mf* *p* *f*

Vc. *f* *mf* *p* *f*

Detailed description: This page contains two systems of musical notation for Violin (Vln.), Viola (Vla.), and Violoncello (Vc.). The first system, starting at measure 164, features a 2/4 time signature. The Violin part begins with a piano (*p*) dynamic and includes trills and triplets, ending with a pizzicato (*pizz.*) instruction. The Viola part starts with a piano (*p*) dynamic. The Violoncello part begins with a forte (*f*) dynamic and includes a fortissimo (*ff*) section and a triplet (*p*³). The second system, starting at measure 166, is marked 'arco' and features a 3/4 time signature. The Violin part starts with a forte (*f*) dynamic and includes a piano (*p*) section. The Viola part starts with a forte (*f*) dynamic and includes a piano (*p*) section. The Violoncello part starts with a forte (*f*) dynamic and includes a mezzo-forte (*mf*) section. Dynamics and articulations like *mf*, *f*, and *p* are used throughout both systems.

B.4 Thriambos

B.4.1 Thriambos score script (segment)

```

;;; 17 MOTIVES

;;; Pulse Basis: 1.0
;;; Tempo Unit: 1.0
;;; Metronome Mark: 72

(with-sound (:channels 2
             :header-type mus-aiff
             :data-format mus-b24int
             :srate 48000
             :output "17motivesScore_berio_NoRhythms_DynEnvs_YesOverlaps_newDefuns.aiff"
             :scaled-to 0.95
             :reverb freeverb
             :decay-time 2.0
             :statistics t
             :play nil)

  (let ((ampScale 0.70))
    ;; Phrase Number: 1
    ;; phraseLength: 5 pulses
    ;; duration: ca. 4.17 seconds
    ;; timeAtBegOfPhrase: 0.0 secs (ca. 0:00")
    ;; timeAtEndOfPhrase: 4.17 secs (ca. 0:04")
    ;; number of simultaneous instruments in the phrase: 2
    ;; new motive in the phrase? YES
    (mot1 4 0.0 4.1666665 '(g4 d5 d5) ampScale) ;; XX
    (mot1 6 0.0 7.5 '(g4 g4 b4) ampScale) ;; XX
    ;; number of consecutive harmonies in the phrase: 3
    ;; harmonies: (G4) (EF4 G4 D5) (A4 B4 D5)

    ;; Phrase Number: 2
    ;; phraseLength: 4 pulses
    ;; duration: ca. 3.33 seconds
    ;; timeAtBegOfPhrase: 4.17 secs (ca. 0:04")
    ;; timeAtEndOfPhrase: 7.5 secs (ca. 0:08")
    ;; number of simultaneous instruments in the phrase: 1
    ;; new motive in the phrase? NO
    ;; (inst01Mot1 4.1666665 7.5 '() ampScale) ;; XX
    ;; number of consecutive harmonies in the phrase: 1
    ;; harmonies: (C4 F54 AF4 B4 D5)

    ;; Phrase Number: 3
    ;; phraseLength: 6 pulses
    ;; duration: ca. 5.0 seconds
    ;; timeAtBegOfPhrase: 7.5 secs (ca. 0:08")
    ;; timeAtEndOfPhrase: 12.5 secs (ca. 0:12")
    ;; number of simultaneous instruments in the phrase: 9
    ;; new motive in the phrase? NO
    ;; (inst01Mot1 7.5 12.5 '() ampScale) ;; XX
    (mot1 2 7.5 12.5 '(c4 c4) ampScale) ;; XX
    (mot1 3 7.5 12.5 '(c4 cs4) ampScale) ;; XX
    (mot1 4 7.5 15.83 '(af4 af4) ampScale) ;; XX
    (mot1 5 7.5 12.5 '(af4 bf4) ampScale) ;; XX
    (mot1 6 7.5 12.5 '(bf4 b4) ampScale) ;; XX
    (mot1 7 7.5 12.5 '(bf4 f5) ampScale) ;; XX
    (mot1 8 7.5 12.5 '(b4 b4) ampScale) ;; XX
    (mot1 9 7.5 12.5 '(b4 f5) ampScale) ;; XX
    ;; number of consecutive harmonies in the phrase: 2
    ;; harmonies: (C4 AF4 BF4 B4) (C4 CS4 AF4 BF4 B4 F5)

    ;; Phrase Number: 4
    ;; phraseLength: 4 pulses
    ;; duration: ca. 3.33 seconds
    ;; timeAtBegOfPhrase: 12.5 secs (ca. 0:12")
    ;; timeAtEndOfPhrase: 15.83 secs (ca. 0:16")
    ;; number of simultaneous instruments in the phrase: 8
    ;; new motive in the phrase? NO
    ;; (inst01Mot1 12.5 15.833333 '() ampScale) ;; XX
    (mot1 2 12.5 16.666666 '(b3 b3) ampScale) ;; XX
    (mot1 3 12.5 16.666666 '(c4 c4) ampScale) ;; XX
    (mot1 4 12.5 15.833333 '(d4 d4) ampScale) ;; XX
    (mot1 6 12.5 15.833333 '(af4 af4) ampScale) ;; XX
  )

```


2

Trombone

38 *f* *p* *f* *p* *f* *p* *f* *p*

42 *f* *mp* *mf* *f* *f*

47 *p* *f* *f* *mp* *mf*

53 *f* *p* *f*

59 *f* *p* *f* *p*

64 *ff* *mf* *f*

69 *f* *f* *f*

74 *p* *f* *ff* *mf* *f*

78 *f* *p* *f* *p*

81 *p* *f*

Detailed description: This page contains the musical score for the Trombone part of the piece 'B.4. THRIAMBOS', measures 38 through 81. The score is written in bass clef and consists of ten staves. The time signatures vary throughout, including 3/4, 2/4, 12/4, 3/4, 4/4, 6/4, 7/4, 10/4, 3/4, 4/4, 6/4, 5/4, 3/4, 4/4, 6/4, and 7/4. The dynamics range from *ff* (fortissimo) to *p* (piano). The music features various rhythmic patterns, including triplets and sixteenth-note runs. There are several accents and slurs throughout the piece. The key signature changes from one flat to two flats and back to one flat.

Trombone

3

86

f

89

p 3 3 3

94

p *f*

99

p *f*

104

f

108

ff *mf* *f* *ff* *mf* *f*

111

f *ff* *mf* *f*

114

f *p* *f* *p*

4

Trombone

117 *f* *mp* *mf* *f* *ff* *mf* *f*

120 *p* *f*

122 *mp* *f* *>p*

127 *f* *mp* *p* *mf* *f* *p* *f*

130 *f* *p*

135 *mp* *f* *>p* *mp* *f* *>p*

140 *f* *p* *mp* *f* *>p* *f* *ff* *mf* *<f*

144 *f* *ff* *mf* *<f*

148 *f* *mf* *f* *p* *p*

151 *mp* *f* *>p* *f* **2**

Detailed description: This page contains the musical score for the Trombone part of the piece 'B.4. THRIAMBOS', measures 117 through 151. The score is written in bass clef with various time signatures including 3/4, 10/4, 12/4, 6/4, 9/4, 5/4, 8/4, 7/4, 6/4, 3/4, 2/4, and 3/2. The music features a variety of dynamics such as *f* (forte), *mp* (mezzo-piano), *mf* (mezzo-forte), *ff* (fortissimo), and *p* (piano), along with accents and hairpins. There are several triplet markings (indicated by a '3' in a box) and slurs. The piece concludes with a double bar line and a '2' above it, indicating a second ending.

Trombone

5

158

161

f *ff* *mf* *<f* *3* *p* *f* *p* *f* *p* *f* *p*

f *ff* *mf* *f* *ff*

B.5 Interminable Delirium

B.5.1 Interminable Delirium score script (segment)

```

;;; Pulse Basis: 1.0
;;; Tempo Unit: 1.0
;;; Metronome Mark: 48

(with-sound (:channels 2
:header-type mus-aiff
:data-format mus-b24int
:rate 48000
:output "newICC_Spl_14mots_11mins_tapeScore.aiff"
:scaled-to 0.95
:reverb freeverb
:decay-time 2.0
:statistics t
:play nil)

(let ((ampScale 0.65))

;;; Phrase Number: 1
;;; phraseLength: 4 pulses
;;; duration: ca. 5.0 seconds
;;; timeAtBegOfPhrase: 0.0 secs (ca. 0:00")
;;; timeAtEndOfPhrase: 5.0 secs (ca. 0:05")
;;; number of simultaneous instruments in the phrase: 6
;;; new motive in the phrase? YES
;;; (mot1 1 0 5.0 '() ampScale) ;; OoR
;;; (mot1 2 0 5.0 '() ampScale) ;; NOL
;;; (mot1 3 0 5.0 '() ampScale) ;; NOL
;;; (mot1 4 0 5.0 '() ampScale) ;; NOL
;;; (mot1 5 0 5.0 '() ampScale) ;; OL
(mot1 6 0 5.0 '(c4 g3) ampScale) ;; NOL
;;; number of consecutive harmonies in the phrase: 2
;;; harmonies:
; (C4)
; (G3 C4 D4 E4)

;;; Phrase Number: 2
;;; phraseLength: 1 pulses
;;; duration: ca. 1.25 seconds
;;; timeAtBegOfPhrase: 5.0 secs (ca. 0:05")
;;; timeAtEndOfPhrase: 6.25 secs (ca. 0:06")
;;; number of simultaneous instruments in the phrase: 7
;;; new motive in the phrase? YES
;;; (mot1 1 5.0 6.25 '() ampScale) ;; OoR
;;; (mot2 2 5.0 6.25 '() ampScale) ;; NOL
;;; (mot1 3 5.0 6.25 '() ampScale) ;; NOL
;;; (mot1 5 5.0 6.25 '() ampScale) ;; OL
(mot2 7 5.0 6.25 '(g3 g3 fs3 e3) ampScale) ;; NOL
(mot1 9 5.0 6.25 '(c4 c4 c4 ef4) ampScale) ;; NOL
(mot2 10 5.0 6.25 '(fs4 g4 g4 g4) ampScale) ;; NOL
;;; number of consecutive harmonies in the phrase: 4
;;; harmonies:
; (G3 C4 E4 FS4)
; (G3 C4 E4 FS4 G4)
; (FS3 C4 E4 FS4 G4)
; (E3 G3 EF4 F4 FS4 G4)

;;; Phrase Number: 3
;;; phraseLength: 1 pulses
;;; duration: ca. 1.25 seconds
;;; timeAtBegOfPhrase: 6.25 secs (ca. 0:06")
;;; timeAtEndOfPhrase: 7.5 secs (ca. 0:08")
;;; number of simultaneous instruments in the phrase: 0

```

B.5.2 *Interminable Delirium* instrumental score

Sean Reed

Interminable Delirium

2

Notes to the performers:

All tremolo hash marks are to be performed as unmeasured tremolos. Measured tremolos are written out in full.

All instruments are to be amplified and processed through a reverb effect with a roughly 2-second decay time. The volume of the amplification is not intended to be subtle, but rather to be noticeably loud. The volume is to balance evenly with the tape part such that the loudest tutti of the acoustic instruments matches the level/intensity of the full sections in the tape part.

The meter is intended for rehearsal purposes only and does not fully reflect phrasing or strong-beat/weak-beat emphasis.

At least one performer should have a click-track with one pitch/timbre only, in a monitor-headphone, set at quarter=48.

The instruments are to be tuned at A=440 so that they will correspond to pitches within the tape part.

The xylophone is to be played with medium yarn mallets to avoid overpowering the ensemble.

All dynamics reflect firstly the balanced dynamic of the ensemble rather than being solely specific to the extreme dynamic spectrum of the given instrument.

The score and parts are notated transposing (xylophone and contrabass at written rather than sounding pitch).

Duration: 10'59" minutes

Composed 2008 for the Irish Composers Collective

-Sean Reed

Interminable Delirium

Sean Reed

♩ = 48

Xylophone

Harpichord

Viola

Violoncello

Contrabass

2

Xyl.

Hpsd.

Vla.

Vc.

Cb.

4

Musical score for measures 3-4. The score includes staves for Xyl., Hpsd., Vla., Vc., and Cb. Measure 3 features a triplet in the Xyl. and Hpsd. staves, and a quintuplet in the Vla. staff. Dynamics include *f*, *p*, and *f*. Measure 4 continues the patterns with a triplet in the Vla. staff. The Vc. and Cb. staves show dense rhythmic patterns.

Musical score for measures 4-5. The score includes staves for Xyl., Hpsd., Vla., Vc., and Cb. Measure 4 is mostly silent for the first three staves. Measure 5 features a triplet in the Vc. staff and a triplet in the Cb. staff. Dynamics include *f*. The Vc. and Cb. staves show rhythmic patterns.

5

Musical score for measures 5-8. The score is written for five instruments: Xyl. (Xylophone), Hpsd. (Harp), Vla. (Viola), Vc. (Violin), and Cb. (Cello). The time signature is 4/4. The Xyl. part is silent, indicated by a horizontal line. The Hpsd. part consists of a complex, rhythmic pattern of chords in both hands. The Vla. part features a series of sixteenth-note chords, starting with a forte (*f*) dynamic. The Vc. and Cb. parts play a similar rhythmic pattern of sixteenth-note chords, with the Cb. part starting with a flat (*b*) dynamic.

6

Musical score for measures 9-12. The score is written for four instruments: Hpsd. (Harp), Vla. (Viola), Vc. (Violin), and Cb. (Cello). The Xyl. part is silent, indicated by a horizontal line. The Hpsd. part continues with a complex, rhythmic pattern of chords in both hands. The Vla. part features a series of sixteenth-note chords. The Vc. and Cb. parts play a similar rhythmic pattern of sixteenth-note chords.

6

Musical score for measures 6 and 7. The score includes staves for Xyl. (Xylophone), Hpsd. (Harp), Vla. (Viola), Vc. (Violin), and Cb. (Cello). Measure 6 shows dense rhythmic patterns for Hpsd., Vla., Vc., and Cb. Measure 7 features a melodic line for Xyl. starting with a forte (*f*) dynamic, and Hpsd., Vla., Vc., and Cb. continuing with rhythmic accompaniment.

Musical score for measures 8 and 9. The score includes staves for Xyl., Hpsd., Vla., Vc., and Cb. Measure 8 shows sparse activity for Xyl. and Hpsd. with triplets, while Vla., Vc., and Cb. are silent. Measure 9 shows Hpsd. with triplets and Vla., Vc., and Cb. with rhythmic accompaniment.

10

Xyl. *mf* *p* *f* *pf* *p*

Hpsd.

Vla. *mf* *p*

Vc.

Cb.

13

Xyl. *p* *mf* *f*

Hpsd.

Vla.

Vc.

Cb.

8

Musical score for measures 15-17. The score is for five instruments: Xyl. (Xylophone), Hpsd. (Harp), Vla. (Viola), Vc. (Violoncello), and Cb. (Contrabasso). Measure 15 starts with a dynamic of *p* and features a triplet of eighth notes in the Xyl. and Vla. parts. Measure 16 has a dynamic of *mf*. Measure 17 has a dynamic of *f* and features a triplet of eighth notes in the Xyl. and Vla. parts. The Cb. part is silent in these measures.

Musical score for measures 16-18. The score is for five instruments: Xyl. (Xylophone), Hpsd. (Harp), Vla. (Viola), Vc. (Violoncello), and Cb. (Contrabasso). Measure 16 starts with a dynamic of *f* and features a triplet of eighth notes in the Xyl. and Vla. parts. Measure 17 has a dynamic of *mf*. Measure 18 has a dynamic of *f* and features a triplet of eighth notes in the Xyl. and Vla. parts. The Cb. part is silent in these measures.

17

Xyl.

Hpsd.

Vla.

Vc.

Cb.

p *f* *p*

f *p*

f *p* *f* *p* *mf*

19

Xyl.

Hpsd.

Vla.

Vc.

Cb.

f

p *mf*

10

20

Xyl.

Hpsd.

Vla.

Vc.

Cb.

f

21

Xyl.

Hpsd.

Vla.

Vc.

Cb.

f

mf

pf

p

23

Xyl. *f*

Hpsd.

Vla. *mf* *p* *f* *p* *f*

Vc. *mp* *f*

Cb.

26

Xyl. *f* *mf* *p* *f* *p* *f* *p* *f* *mf*

Hpsd.

Vla. *p*

Vc. *f* *p* *mf* *f*

Cb.

12

Musical score for measures 28-30. The Xyl. part features a triplet of eighth notes starting at measure 28, followed by a triplet of quarter notes in measure 29, and a triplet of eighth notes in measure 30. Dynamics are marked *f*, *mf*, *p*, and *f*. The Vla. part has a dynamic of *f* and a triplet of eighth notes in measure 30. The Vc. part has a dynamic of *f* and a triplet of eighth notes in measure 30. The Cb. part is silent.

Musical score for measures 31-32. The Xyl. part features a triplet of eighth notes starting at measure 31, followed by a triplet of quarter notes in measure 32. Dynamics are marked *p*, *f*, *p*, and *f*. The Vla. part has a dynamic of *f* and a triplet of eighth notes in measure 32. The Vc. and Cb. parts are silent.

33

Musical score for measures 33-34. The score includes parts for Xyl., Hpsd., Vla., Vc., and Cb. in 5/4 time. The Xyl. part is silent. The Hpsd. part features a triplet of eighth notes in the right hand and a triplet of eighth notes in the left hand. The Vla. part has a dynamic marking of *f*. The Vc. part has dynamic markings of *f*, *p*, and *f*, and includes a triplet of eighth notes. The Cb. part is silent.

35

Musical score for measures 35-36. The score includes parts for Xyl., Hpsd., Vla., Vc., and Cb. in 5/4 time. The Xyl. part is silent. The Hpsd. part features a dense texture of sixteenth notes in the right hand, starting with a dynamic marking of *f*. The Vla. part has dynamic markings of *mf*, *p*, *f*, and *p*, and includes a triplet of eighth notes. The Vc. part has a dynamic marking of *f* and features a dense texture of sixteenth notes. The Cb. part is silent.

38

Xyl. *p* *p*

Hpsd.

Vla. *p*

Vc. *p*

Cb.

44

Xyl. *f*

Hpsd.

Vla. *f* *p* *f* *p* *mf* *f*

Vc.

Cb.

16

46

Xyl.

Hpsd.

Vla.

Vc.

Cb.

p *mf* *f* *mf* *f* *p*

51

Xyl.

Hpsd.

Vla.

Vc.

Cb.

f *p* *mf* *f*

56

Xyl. *f* 3 3 3 3 *f* 3 *p*

Hpsd.

Vla. *p* *f* *f*

Vc.

Cb.

60

Xyl. *mf* 3 *f*

Hpsd.

Vla.

Vc.

Cb.

18

63

Xyl. *f*

Hpsd.

Vla.

Vc.

Cb.

65

Xyl. *mf* *p*

Hpsd.

Vla.

Vc.

Cb.

69

Xyl.

Hpsd.

Vla.

Vc.

Cb.

72

Xyl.

Hpsd.

Vla.

Vc.

Cb.

20

73 *b*

Xyl.

Hpsd

Vla.

Vc.

Cb.

74

Xyl.

Hpsd

Vla.

Vc.

Cb.

p

p

p

75

Xyl.

Hpsd.

Vla.

Vc.

Cb.

78

Xyl.

Hpsd.

Vla.

Vc.

Cb.

22

79

Xyl.

Hpsd.

Vla.

Vc.

Cb.

80

Xyl.

Hpsd.

Vla.

Vc.

Cb.

81

Xyl.

Hpsd.

Vla.

Vc.

Cb.

82

Xyl.

Hpsd.

Vla.

Vc.

Cb.

f *p* *f* *p* *mf* *f* *p*

24

85

Musical score for measures 85-86. The score is in 3/4 time and features five staves: Xyl., Hpsd., Vla., Vc., and Cb. The key signature has one sharp (F#). Measure 85 contains a xylophone part with a triplet of eighth notes (F#, G, A) and a dynamic marking of *f*. The harpsichord part also features a triplet of eighth notes (F#, G, A) in both hands. The double bass part has a single eighth note (F#) with a dynamic marking of *f*. Measures 86 are mostly rests for all instruments.

87

Musical score for measure 87. The score is in 3/4 time and features five staves: Xyl., Hpsd., Vla., Vc., and Cb. The key signature has one sharp (F#). Measure 87 contains a xylophone part with a dense, rhythmic pattern of eighth notes and a dynamic marking of *f*. The harpsichord part is mostly rests. The double bass part has a dense, rhythmic pattern of eighth notes with a dynamic marking of *f*. The violin and viola parts also have dense, rhythmic patterns of eighth notes with a dynamic marking of *f*.

88

Xyl.

Hpsd.

Vla.

Vc.

Cb.

89

Xyl.

Hpsd.

Vla.

Vc.

Cb.

26

90

Musical score for measures 90-93. The score includes parts for Xyl., Hpsd., Vla., Vc., and Cb. Measure 90 features a xylophone melody with triplets and dynamics *f* and *p*. The harpsichord and bassoon parts also feature triplets. The violin and cello parts have dynamics *f*, *mf*, and *f*. The double bass part has a dynamic of *f*.

94

Musical score for measures 94-97. The score includes parts for Xyl., Hpsd., Vla., Vc., and Cb. Measure 94 features a xylophone melody with a triplet and dynamic *mf*. The harpsichord and bassoon parts also feature triplets. The violin and cello parts have dynamics *p* and *mf*. The double bass part has a dynamic of *p*.

98

Xyl. *p* *f* *p*

Hpsd.

Vla. *p*

Vc. *f* *p* *f*

Cb. *p*

101

Xyl. *mf*

Hpsd.

Vla. *f*

Vc. *p* *f*

Cb. *p* *f*

28

103

Musical score for measures 103-104. The score is in 3/4 time and changes to 4/4 at the end of measure 104. The instruments are Xyl., Hpsd., Vla., Vc., and Cb. Xyl. plays a continuous eighth-note pattern in measure 103, marked *f*. Hpsd. has a treble and bass staff; the treble staff has a triplet of eighth notes in measure 103, and the bass staff has a triplet of eighth notes in measure 103. Vla. is silent in measure 103 and plays a half note in measure 104, marked *p*. Vc. and Cb. are silent in measure 103 and play chords in measure 104, marked *p*.

105

Musical score for measure 105. The score is in 4/4 time. The instruments are Xyl., Hpsd., Vla., Vc., and Cb. Xyl. is silent. Hpsd. has a treble and bass staff, both containing a whole note chord. Vla. plays a continuous sixteenth-note pattern, marked *f*. Vc. and Cb. are silent.

106

Xyl. *mf* *pf* *p* *f* *p*

Hpsd.

Vla. *f* *p*

Vc. *p*

Cb. *f* *p*

111

Xyl. *p* *p* *mf* *f*

Hpsd. *p*

Vla. *p* *p*

Vc. *p*

Cb. *p* *mf* *f*

30

115

Xyl. *p* *f*

Hpsd. *f* *mf*

Vla. *f* *mf*

Vc. *f* *p* *mf*

Cb. *f*

120

Xyl. *f*

Hpsd. *f*

Vla. *p* *f* *p* *f*

Vc. *f*

Cb.

124

Xyl. *mf* *p f* *p* *f*

Hpsd.

Vla. *mf* *p f* *p* *f*

Vc.

Cb.

129

Xyl. *f* *p* *f*

Hpsd.

Vla. *p*

Vc.

Cb.

32

131

Xyl.

Hpsd.

Vla.

Vc.

Cb.

133

Xyl.

Hpsd.

Vla.

Vc.

Cb.

134

Xyl.

Hpsd.

Vla.

Vc.

Cb.

Detailed description: This system of musical notation covers measures 134 and 135. It features five staves: Xyl. (Xylophone), Hpsd. (Harp), Vla. (Viola), Vc. (Violoncello), and Cb. (Contrabasso). The key signature has one sharp (F#) and the time signature is 3/4. In measure 134, the Xyl. and Hpsd. parts play a continuous, dense sixteenth-note pattern. The Vla. part plays a similar sixteenth-note pattern. The Vc. and Cb. parts are silent, indicated by a horizontal line with a bar. In measure 135, the Xyl. part has a dynamic marking of *f* and plays a series of notes with accents. The Hpsd. part has a triplet of eighth notes in the first half of the measure. The Vla. part continues with its sixteenth-note pattern. The Vc. and Cb. parts remain silent.

135

Xyl.

Hpsd.

Vla.

Vc.

Cb.

Detailed description: This system of musical notation covers measures 135 and 136. It features five staves: Xyl. (Xylophone), Hpsd. (Harp), Vla. (Viola), Vc. (Violoncello), and Cb. (Contrabasso). The key signature has one sharp (F#) and the time signature is 3/4. In measure 135, the Xyl. part has a dynamic marking of *f* and plays a series of notes with accents. The Hpsd. part has a triplet of eighth notes in the first half of the measure. The Vla. part continues with its sixteenth-note pattern. The Vc. and Cb. parts remain silent. In measure 136, the Xyl. part plays a series of notes with accents. The Hpsd. part has a triplet of eighth notes in the first half of the measure. The Vla. part continues with its sixteenth-note pattern. The Vc. and Cb. parts remain silent.

34

Musical score for measures 136-137, featuring five staves: Xyl., Hpsd., Vla., Vc., and Cb. The score is in 3/4 time and D major. Measure 136 contains a triplet of eighth notes in the Xyl. part, a triplet of eighth notes in the Hpsd. part, and a triplet of eighth notes in the Vc. part. Measure 137 contains a triplet of eighth notes in the Xyl. part, a triplet of eighth notes in the Hpsd. part, and a triplet of eighth notes in the Vc. part. The Vla. part has a whole note chord in measure 136 and a whole note chord in measure 137. The Cb. part has a whole note chord in measure 136 and a whole note chord in measure 137. Dynamics include *p* (piano) in the Vc. part.

B.6 More Than Is Wise

B.6.1 More Than Is Wise score script (excerpt)

```
(cd ~/Users/Seamless/Documents/compositions/Projects/moreThanIsWise)

!!! Pulse Bats: 1 0
!!! Metronome Mark: 96
!!! Metronome Mark: 96

(withSound c:channels 2
  data:format mus2Sint
  data:rate 44800
  data:unpack moreThanIsWiseOpul.staff~
  scd:cd 0.95
  scd:time 2.0
  scd:unpack t
  play nil)

(let ((ampScale 0.65))

  !!! Phrase Number: 1
  !!! phraseLength: 2 pulses
  !!! duration: ca. 1.88 seconds
  !!! timeAtBeginPhrase: 0.8 secs (ca. 0.807)
  !!! timeAtEndPhrase: 2.3 secs (ca. 0.807)
  !!! number of simultaneous instruments in the phrase: 1
  !!! new active in the phrase? YES
  (met1 3 0 2.5 '(c4) ampScale) :: XX
  !!! harmonies: (C4)

  !!! Phrase Number: 2
  !!! phraseLength: 3 pulses
  !!! duration: ca. 1.88 seconds
  !!! timeAtBeginPhrase: 4.38 secs (ca. 0.807)
  !!! timeAtEndPhrase: 6.38 secs (ca. 0.807)
  !!! number of simultaneous instruments in the phrase: 6
  !!! new active in the phrase? YES
  (met2 2 2.5 4.88 '(c4) ampScale) :: XX
  (met2 2 2.5 4.88 '(c4) ampScale) :: XX
  (met2 7 2.5 4.375 '(c4) ampScale) :: XX
  (met2 9 2.5 6.88 '(c4) ampScale) :: XX
  (met2 10 2.5 4.375 '(c4) ampScale) :: XX
  (met2 12 2.5 4.375 '(c4) ampScale) :: XX
  !!! harmonies: (C4) (C4)

  !!! Phrase Number: 3
  !!! phraseLength: 6 pulses
  !!! duration: ca. 2.5 seconds
  !!! timeAtBeginPhrase: 4.38 secs (ca. 0.807)
  !!! timeAtEndPhrase: 6.88 secs (ca. 0.807)
  !!! number of simultaneous instruments in the phrase: 5
  !!! new active in the phrase? NO
  (met1 2 4.375 8.13 '(g3 f3) ampScale) :: XX
  (met1 3 4.375 8.13 '(c4) ampScale) :: XX
  (met1 4 4.375 8.13 '(g3 f3) ampScale) :: XX
  (met1 5 4.375 8.13 '(g3 f3) ampScale) :: XX
  (met1 9 4.375 8.13 '(g3 f3) ampScale) :: XX
  !!! harmonies: (F5) (F5)

  !!! Phrase Number: 4
  !!! phraseLength: 2 pulses
  !!! duration: ca. 1.25 seconds
  !!! timeAtBeginPhrase: 6.88 secs (ca. 0.807)
  !!! timeAtEndPhrase: 8.13 secs (ca. 0.807)
  !!! number of simultaneous instruments in the phrase: 4
  !!! new active in the phrase? YES
  (met1 1 6.875 8.125 '(c4) ampScale) :: XX
  (met1 3 6.875 8.125 '(g3 f3) ampScale) :: XX

  !!! Phrase Number: 5
  !!! phraseLength: 1 pulse
  !!! duration: ca. 0.63 seconds
  !!! timeAtBeginPhrase: 8.13 secs (ca. 0.807)
  !!! timeAtEndPhrase: 8.75 secs (ca. 0.807)
  !!! number of simultaneous instruments in the phrase: 3
  !!! new active in the phrase? YES
  (met1 1 8.125 8.75 '(c4 c4 a4 f4 e4) ampScale) :: XX
  (met1 4 8.125 8.75 '(g3 f3 e3) ampScale) :: XX
  (met1 8 8.125 8.75 '(e3) ampScale) :: XX
  !!! harmonies:
  (C4 A4 F5 F5 C6 E6)
  (C4 A4 F5 F5 B5 E6 F6)
  (A4 F5 F5 B5)
  (E5 F5)
  (E5)

  !!! Phrase Number: 6
  !!! phraseLength: 1 pulse
  !!! duration: ca. 0.63 seconds
  !!! timeAtBeginPhrase: 9.38 secs (ca. 0.807)
  !!! timeAtEndPhrase: 9.38 secs (ca. 0.807)
  !!! number of simultaneous instruments in the phrase: 10
  !!! new active in the phrase? YES
  (met4 2 8.75 9.375 '(e5 f5) ampScale) :: XX
  (met5 3 8.75 12.5 '(e5 f5) ampScale) :: XX
  (met5 4 8.75 9.375 '(e5 f5) ampScale) :: XX
  (met5 6 8.75 9.375 '(e5 f5) ampScale) :: XX
  (met5 7 8.75 9.375 '(e5 f5) ampScale) :: XX
  (met5 8 8.75 9.375 '(e5 f5) ampScale) :: XX
  (met5 11 8.75 9.375 '(e5 f5) ampScale) :: XX
  (met5 12 8.75 9.375 '(e5 f5) ampScale) :: XX
  !!! harmonies:
  (E5)
  (F5)

  !!! Phrase Number: 7
  !!! phraseLength: 5 pulses
  !!! duration: ca. 3.13 seconds
  !!! timeAtBeginPhrase: 9.38 secs (ca. 0.807)
  !!! timeAtEndPhrase: 12.5 secs (ca. 0.812)
  !!! number of simultaneous instruments in the phrase: 1
  !!! new active in the phrase? NO
  (met1 1 9.375 12.5 '(c4) ampScale) :: XX
  !!! harmonies: (G5) (G5) (F5)

  !!! Phrase Number: 8
  !!! phraseLength: 5 pulses
  !!! duration: ca. 3.13 seconds
  !!! timeAtBeginPhrase: 12.5 secs (ca. 0.812)
  !!! timeAtEndPhrase: 15.625 secs (ca. 0.812)
  !!! number of simultaneous instruments in the phrase: 11
  !!! new active in the phrase? NO
  (met1 1 12.5 21.88 '(g3 b4 b4) ampScale) :: XX
  (met1 3 12.5 21.88 '(g5) ampScale) :: XX
  (met1 5 12.5 21.88 '(g3 b4 b4) ampScale) :: XX
  (met1 6 12.5 15.625 '(g5) ampScale) :: XX
  (met1 8 12.5 21.88 '(g3 b4 b4) ampScale) :: XX
  (met1 9 12.5 15.625 '(g3 b4 b4) ampScale) :: XX
  (met1 10 12.5 15.625 '(g3 b4 b4) ampScale) :: XX
  (met1 11 12.5 15.625 '(g3 b4 b4) ampScale) :: XX
```


B.7 Imperishable Raptures

B.7.1 Imperishable Raptures score script (excerpt)

```

::: Cd "/Users/sonareed/Documents/compositionsProjects/imperishableraptures_needTLU/"
::: Pulse basis: 1.0
::: Tempo limit: 1.0
::: Metronome Mark: 108
(With-sound (channel 8
  header-type mas-wfc
  data-format mas-24bit
  sample-rate 44100
  subfile-name imperishableraptures_chan_44k24b.aiff-
  subfile-start 0 95
  reverb freverb
  decay-time 2.0
  statistics t
  p100 ml)
  (let ((ampScale 0.85))
    ::: Phrase Number: 1
    ::: phraselength: 3 pulses
    ::: duration: ca. 1.67 seconds
    ::: timeAtEndOfPhrase: 0.8 secs (ca. 0.87)
    ::: timeAtEndOfPhrase: 0.83 secs (ca. 0.88)
    ::: number of simultaneous instruments in the phrase: 5
    ::: new motive in the phrase? YES
    ::: number of consecutive harmonies in the phrase: 1
    ::: harmonies: (E4)
    ::: phraseFullHarmonyList: ((E4))
    (owl1 2 0 3 3333335 '(E4) ampScale)
    (owl1 4 0 3 3333335 '(E4) ampScale)
    (owl1 5 0 1 666667 '(E4) ampScale)
    (owl1 13 0 1 666667 '(E4) ampScale)
  )
  ::: Phrase Number: 2
  ::: phraselength: 6 pulses
  ::: duration: ca. 1.67 seconds
  ::: timeAtEndOfPhrase: 1.67 secs (ca. 0.87)
  ::: timeAtEndOfPhrase: 3.33 secs (ca. 0.87)
  ::: number of simultaneous instruments in the phrase: 1
  ::: new motive in the phrase? YES
  ::: number of consecutive harmonies in the phrase: 1
  ::: harmonies: (E4)
  ::: phraseFullHarmonyList: ((E4))
  (owl2 7 1 666667 3.333335 '(E4) ampScale)
  ::: Phrase Number: 3
  ::: phraselength: 6 pulses
  ::: duration: ca. 2.22 seconds
  ::: timeAtEndOfPhrase: 2.22 secs (ca. 0.157)
  ::: timeAtEndOfPhrase: 16.67 secs (ca. 0.177)
  ::: number of simultaneous instruments in the phrase: 12
  ::: new motive in the phrase? YES
  ::: number of consecutive harmonies in the phrase: 4
  ::: harmonies: (E4) (F4) (G4) (A4) (B4)
  ::: phraseFullHarmonyList: ((E4) (F4) (G4) (A4) (B4))
  (owl1 3 3 3333335 6.666667 '(E4 F4 G4 A4 B4) ampScale)
  (owl2 4 3 3333335 6.666667 '(E4 F4 G4 A4 B4) ampScale)
  (owl1 5 3 3333335 6.666667 '(E4 F4 G4 A4) ampScale)
  (owl3 6 3 3333335 8.333334 '(E4 F4 G4 A4) ampScale)
  (owl1 8 3 3333335 8.333334 '(E4 F4 G4 A4) ampScale)
  (owl2 9 3 3333335 6.666667 '(E4 F4 G4 A4) ampScale)
  (owl1 10 3 3333335 6.666667 '(E4 F4 G4 A4) ampScale)
  (owl2 12 3 3333335 8.333334 '(E4 F4 G4 A4) ampScale)
  (owl1 13 3 3333335 6.666667 '(E4 F4 G4 A4) ampScale)
  ::: Phrase Number: 4
  ::: phraselength: 3 pulses
  ::: duration: ca. 2.78 seconds
  ::: timeAtEndOfPhrase: 2.78 secs (ca. 0.887)
  ::: timeAtEndOfPhrase: 8.33 secs (ca. 0.887)
  ::: number of simultaneous instruments in the phrase: 4
  ::: new motive in the phrase? YES
  ::: number of consecutive harmonies in the phrase: 1
  ::: harmonies: (A3) (C4) (E4) (F4)
  ::: phraseFullHarmonyList: ((F4) (E4) (C4) (A3))
  (owl2 5 6 666667 11.11112 '(C4) ampScale)
  (owl2 6 6 666667 11.11112 '(C4) ampScale)
  (owl2 10 6 666667 8.333334 '(C4) ampScale)
  ::: Phrase Number: 5
  ::: phraselength: 5 pulses
  ::: duration: ca. 2.78 seconds
  ::: timeAtEndOfPhrase: 2.78 secs (ca. 0.887)
  ::: timeAtEndOfPhrase: 8.33 secs (ca. 0.887)
  ::: number of simultaneous instruments in the phrase: 6
  ::: new motive in the phrase? YES
  ::: number of consecutive harmonies in the phrase: 1
  ::: harmonies: (A3) (C4) (E4) (F4)
  ::: phraseFullHarmonyList: ((F4) (E4) (C4) (A3))
  (owl2 7 8 333334 11.11112 '(E3) ampScale)
  (owl2 8 8 333334 11.11112 '(E3) ampScale)
  (owl2 9 8 333334 11.11112 '(E3) ampScale)
  (owl2 12 8 333334 11.11112 '(E3) ampScale)
  (owl2 14 8 333334 11.11112 '(E3) ampScale)
  ::: Phrase Number: 6
  ::: phraselength: 6 pulses
  ::: duration: ca. 3.33 seconds
  ::: timeAtEndOfPhrase: 3.33 secs (ca. 0.147)
  ::: timeAtEndOfPhrase: 14.44 secs (ca. 0.147)
  ::: number of simultaneous instruments in the phrase: 7
  ::: new motive in the phrase? YES
  ::: number of consecutive harmonies in the phrase: 3
  ::: harmonies: (E3) (E4) (F4) (G4) (A3) (A4) (E5)
  ::: phraseFullHarmonyList: ((E3) (E4) (F4) (G4) (A3) (A4) (E5))
  (owl15 2 11.11112 14.44445 '(E3 E4 F4 G4 A3 A4 E5) ampScale)
  (owl15 3 11.11112 14.44445 '(E3 E4 F4 G4 A3) ampScale)
  (owl15 4 11.11112 14.44445 '(E3 E4 F4 G4 A3) ampScale)
  (owl15 5 11.11112 16.66668 '(F4 F4) ampScale)
  (owl15 6 11.11112 14.44445 '(E3 E4 F4 G4 A3) ampScale)
  (owl15 8 11.11112 14.44445 '(G4 C4 G4) ampScale)
  (owl15 10 11.11112 14.44445 '(G4 A4 E3) ampScale)
  ::: Phrase Number: 7
  ::: phraselength: 4 pulses
  ::: duration: ca. 2.22 seconds
  ::: timeAtEndOfPhrase: 2.22 secs (ca. 0.157)
  ::: timeAtEndOfPhrase: 16.67 secs (ca. 0.177)
  ::: number of simultaneous instruments in the phrase: 2
  ::: new motive in the phrase? YES
  ::: number of consecutive harmonies in the phrase: 3
  ::: harmonies: (E3) (A3) (D4) (E4) (F4) (G4) (A3) (E4) (F4) (E5) (A5) (G6) (B6)
  ::: phraseFullHarmonyList: ((E3) (A3) (D4) (E4) (F4) (G4) (A3) (E4) (F4) (E5) (A5) (G6) (B6))
  (owl6 7 14.44445 16.66668 '(G6) (G6) (A3) ampScale)
  (owl6 12 14.44445 18.33334 '(E3) (A3) (B6) ampScale)
  ::: Phrase Number: 8
  ::: phraselength: 3 pulses
  ::: duration: ca. 1.67 seconds
  ::: timeAtEndOfPhrase: 1.67 secs (ca. 0.177)
  ::: timeAtEndOfPhrase: 18.33 secs (ca. 0.187)
  ::: number of simultaneous instruments in the phrase: 1
  ::: new motive in the phrase? YES
  ::: number of consecutive harmonies in the phrase: 1
  ::: harmonies: (D4) (E4) (F4) (E5) (A5) (B6)
  ::: phraseFullHarmonyList: ((E2) (E4) (F4) (E5) (A5) (B6))

```

B.8 *Rattling the Cage*

B.8.1 *Rattling the Cage* score script (segment)

```

;;; Pulse Basis: 1.0
;;; Tempo Unit: 1.0
;;; Metronome Mark: 76

(with-sound (:channels 2
             :header-type mus-aiff
             :data-format mus-b24int
             :srate 48000
             :output "rattlingTheCage_tapeOutput.aiff"
             :scaled-to 0.95
             :reverb freeverb
             :decay-time 2.0
             :statistics t
             :play nil)

  (let ((ampScale 0.65))

    ;; Phrase Number: 1
    ;; phraseLength: 4 pulses
    ;; duration: ca. 3.16 seconds
    ;; timeAtBegOfPhrase: 0.0 secs (ca. 0:00")
    ;; timeAtEndOfPhrase: 3.16 secs (ca. 0:03")
    ;; number of simultaneous instruments in the phrase: 9
    ;; new motive in the phrase? YES
    (mot1 3 0 5.53 '(c4) ampScale)
    (mot1 6 0 5.53 '(c4) ampScale)
    (mot1 7 0 5.53 '(c4) ampScale)
    (mot1 8 0 3.1578948 '(c4) ampScale)
    (mot1 9 0 5.53 '(c4) ampScale)
    ;; (mot1 10 0 3.1578948 '(c4) ampScale)
    ;; (mot1 11 0 3.1578948 '(c4) ampScale)
    (mot1 14 0 5.53 '(c4) ampScale)
    (mot1 16 0 3.1578948 '(c4) ampScale)
    ;; ;; number of consecutive harmonies in the phrase: 1
    ;; ;; harmonies: (C4)

    ;; ;; Phrase Number: 2
    ;; ;; phraseLength: 3 pulses
    ;; ;; duration: ca. 2.37 seconds
    ;; ;; timeAtBegOfPhrase: 3.16 secs (ca. 0:03")
    ;; ;; timeAtEndOfPhrase: 5.53 secs (ca. 0:06")
    ;; ;; number of simultaneous instruments in the phrase: 12
    ;; ;; new motive in the phrase? YES
    (mot1 3 3.1578948 5.5263157 '(b3) ampScale)
    (mot1 5 3.1578948 5.5263157 '(b3) ampScale)
    (mot2 6 3.1578948 5.5263157 '(b3) ampScale)
    (mot1 7 3.1578948 5.5263157 '(b3) ampScale)
    (mot2 8 3.1578948 6.32 '(b3) ampScale)
    (mot2 9 3.1578948 6.32 '(b3) ampScale)
    ;; (mot2 10 3.1578948 5.5263157 '(b3) ampScale)
    (mot2 11 3.1578948 5.5263157 '(b3) ampScale)
    (mot1 12 3.1578948 5.5263157 '(b3) ampScale)
    (mot2 13 3.1578948 6.32 '(b3) ampScale)
    (mot2 14 3.1578948 5.5263157 '(b3) ampScale)
    (mot1 16 3.1578948 6.32 '(b3) ampScale)
    ;; PIANO: mot1
    ;; ;; number of consecutive harmonies in the phrase: 2
    ;; ;; harmonies: (B3) (B3)

    ;; ;; Phrase Number: 3
    ;; ;; phraseLength: 1 pulses
    ;; ;; duration: ca. 0.79 seconds
    ;; ;; timeAtBegOfPhrase: 5.53 secs (ca. 0:06")
    ;; ;; timeAtEndOfPhrase: 6.32 secs (ca. 0:06")
    ;; ;; number of simultaneous instruments in the phrase: 14
    ;; ;; new motive in the phrase? YES
    (mot3 1 5.5263157 6.315789 '(b3 b3 b3 bf3) ampScale)
    (mot3 2 5.5263157 6.315789 '(b3) ampScale)
    (mot3 3 5.5263157 6.315789 '(b3 b3 b3 bf3) ampScale)
    (mot3 4 5.5263157 6.315789 '(b3) ampScale)
    (mot3 5 5.5263157 6.315789 '(b3 b3 b3 bf3) ampScale)
    (mot3 6 5.5263157 6.315789 '(b3) ampScale)
  )

```


B.8.2 *Rattling the Cage* piano score

SEAN REED

RATTLING THE CAGE

FOR PREPARED PIANO AND TAPE

PERFORMANCE NOTES

THE PIECE IS TO BE PERFORMED TOGETHER WITH THE ACCOMPANYING TAPE PART USING HARD-DISK PLAYBACK AND HEADPHONES WITH A CLICK TRACK. THE PIANO IS TO BE MICROPHONED AND AMPLIFIED TO A LEVEL BALANCED WITH THE STEREO PLAYBACK, USING NO EXTRA EFFECTS. THE CLICK IS TO BE SET AT QUARTER=76 IN 4/4 TIME WITH AN ACCENTUATED CLICK DEMARCATING THE BEGINNING OF EACH NEW MEASURE.

THE PIANO IS TO BE PREPARED IN ACCORDANCE WITH THE INSTRUCTIONS GIVEN IN JOHN CAGE'S 'SONATAS AND INTERLUDES'.

THE PIANO PART IS NOTATED IN 4/4 TIME TO FACILITATE REHEARSAL. THE PIECE, HOWEVER, CONSISTS OF GESTURES WHICH ARE ANYWHERE FROM 1 TO 11 BEATS LONG AND THEREFORE DO NOT COINCIDE WITH THE METER. THESE GESTURES ARE INDICATED WITH DASHED PHRASING SLURS AND SHOULD BE PERFORMED IN ACCORDANCE WITH THE PHRASE MARKINGS AND NOT THE METER.

THE AUDIO MIXDOWN OF THE BOTH PARTS COMBINED IS INTENDED TO OFFER AN OVERALL IMPRESSION. TECHNICAL CONSTRAINTS HAVE MADE IT IMPOSSIBLE TO PRODUCE THAT MIXDOWN WITH OBSERVANCE OF THE DYNAMICS IN THE SCORE. THE PERFORMER IS TO ADHERE TO THE DYNAMICS MARKED IN THE SCORE AND DISREGARD DYNAMICS HEARD IN THE MIXDOWN (THE E3 OF THE BASS CLEF IS ONE DISTINCT EXAMPLE OF THIS DIFFERENCE.)

THE COMPOSITION IS BASED ON THE SIXTEEN OPENING MOTIVES OF EACH OF THE SONATAS FROM CAGE'S 'SONATAS AND INTERLUDES'. THE TAPE PART IS CONSTRUCTED FROM RECORDINGS OF 16 OF THE PREPARATIONS INDICATED IN CAGE'S SCORE.

'RATTLING THE CAGE' WAS COMPOSED IN 2009 FOR THE TRINITY COLLEGE DUBLIN 'NODE' CONCERT SERIES.

DURATION: 4:27

- SEAN REED, DUBLIN

RATTLING THE CAGE (2009)

SEAN REED

♩ = 76

The musical score is written for piano in 4/4 time with a tempo of quarter note = 76. It consists of seven systems of two staves each (treble and bass clef). The piece features a variety of dynamics including fortissimo (f), piano (p), pianissimo (pp), pianississimo (ppp), mezzo-forte (mf), and mezzo-piano (mp). It includes several triplet markings (3) and slurs. The key signature changes from one flat (B-flat) to two flats (B-flat and E-flat) at measure 22. The notation includes eighth and sixteenth notes, rests, and various articulation marks.

4

36

f *p* *mf* *f*

40

pp *mp* *f* *mf*

44

pp *p*

49

f *pp* *p*

54

mf *p* *mf* *pp*

59

pp *mf* *ppp* *p*

66

pp *mf* *pp* *p*

Detailed description: This page of a musical score contains seven systems of piano music, numbered 36 through 66. Each system consists of a grand staff with a treble and bass clef. The music is written in a key signature of one flat (B-flat major or D minor). The score includes various dynamic markings such as *f* (forte), *p* (piano), *mf* (mezzo-forte), *pp* (pianissimo), and *ppp* (pianississimo). It also features articulation marks like accents and slurs, as well as performance instructions such as triplets (marked with a '3') and fingerings (marked with numbers 1-5). The notation includes sixteenth and thirty-second notes, often beamed together, and rests. The systems are connected by a large bracket at the bottom of the page.

Musical score for 'Rattling the Cage', measures 71-82. The score is written for piano and features dynamic markings such as *pp*, *p*, *ppp*, *f*, *mf*, *ff*, and *mp*. It includes various musical notations like slurs, accents, and triplets.

Measure 71: Treble clef, piano. Dynamics: *pp*, *p*, *ppp*, *f*. Bass clef, piano. Dynamic: *mf*. Slurs connect notes across measures.

Measure 78: Treble clef, piano. Dynamics: *ff*, *mp*. Bass clef, piano. Dynamic: *mp*. Includes a triplet in the treble clef.

Measure 82: Treble clef, piano. Dynamics: *mf*, *ff*. Bass clef, piano. Dynamics: *pp*, *ppp*. Includes triplets in the treble clef.

B.9 *Wistling Dixie*

Sean Reed

Wistling Dixie

Instrumentation

Flute
Clarinet in B \flat
Bass Clarinet in B \flat
Horn in F
Trumpet in B \flat
Trombone
Xylophone
Piano
2 Violins
Viola
Double Bass

Score in C

Bass Clarinet and Double Bass notated an octave higher than sounding
Accidentals apply to the given octave only and for the duration of the bar.
Dynamics remain the same until a new dynamic is introduced.

Duration - 6 1/2 minutes

Composed for the Trinity College Dublin NODE ensemble.
Completed January 2010.

Wistling Dixie

The musical score is arranged in two systems. The first system includes parts for Flute, Clarinet in Bb, Bass Clarinet in Bb, Horn in F, Trumpet in Bb, Tenor Trombone, Xylophone, and Piano. The second system includes Violin I, Violin II, Viola, Violoncello, and Contrabass. The Flute part begins with a 'Star Reed' marking. The score features various musical notations such as triplets, slurs, and dynamic markings like *p*, *mf*, and *ppz*. The tempo is marked with a quarter note followed by '= 72'. The score concludes with a copyright notice: Copyright © 2009.

This musical score is for the piece "Wistling Dixie" and is arranged for a large ensemble. The score is written for the following instruments: Flute (Fl), Clarinet (Cl), Bass Clarinet (B. Cl.), Horn (Hr), Trumpet (Tr), Trombone (Tbn), Saxophone (Sax), Piano (Pno), Violin (Vln), Viola (Vla), Violoncello (Vc), and Contrabass (Cb). The score is organized into systems, with each instrument part on its own staff. The music is in 2/4 time and features a variety of rhythmic patterns, including eighth and sixteenth notes, as well as rests. Dynamics such as *f* (forte), *mf* (mezzo-forte), and *p* (piano) are indicated throughout. Performance instructions like "arco" and "pizz." are also present. The score includes fingerings, slurs, and accents to guide the performer. The piece concludes with a final cadence in the contrabass part.

7

This page contains the musical score for measures 21 through 30 of a section. The instruments are arranged in two systems. The first system includes Flute (Fl), Clarinet (Cl), Bass Clarinet (B. Cl), Horn (Hn), Trumpet (Tr), Trombone (Tbn), Saxophone (Sax), and Piano (Pno). The second system includes Violin (Vln), Viola (Vla), Violoncello (Vcl), and Contrabass (Cb). The score is written in a key signature of one flat and a 4/4 time signature. It features complex rhythmic patterns, including triplets and sixteenth-note runs, with various dynamic markings such as *ff*, *f*, *mf*, and *pp*. Performance instructions like *arco* and *pizz* are present for the strings. The page number '7' is located at the top left.

This musical score is for the piece "B.9. WISTLING DIXIE". It is arranged for a large ensemble. The instruments included are:

- Flute (Fl)
- Clarinet (Cl)
- Bass Clarinet (B. Cl.)
- Saxophone (Sax)
- Trumpet (Trp)
- Trombone (Tbn)
- Piano (Pno)
- Violin I (Vln I)
- Violin II (Vln II)
- Viola (Vla)
- Violoncello (Vcl)
- Double Bass (Cb)

The score is written in 4/4 time and features a variety of musical textures. The woodwinds and brass sections play melodic lines, often with triplets and slurs. The piano part provides a rhythmic accompaniment with chords and arpeggios. The string section plays a steady accompaniment, with some parts featuring triplets and slurs. Dynamics markings such as *ppp*, *p*, *mf*, and *f* are used throughout. The score includes many slurs, ties, and triplet markings, indicating complex rhythmic patterns and phrasing. The piece concludes with a final cadence in the key of G major.

9

This page of a musical score, numbered 9, features a complex arrangement for brass and woodwind instruments. The score is organized into systems, with each instrument part on a separate staff. The instruments included are Flute (Fl), Clarinet (Cl), Bass Clarinet (B. Cl), Horn (Hn), Trumpet (Tpt), Trombone (Tbn), Saxophone (Sax), and Percussion (Perc). The notation is dense, with many notes, rests, and dynamic markings such as *mf*, *f*, and *ff*. The score includes various musical notations such as slurs, ties, and articulation marks. The percussion part is indicated by a bracketed staff with a drumstick icon. The overall layout is professional and detailed, typical of a high-quality musical score.

This musical score is for the piece "Wistling Dixie" (B.9). It is a full orchestration for a large ensemble. The score is written for the following instruments: Flute (Fl), Clarinet (Cl), Bassoon (B. Cl), Horns (Hrn), Trumpets (Trp), Trombones (Tbn), Saxophone (Sax), Piano (Pno), Violins (Vln), Viola (Vla), Violoncello (Vcl), and Double Bass (Cb). The score is divided into two systems. The first system covers measures 56 to 60, and the second system covers measures 61 to 65. The music is characterized by intricate melodic lines, often featuring triplets and sixteenth-note patterns. Dynamics such as *ff* (fortissimo) and *f* (forte) are used throughout. The score includes various musical notations such as slurs, ties, and articulation marks.

This page of a musical score, numbered 11, contains measures 65 through 74. The score is arranged in a standard orchestral format with multiple staves for each instrument. The instruments listed at the bottom of the page are Flute (Fl), Clarinet (Cl), Bassoon (B. Cl.), Horns (Hn), Trumpets (Trpt), Trombones (Tbn), Saxophone (Sax), Piano (Pno), Violins (Vln), Viola (Vla), and Cello (Cb). The music is characterized by complex rhythmic patterns, including triplets and sixteenth-note runs. Dynamic markings such as *ff* (fortissimo), *f* (forte), *p* (piano), and *pp* (pianissimo) are used throughout. Performance instructions like *acc.* (accents) and *tr.* (trills) are present. The score is written in a key signature of one flat and a 2/4 time signature. The page number '11' is located at the top left, and the page number '316' is at the top left of the image. The section header 'B. SCORES' is at the top right.

This musical score is for the piece "Wistling Dixie" and is arranged for a large ensemble. The score is divided into two systems, with the first system starting at measure 75 and the second at measure 88. The instruments are arranged as follows:

- Brass:** Horns (Hr), Trumpets (Tr), Trombones (Tbn), and Saxophones (Sax).
- Woodwinds:** Clarinets (Cl), Bass Clarinet (B. Cl), Flutes (Fl), and Piccolo (Pic).
- Percussion:** Drums (Drum) and Cymbals (Cym).
- Strings:** Violins (Vln), Violas (Vla), Violas (Vlc), and Cellos (Cb).

The score includes various musical notations such as dynamics (p, mf, ff), articulation (accents), and performance instructions like "ohne Dämpfer" (without mutes) for the horns and "absetz Dämpfer" (release mutes) for the trumpets. The piece features a complex rhythmic pattern with many triplets and sixteenth notes. The first system ends with a double bar line and a repeat sign, and the second system begins with a dotted line indicating a continuation of the previous system's notation.

13

This page contains musical notation for measures 13 and 14 of a score. The instruments listed at the bottom are Flute (Fl), Clarinet (Cl), Bassoon (B. Cl), Horn (Hr), Trumpet (Tr), Trombone (Tbn), Saxophone (Sax), Piano (Pno), Violin (Vln), Viola (Vla), Violoncello (Vcl), and Double Bass (Cb). The notation includes various musical symbols such as dynamics (e.g., *f*, *mf*, *ff*), articulation marks (accents, slurs), and performance instructions like *rit.* and *rit. to *mf**. The score is written in a standard musical notation style with a key signature of one flat and a 4/4 time signature.

This musical score is for the piece "Wistling Dixie" and is arranged for a large ensemble. The score is written for the following instruments: Flute (Fl), Clarinet (Cl), Bass Clarinet (B. Cl), Horns (Hn), Trumpets (Tr), Trombones (Tbn), Saxophones (Sax), Piano (Pno), Violins (Vln), Viola (Vla), and Cello (Cb). The score is organized into systems, with each instrument part on its own staff. The notation includes various musical symbols such as notes, rests, slurs, and dynamic markings like *f* (forte) and *mf* (mezzo-forte). The piece features a complex rhythmic structure with many triplets and sixteenth notes. The overall style is characteristic of early 20th-century jazz or Dixieland music.

15

This page of a musical score, page 15, features a complex arrangement of instruments. The score is organized into two systems of staves. The first system includes Flute (Fl), Clarinet (Cl), Bass Clarinet (B. Cl), Horn (Hn), Trumpet (Tr), Trombone (Tbn), Saxophone (Sax), and Percussion (Perc). The second system includes Violin (Vln), Viola (Vla), Violoncello (Vcl), and Contrabass (Cb). Each instrument part is written with detailed musical notation, including notes, rests, and dynamic markings such as *ff* (fortissimo) and *f* (forte). The notation is dense, with many notes beamed together, indicating a fast and intricate passage. The page number '15' is located in the upper left corner of the score area.

This musical score is for the piece "Wistling Dixie" (B.9). It is a full orchestration featuring a variety of instruments. The score is written in 2/4 time and includes dynamic markings such as *ff* (fortissimo) and *f* (forte). The instruments and their parts are as follows:

- Flute (Fl):** Features a melodic line with grace notes and slurs.
- Clarinet (Cl):** Provides harmonic support with a similar melodic contour to the flute.
- Bass Clarinet (B. Cl):** Plays a lower register accompaniment.
- Horn (Hn):** Provides harmonic support with a similar melodic contour to the flute.
- Trumpet (Tr):** Features a melodic line with grace notes and slurs.
- Trombone (Tbn):** Provides harmonic support with a similar melodic contour to the flute.
- Saxophone (Sax):** Features a melodic line with grace notes and slurs.
- Piano (Pno):** Provides harmonic support with a similar melodic contour to the flute.
- Violin (Vln):** Features a melodic line with grace notes and slurs.
- Viola (Vla):** Provides harmonic support with a similar melodic contour to the flute.
- Violoncello (Vcl):** Provides harmonic support with a similar melodic contour to the flute.
- Double Bass (Cb):** Provides harmonic support with a similar melodic contour to the flute.

The score is arranged in a standard orchestral format with multiple staves for each instrument. The notation includes various musical symbols such as notes, rests, slurs, and dynamic markings. The overall style is characteristic of early 20th-century jazz and blues music.

17

Musical score for page 17, showing staves for Flute (Fl), Clarinet (Cl), Bass Clarinet (B. Cl), Horn (Hn), Trumpet (Tpt), Trombone (Tbn), Saxophone (Sax), Piano (Pno), Violin (Vln), Viola (Vla), and Cello (Cb). The score is written in 4/4 time and includes various musical notations such as dynamics (e.g., *ff*, *f*, *mf*), articulation (accents, slurs), and fingerings. The piano part features complex rhythmic patterns and textures. The woodwind and string parts provide harmonic support and melodic lines. The saxophone part has a prominent melodic line with slurs and accents.

19

Musical score for measures 126-130, featuring strings and woodwinds. The score is written for Flute (Fl), Clarinet (Cl), Bass Clarinet (B. Cl.), Horn (Hr), Trumpet (Tr), Trombone (Tbn), Saxophone (Sax), Percussion (Perc), Violin (Vln), Viola (Vla), Violoncello (Vcl), and Contrabass (Cb). The music is in 4/4 time and includes various dynamics such as *p*, *pp*, *ppp*, *ppp* *mit Dämpfer*, *pp*, *ppp*, *pizz.*, and *pp*. The woodwinds and strings play complex rhythmic patterns, often with triplets and slurs. The percussion part features a steady, rhythmic accompaniment. The strings play a dense, textured accompaniment, often with triplets and slurs. The woodwinds play a melodic line, often with triplets and slurs. The percussion part features a steady, rhythmic accompaniment. The strings play a dense, textured accompaniment, often with triplets and slurs. The woodwinds play a melodic line, often with triplets and slurs.

This musical score is for the piece 'Wistling Dixie' and is arranged for a full orchestra. The score is divided into two systems. The first system includes parts for Flute (Fl), Clarinet (Cl), Bass Clarinet (B. Cl), Horn (Hr), Trumpet (Tr), Trombone (Tbn), and Saxophone (Sax). The second system includes parts for Piano (Pno), Violin (Vln), Viola (Vla), Violoncello (Vcl), and Contrabass (Cb). The music is written in 4/4 time and features a variety of rhythmic patterns, including triplets and sixteenth-note runs. Dynamics such as *pp*, *mf*, and *ff* are indicated throughout. The score includes detailed fingering and bowing instructions for the instruments.

B.10 *Return Through the Beautiful Sopping Mountain*

The score for *Return Through the Beautiful Sopping Mountain* can be found in the accompanying second volume in A3 format.