FORCE: A STUDY IN POLYRHYTHM

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INTRODUCTION

This paper is a study of polyrhythmic music.

Polyrhythmic music is characterized by the simultaneous use of two or more different pulses. Melodies tend to have simple, visceral rhythms, marking a clear tempo. Polyrhythmic textures are created by the superimposition of different tempos or pulses as individual melodies fuse, splinter and clash forming complex rhythmic designs.

What interests me about polyrhythmic music is that rhythm replaces harmony as the structural basis of music. Polyrhythmic techniques determine melodic features, textural designs, harmonic progressions and formal shapes. Ideas such as rhythmic dissonance and polyrhythmic cycles become defining features in the music. In this paper I will explore the structural power of polyrhythm as found in various pieces including my composition Force for choir and instrumental ensemble.

The paper is organized into three chapters. Basic features of polyrhythmic music are established in chapter one. In chapter two polyrhythmic ideas found in the music of Elliott Carter, Igor Stravinsky and Philip Glass are discussed. It will be shown that each composer offers a re-evaluation of the traditional ideas of rhythm with interesting ramifications on other musical features. In chapter three attention will turn to some polyrhythmic techniques in my recent pieces. By looking at two pieces in particular (*Force* for choir and instrumental ensemble, and *Piano Music '98* for solo piano), it will become clear how my compositional

approach has incorporated techniques discussed in chapter three. Lastly, the epilogue introduces some of the ideas behind *Force.*

Over the course of the paper I will introduce music by various composers: Igor Stravinsky, Elliott Carter, Philip Glass and Michael Gordon. This is not an analytical paper, however. It does not aim to provide information about the particular pieces. Instead various music is introduced to highlight issues related to polyrhythmic music. Usually the musical examples provide a springboard into a discussion about a particular technique. I have decided to focus on these particular composers because their music represents the three different types of music that make use of polyrhythms: early twentieth-century modernism and specifically additive rhythm (Igor Stravinsky); the American Experimental tradition, which includes the work of Henry Cowell (particularly *New Musical Resources*) and Conlon Nancarrow (Elliott Carter); and recent American polyrhythmic music (Philip Glass and Michael Gordon).

Accompanying this paper is a cassette with various examples that are referred to in the text. The reason for this is that some of the music (specifically that of Philip Glass and Michael Gordon) cannot be clearly communicated by the score.

Lastly, reference is often made over the course of the paper to the “listener.” I am interested in finding out not only what the score indicates but also what is perceivable and thereby understandable to the listener. When I refer to the listener, I am basing the observations on my experiences with this music.

CHAPTER 1: WHAT IS POLYRHYTHM?

The discussion on polyrhythm begins with two musical examples: (1) an excerpt from the first movement of Elliott Carter's String Quartet No. 1, and (2) the opening measures from *Yo Shakespeare* by Michael Gordon.

Example 1

(a) Carter, String Quartet No. 1, movement 1, mm.22-32

Cassette: Side 2, (a) & (b)

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b) Gordon, *Yo Shakespeare,* mm. 1-13

What is perhaps most striking about the two excerpts is how dissimilar they are. Written in the mid-century, Carter's String Quartet contains both traditional and experimental elements. By using the string quartet medium, a genre associated with some of the greatest achievements in Western Art music, he places the piece in the tradition he inherited from composers such as Bartok and Schoenberg. And, at the same time, Carter consciously develops new formal and expressive designs. *Yo Shakespeare*, on the other hand, written for the eclectic English ensemble Icebreaker seems, on first listening, like a strange amalgam of music of Philip Glass and popular music. With an amplified assortment of such instruments as electric guitar, keyboards, saxophones and pan pipes, the music has an impersonal disembodied sound closer to rock'n'roll than to Classical music.

And yet, despite all these differences, the two examples share something in common: a similar approach to rhythm.

Carter employs the most restrictive approach possible. Each line comprises only one rhythmic duration: violin 1, a five triplet quarter note value or 36 beats per minute; violin 2, a five sixteenth note value or 96; viola, a one triplet quarter note or 180; and cello, a quarter note or 120. These melodies do not really function as traditional melodies. There are no phrases or cadences or any sense of an ebb and flow; instead the lines are like “lower-level” beings which articulate a particular speed or tempo.

Not surprisingly, the character of the melodic material influences how these lines interact with to each other. This music is unremittingly polyphonic. The four parts never coalesce to define phrase breaks or larger sections. Here there are four different tempos in a polyrhythmic texture. In this type of texture fluctuations of tension are dictated in part by changing levels of rhythmic dissonance between the parts. Therefore the viola and cello 2:3 rhythmic ratio is considered less dissonant than the 3:8 ration between the two violins.

There is a similar situation in *Yo Shakespeare*. At the beginning of the piece there are two lines, each made up of two different sets of durations. As in the String Quartet, the rhythmic character of these lines is rigid. In contrast to the Carter though, the rhythms consistently group into larger units that are asymmetrical in relation to the notated meter and even the beat.

Part A in Example 1(b) is 5 quarter notes long, which contradicts the 4/4 meter, while the Part B unit at 4 + 1/3 quarter notes does not fit into the notated beat.

The beginning of the unit only coincides with the notated beat every third time. Pitch features reinforce the grouping of rhythms into larger cells as one pitch is allocated to a different rhythmic type thereby making the rhythmic character as clear as possible. In Part A, the dotted eighth notes play D and the quarter notes B flat, and in Part B the pitch A is used for both the eighth and the triplet quarter rhythms.

In the same way that Part B goes out of synchronization with the notated meter, Gordon plays the Parts A and B against each other. Because they are different lengths, the parts are related by a 14:15 ratio relationship and come back into synchronization after a 42 beat cycle.[1] Just as in the String Quartet, a complex polyrhythmic continuity is created from simple lines.

From a cursory discussion of these two pieces, it has been established that they share the following rhythmic features:

• Individual lines are simple, comprising one or two different rhythmic durations, and are often ostinatos.

• Lines have a “mechanical” quality with no rubato or rhythmic suppleness.

• Rhythmic interest becomes focused on the relationship between the lines, rather than on the particular lines themselves.

• Cycles, where the lines of various speeds go in and out of phase, become larger rhythmic units.

While these four characteristics describe the general polyrhythmic features, they also raise questions about other aspects of the music. For example, how does

[1]It should be pointed out that if the two figures were unchanged, the cycle would be seventy beats long. As can be seen in measure 10, the last three statements of Part A contract to a four quarter note group.

meter function in this music? Does each part have its own meter, or perhaps there is no meter? Or perhaps the meter of one layer subsumes the meters of the conflicting layers? Also, what types of continuities and formal designs are created by each type of music? If the nature of the style is to superimpose diverse materials, how are we to understand the textural character in this music?

The next chapter will grapple with these questions through a discussion of three different examples of polyrhythmic music.

CHAPTER 2: THREE VIEWS OF POLYRHYTHM

In this chapter three applications of polyrhythmic techniques will be discussed: Carter's String Quartet No. 1, Stravinsky's *Symphonies of Winds* and *Einstein on the Beach* by Glass. I will show how each offers a different understanding of polyrhythm and, in the process, consider the questions posed at the end of the previous chapter. Specifically, issues such as polyrhythm as heterophany, additive rhythm and its relation to meter, and cycles will be examined.

(a) Absolute Rhythm:
Elliott Carter, String Quartet No. 1

A clear example of heterophonic potential of polyrhythmic techniques can be seen by turning back to measures 22-32 from the first movement of String Quartet No. 1 by Elliott Carter.

Example 2
Carter, String Quartet No. 1, movement 1, mm 22-32

One striking aspect of this excerpt is the independence of the four lines. This is achieved by avoiding a rhythmic hierarchy and downplaying the polyrhythmic relationships. In measures 22-26 it can be seen that the second violin groups into 2+3+3+3+3+2 before it begins to speed up in measure 27. By varying groupings

Carter avoids a suggestion of a rhythmic hierarchy in which the surface rhythmic details are organized into slower moving rhythmic units, such as measures. This feature is common to all melodies played by the first violin, viola and cello.

Not only is there no sense of hierarchy in the individual parts but also the relationship between the various melodies is not stressed. Usually, in a polyrhythmic texture pairs of lines will coincide, thereby creating larger units or periods. Carter, however, uses melodic contour and other aspects to downplay this notion of periodicy. In measures 22-3, for example, there is a 4:5 polyrhythm between the second violin and the cello, which suggests a five quarter note period. In example 3, however, it can be seen that the 4:5 polyrhythm between the second violin and the cello is obscured by the melodic contour and pitch characteristics of the two instruments. Also the listener's attention is drawn away from the second violin and cello polyrhythm by the entrance of the first violin in measure 22.

Example 3
mm 22-3

The independence of the parts is projected onto the larger formal design of the movement through use of absolute rhythm. Absolute rhythm refers to the speed of a rhythm in clock-time and therefore stresses the self-contained nature of the theme rather than its relationship to the other parts. Over the whole movement eight themes, each with its own speed, gestural identity and intervallic character, are used. Below in Example 4 I have included the four statements of the pizzicato theme first introduced in Example 2, mm 22-30, 91-101, 158-163, 178-180.

Example 4

In all four statements the theme is unchanged. It begins with an E major first inversion chord always with a falling half step. Even though it is notated in different rhythmic values, the first three statements are at the same absolute speed, 96 beats per minute.[2]

Continuities are formed by juxtaposing different combinations of these fixed themes through the use of metric modulation. In measures 158-164, as shown in Example 5, the pizzicato theme is combined with the cello theme that opens the whole movement (now played by the viola). At the original notated tempo of quarter note equals 120 this would not have been possible. Metric modulation

[2]In measures 178-80 the theme returns at a faster speed, 160 which raises questions about the importance of absolute rhythm for the listener. Recognition of thematic return is based as much on melodic contour and pitch features as it is on the absolute rhythm. Therefore when the theme returns at 160 instead of 96 it is still clearly heard as relating to the earlier statements. Similarities such as the pizzicato articulation, the first inversion triad and falling half step prove to be stronger than the difference in speed.

therefore can be understood as a broadening of the notated tempo, enabling Carter to create a great variety of contrapuntal situations.[3]

Example 5

mm156 -164

Over the course of the movement, there is no attempt to fuse or link the themes as the notion of heterophony is maintained. By stressing the idea of multiplicity inherent in polyrhythm, it is as though traditional meter has been removed. Nothing that can suggest a link between the parts, whether it is the notated meter, periodicy or forming rhythmic hierarchy, is emphasized. Instead the diverse material, unencumbered by a metrical hierarchy, creates a sense of building, leading to the climax in measure 313.

[3]It is assumed that the reader knows about how this technique works. There will be more discussion of metric modulation in Chapter 3.

Because Carter chooses to present a variety of themes unhinged from a metrical context, it is not surprising that polyrhythmic relationships between the four parts are obscured. For the listener the independence of the four parts is suggested by the complexity of the polyrhythmic textures. In measures 22-32 a situation is created in which the listener is not able to identify rhythmic relationships between the various themes, due to the complexity and brevity of the polyrhythms. The four part textural design set up in measure 22 starts to change in measure 27 so that the opening polyrhythmic configuration lasts a mere ten seconds. It is not possible here for the listener to perceive the actual proportional relationships.

This brief discussion shows how the heterophonic potential of polyrhythm is emphasized in Carter's String Quartet. Multiple themes, each with its own individual tempo, are juxtaposed rather than fused. Because meter is absent, any material, theoretically, could be included. This all-inclusive attitude, therefore, is a celebration of diversity rather than unity.

(b) Additive Rhythm:

Stravinsky, *Symphonies of Winds*

The second application of polyrhythm is to be found in *Symphonies of Winds.* While Carter, in the String Quartet No. 1, uses rhythm unhinged from a metric context, the rhythmic approach in *Symphonies of Winds* is based on the emancipation of meter.

It may seem surprising that a discussion of polyrhythm should include Stravinsky and in particular *Symphonies of Winds;* after all this piece is more monophonic than polyrhythmic. But by examining a rhythmic conception that privileges meter, we will come to an understanding of additive rhythm and its polyrhythmic potential.

The importance of meter can be seen in the opening of *Symphonies of Winds,* in Example 6 below:

Example 6

Stravinsky,*Symphonies of Winds,* mm 1-6

Cassette: Side 2, (c)

Here all musical elements work towards a common goal: the expression of meter. Elements such as rhythm, harmony and melody project features of the measure. The composite or ensemble rhythmic scheme presents continuous eighth notes, corresponding to the smallest value of the notated 2/8 and 3/8 measures. Harmonic progression is wedded to the measure as chord changes are linked to the downbeat. This section oscillates between two chords where the

second (measures 3 and 5) has a cadential function. Melodic cells not only exist within the measure (they never cross the barline) but they project the accentual character of the measure. The importance of the downbeat, for example, is marked by the flutes, clarinets 1 and 2, and trumpets 2 and 3; the upbeat in the 3/8 measures is articulated by the clarinets and flutes; trombones play the second beat of each larger unit or phrase. In short, qualities of the measure, its length and internal features, are foregrounded.

One result of elevating meter so it comes to dominate the musical continuity, is that metric irregularity is highlighted. In the first two measures of *Symphonies of Winds* (Example 6 above), we can see how Stravinsky emphasizes the irregular over the regular. The third clarinet, by playing a five eighth note pattern subtly contradicting the metric design (grouping into 3 and 2 instead of 3 and 2), suggests a regular 5/8 pattern. If, however, Stravinsky had decided to notate this opening section into three measures of 5/8, the importance of the written meter would have been diminished. The melodic shapes and the phrases would have been independent of the bar line, thus pushing meter into a more traditional and subservient role.

The emphasis on irregular meter creates a sense of stasis. Traditionally, meter functions as a grid that is regular and combines with rhythm to create a sense of motion in music. In the *Symphonies of Winds*, on the other hand, meter is foregrounded and irregular. This creates a situation in which there is no sense of an upbeat, only irregularly spaced downbeats. Unable to anticipate the next upbeat, the listener is forced to abandon any sense of expectation and instead attention is focused on the repeating measure. Fluctuations in the size of a repeating measure replaces the notion of progression or development.

The character of other elements such as melody, harmony and rhythm is influenced by this sense of stasis. Melodies play ostinatos that reflect the accentual pattern of the measures. Harmony is no longer functional and instead becomes a color, which defines changes of measure. Likewise, rhythm is bound to meter with the result that there can be no such thing as rubato or syncopation. Undoubtedly, this approach to rhythmic organization contributes to the oft-stated notion that Stravinsky's music is impersonal. In Stravinsky's music there is a singularity of purpose, where all the musical elements project the measure.

An understanding of the importance of meter in this excerpt reveals the relationship between additive rhythm and meter. Additive rhythm, a technique long associated with Stravinsky's music, is a way of articulating metrical qualities. From this perspective it would be more correct to use the term additive meter rather than additive rhythm because this technique is an expression of meter.

In String Quartet No. 1, Carter's insight into rhythm is to replace the traditional rhythmic design with rhythms unhinged from context. Without meter, rhythms adopt an absolute identity, creating a truly polyphonic conception. Stravinsky, on the other hand, opts for the other extreme. All elements are subordinate to meter, creating a unity of purpose. His music is an exploration of the power of meter.

But what influence does this have on polyrhythmic techniques? By privileging meter over other elements, Stravinsky emphasizes the organizing power of rhythm. Also, specific features of meter come to be important in polyrhythmic music: for example, the repeating unit of the measure and non-rubato,

mechanical rhythm. A look back at *Yo Shakespeare* (example 1b) shows the relationship between Stravinsky's procedures and polyrhythmic techniques. The two parts in *Yo Shakespeare* can be seen as two metrical units, not unlike the material in *Symphonies of Winds* where the changes in Part A are a result of additive processes. It could therefore be argued that *Yo Shakespeare* is polymetric.

(c) Cyclic rhythm:

Philip Glass: *Einstein on the Beach*

If Stravinsky's music is described as a foregrounding of meter, then in the following excerpt melody is frozen into meter.

The first two sections from *Einstein on the Beach,* Act II, Scene 1 are presented in Example 7 below:

Example 7[4]

Glass,*Einstein on the Beach,* Act II, Scene 1, mm. 1-14

Cassette: Side 2, (d)

[4]This is my transcription, except for the first two measures, which are included in *The Music of Philip Glass*. I have chosen to notate the music in quarter and eighth notes following the two measures from Glass, even though, at the tempo of quarter note equals 264, the quarter is not really perceived as the beat.

Clearly if this music is about anything, it is about rhythm. All other musical elements are de-emphasized: harmony is static and diatonic; dynamics are unchanging; there is no accentual patterns; melody is simple; the ensemble plays tutti throughout. Only in the area of rhythm is there any sense of change. Inevitably, the listener is drawn to the fluctuating melodic cells as they expand and contract through additive processes. I will argue that understanding this music is determined by following the rhythmic changes, which are complex and yet perceptible.

Glass uses both additive and divisive techniques in this piece: additive techniques apply to the individual line, while divisive processes determine the relationship between the lines. Though these techniques Glass creates a complex rhythmic situation from simple means.

As shown in Example 7, there is a two-part texture in which Part A comprises quarter notes only and Part B eighth notes. As there are no rests, an absolutely unchanging rhythmic surface is created.

Larger rhythmic groupings are created by melodic shapes. Part A, played by the saxophones, is a fixed three-note figure while Part B is constantly changing size through additive processes. This part, played by the voice, organs and flutes, is not so much a melody, but a compound line, in rhythmic unison.

The melodic cells in Parts A and B combine, in turn, to form cycles. This level is shaped by the polyrhythmic relationship between the two parts. In every

notated measure[5] the melodic cells repeat until the beginning of each coincide. For this reason the size of Part B, and therefore the polyrhythmic relationship between the two parts, determines the length of the cycles. In measure 6, for example, the cycle is 15 quarter note beats long, while in the following measure the cycle is six beats.

Figure 1 outlines the three levels of the rhythmic hierarchy – the beat, melodic motive and cycle – in this piece.

Figure 1

As mentioned the fastest level (the beat) is fixed in both Parts A (eighth notes) and B (quarter notes). Beats group into melodic cells (motives) which, because Part B is changing through additive processes, are irregular. The cycle level, while it does share the irregularity with the motive level, is shaped by divisive techniques.

[5]I am calling the cycles "measure" for convenience because they look like measures in the score. They are not measures as found in the metric hierarchy.

Formal design is constructed from consecutive cycles. In this music there is no feeling of progression (in the sense of the music building to a climax) for two reasons: firstly, other elements such as harmony and dynamics are fixed and discourage the feeling of development; and secondly, Part B does not have a "logical" progression. The additive processes are unpredictable, creating a sense of an ebb and flow within a static environment. Fluctuating tension on the musical surface is created by varying levels of polyrhythmic dissonance. More complicated polyrhythms create more tension, are longer and tend to resolve to simpler polyrhythms (or even rhythmic unisons for example in measures 3 and 13). In measure two, for example, the 3:4 polyrhythm "resolves" to the "consonance" of the common 3/4 in the measure three. Rhythm here replaces the harmony as the means of regulating tension.

The organizing power of the polyrhythm offers an alternative to the polyrhythmic techniques as found in the music of Carter. Carter, in the String Quartet, is concerned with downplaying the relationship between the parts and asserting the independence of the lines. In *Einstein*, by contrast, the relationship between the two parts is all-important. Attention is focused on the relationship, because not only does it create cycles, but also the two parts are defined by their relationship to each other. This can be seen in the first two measures. Even though Part A is unchanged, it sounds different in measure two when Part B enters. Because Part B is more dominant, its entrance in the second measure creates polyrhythmic tension as the 3/4 meter of Part A is now heard in the context of the 4/4 of Part B.

The mechanical, impersonal nature of the music suggests that rhythmic procedures in *Einstein* are more closely related to Stravinsky than to Carter. Certainly they both use additive processes and both create a hierarchy. In both pieces the expanding and contracting cells create irregular measures and larger shapes which frustrate listener's expectation.

But in *Einstein* not only is the notion of the upbeat disguised but also the downbeat. Unlike the *Symphonies of Winds* where all the lines highlight the downbeat, here the downbeat can only be recognized after it has occurred. With the fixed rhythmic surface and static harmony, it is only when the melodic shapes have changed that the listener registers the downbeat. In Example 8 Part B moves from a three to a four quarter note figure in measures three and four. Notice how the change occurs at the end of the cell and that it is a repetition of the first beat of the cell. Therefore the listener does not realize until the beginning of the second statement of measure four that the cell has expanded.

Example 8
mm. 3-4

Measures three and four also show how the melodic shape of Part B contributes to the blurring of the meter. In measure 4 the Part B cell is really a 3/4 plus 1/4

and not a 4/4 measure. The figure does not reflect the accentual pattern of a 4/4 measure, and in fact the first and fourth beats are identical. For the listener it becomes difficult to recognize the downbeat. A similar situation is found in Part A. Confusion is created because the E flat on the unaccented third beat begins to be heard as a kind of tonic, or downbeat, suggesting a point of arrival. Here the rhythmic and pitch features blur metric definition.

Another factor that obscures metric identity is the fast tempo (quarter note equals 274). In Figure 1 the three levels of the rhythmic hierarchy were labeled as beat, motive and cycle and yet the actual tempo forces the listener to hear beats as subdivisions of the beat. The melodic motivic level, therefore, comes to be heard as the beat. Because Part B is always changing and is almost always different from Part A, there are always two simultaneous beats present.

This obfuscation of meter is created by a rhythmic conception that is fundamentally different from Stravinsky's. In *Einstein* the two parts do not project the accentual pattern of the measure; on the contrary, as pointed out above, a feature of the music is the absence of accents. The listener is faced with the odd situation of repetitive, motoric rhythms where the meter is elusive. Melodic cells are characterized by rhythmic features that are frozen and juxtaposed with another cell of a different length. We are left with a music that projects a rhythmic hierarchy without traditional rhythmic features. There is no sense of breathing in the music, no rubato, cadences, or phrases. Instead, the effect of the relentless rhythmic character combined with an unchanging articulation, fixed dynamic levels and static harmony is of a mechanical music.

(d) Conclusion

The three musical examples included in this chapter offer different applications of polyrhythmic thinking. Each piece raises questions about polyrhythms and their influence on the musical surface.

Elliott Carter's String Quartet No. 1 explores the heterophonic potential of polyrhythm. His music is characterized by independence between the parts as he strives to create a music without context – in effect a meter-less music. Without a sense of meter rhythms seem to be unhinged from context, suggesting a music of fragmentation. Carter constructs larger formal designs through techniques such as metric modulation and emphasis on absolute rhythm. Problems of perception were raised with the polyrhythmic techniques. It was suggested that because he stresses the notion of multiplicity, the actual relationships between the lines are not emphasized.

Igor Stravinsky's *Symphonies of Wind*s, on the other hand, presents an application of rhythm totally opposite to Carter. While the String Quartet No. 1 suggests rhythm without meter, *Symphonies* has music as only meter. By projecting the characteristics of meter onto the musical surface, Stravinsky develops additive processes that are understood as expressions of meter. His rhythmic features are devoid of rubato or syncopation as every element supports the metric progression. The mechanical and static nature of meter comes to dominate the expressive mood.

In Philip Glass's *Einstein on the Beach* the polyrhythm becomes the defining feature in musical continuity. All other musical elements are static, and changing

polyrhythms dictate the ebb and flow of the music. Through a combination of additive and divisive techniques, he creates a rhythmic design that is complex and yet transparent to the listener. His approach is based on the rhythmic hierarchy, which curiously adopts some characteristics of meter while, at the same time, obscuring any sense of meter.

The discussion of three applications raised many issues associated with polyrhythmic techniques. It will be left to the next chapter to see how all these insights have influenced my own rhythmic thinking.

Chapter 3: Polyrhythm in my Music

This chapter deals with some of the polyrhythmic ideas in my recent music. I will show how rhythmic ideas in the music of Carter, Stravinsky and Glass have been incorporated into my rhythmic thinking. Specifically, I am interested in exploring the potential for polyrhythm to create a polyphonic environment, in which multiple rhythmic processes exist simultaneously.

Figure 2 presents a rhythmic design that has formed the basis for my recent pieces.

Figure 2

Figure 2 can be viewed as a reservoir of possibilities. It does not mandate a certain type of progression; instead it contains a web of relationships which can be realized in different ways. Techniques already discussed in this paper – such as metric modulation, additive rhythm / meter and cyclic processes – are incorporated into the rhythmic design above.

The first part of the chapter will focus on some of the features found in Figure 2. I will look at the features of the rhythmic model from (i) a vertical perspective, examining the hierarchical aspects of the design; (ii) a horizontal perspective, explaining the relationship between the speeds or cells on a particular level; (iii) the role of meter and metric modulation as organizing features; and (iv) the "bug" in the system.

Secondly, I will outline how some of these features are realized in *Force*, a piece for choir and instrumental ensemble, and *Piano Music'98* for solo piano.

(a) The Rhythmic Design

(i) The Vertical Hierarchy

In Figure 2 there are three rhythmic levels: the subdivided beat, the beat and the measure. The impetus for this model begins at the beat level and the relationship between the two parts, labeled A and B. On the left side of the figure, Part A comprises dotted eighth durations, and Part B triplet quarter notes. The relationship between the two parts is an 8:9 ratio. On the right side of the figure Part A is notated in triplet quarter notes and Part B in quintuplets, and because

the speed of Part B is slower (210 rather than 212.625) the ratio between the parts becomes 9:10. [6]

A hierarchy for Parts A and B is constructed in both the notated tempos. In Figure 3 the three levels of the Part A hierarchy can be seen.

Figure 3

The beat in Part A can be grouped into four or three so that the measure or slowest level is either 47.25 beats per minute in absolute time or 63 beats per minute. In the same way the fastest level can either subdivide the beat into three (567) at notated tempo of quarter note equals 141.75 or two (378) at quarter note equals 126.

Part B is organized in the same way.

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[6]This changing ratio and its influence on other rhythmic features will be discussed below.

Figure 4

In Figure 4 it will be noticed that the tempo 141.75 is here notated as 140. As mentioned above, in Figure 2 the beat of Part B slows from 212.625 to 210. By notating 141.75 as 140 the beat of Part B is held constant at 210 and it is the Part A beat which slows down to 186.67 at notated quarter note equals 140.

As in Part A, Part B is organized into a hierarchy where the beat level is fixed and the measure and the subdivided levels each have two speeds: the beat of Part B groups into three (70) or five (42), and the fastest level subdivides the beat into three (630) or two (420). Figure 5 adds to the information of Figure 2 quarter note equals 140.

Figure 5

(The symbol is used to indicate approximate equality.)

The grouping of the Part A beat into four or three and Part B into three or five beat measures is not arbitrary but is dictated by the notated tempo. At quarter note equals 141.75 the grouping of Part A into four (47.25) and Part B into three (70.875) produces a measure level in synchronization with the notated tempo: 47.25 equals a dotted half note and 70.875 a half note. Similarly, at quarter note equals 126, groups of three in Part A (63) equal a half note, and groups of five in

Part B equal a dotted half note. The relationship between the grouping and the two notated tempos is shown in Figure 6.

Figure 6

That each of the two parts can be grouped in two different ways as shown in Figure 6, and that these coincide with the notated tempo, can be understood as a systemization of additive processes as found in Stravinsky and Glass. Unlike the irregular additive progressions in Stravinsky and Glass, here the expanding and contracting cells are integrated into a hierarchy that is regular.

The subdivided or the fastest level of the hierarchy is, likewise, shaped by the notated meter. The Part A beat is subdivided into three at the notated quarter note of 141.75 and two at 126 on the right side of Figure 4. Exactly the same situation holds for Part B: at notated quarter note 141.75, the triplet quarter note subdivides into two and at 126 into three.

To summarize, the subdivision / fastest level and the measure / slowest level in each of the two parts comprise two different rhythmic speeds. In the next section

we will see that each of the three levels has its own independent progression, while always remaining within the hierarchy.

(ii) The Horizontal: Individual Levels

When examining the rhythmic model from the vertical perspective, I stressed that there were two separate hierarchies: Part A and Part B. In this section we will instead parse the design into three separate levels (the fastest / subdivided beat, medium / beat and slowest / measure) and consider the relationship among the various rhythmic values in each. If we look at the fastest level independent of the two slower levels, there is an interesting relationship among the four rhythmic values.

Figure 7

The relationship between the two fastest rhythmic values in each part is a 2:3 ratio, even though this was not highlighted by the notation: in Part A 567 and 378, and Part B 630 and 420. If we consider these four rhythms together, we can see that they are all linked by a 2:3 ratio: either 637.875, 425.525, 283.5 and 189; or

630, 420, 280 and 186.67. [7] One application of this feature could be a terraced accelerando or ritardando progression.

Figure 8

The same feature is present in the slowest / measure level as shown in Figure 9.

Figure 9

[7] In order to create the 2:3 ratio the two speeds in Part A have been halved. In my opinion this does not destroy the integrity of this design because 2:1 is not really a ratio; instead it is a variation of the same speed – a rhythmic analogy to the octave.

What this reveals is that the horizontal level (the subdivided, beat or measure levels) and the vertical (the Part A or B hierarchies) can have independent rhythmic progressions. In Figure 10 I have indicated a possible progression where the fastest level is slowing down at a 3:2 ratio, the beat level is fixed and the slowest is speeding up at a 2:3 relationship. The effect of this complex polyrhythmic situation is a powerful imploding or focusing of energies. (This technique is used in *Force*.)

Figure 10

(iii) Metric Modulation

It is really the measure and metric modulation that guides the continuity in this rhythmic model. Both Stravinsky's insight into the power of the measure and Carter's expansion of tempo possibilities influence my attitude to metric modulation.

Metric modulation essentially combines both additive and divisive techniques. In order to create a rhythmically polyphonic situation, one element remains fixed

while the other changes. This is done either by keeping the beat constant and varying the size of the measure (additive), or by maintaining the measure and subdividing it in different ways (divisive).

Metric modulation in the rhythmic model above differs from Carter's conception as discussed with respect to String Quartet No. 1, chiefly because the notated tempo is always articulated on the musical surface. An example of the active involvement of notated tempo and meter can be seen in Figure 11. When the Part B hierarchy moves from a three to a five note melodic cell at notated quarter note equals 140, metric dissonance results. At five triplet quarter notes the length of the cell does not coincide with the notated beat. One way to resolve this dissonance is to modulate to quarter note equals 126. In the new tempo the five note cell becomes consonant with the notated tempo – i.e. it groups into a dotted half note. Or perhaps it can be understood that the notated meter becomes consonant with the five note cell. In this situation it is the notated tempo, and not the melodic cell, which changes.

Figure 11

In this case metric modulation creates a move from polyrhythmic dissonance to consonance and the notated measure becomes an important element in shaping musical continuities.

(iv) The “Bug”

As already mentioned there is a “bug” in the design. A comparison of Figure 2 with Figure 8 reveals a curious fact. In Figure 8 the 3:2 ratio progression on the subdivided level begins with 630 and finishes with 186.67. 630 is the value of the subdivided Part B level in quarter note equals 126. In Figure 2 this hierarchy is combined with Part A which has 189 as the beat and 378 at the subdivided level. We are left with two different durations 186.67 and 189. Admittedly, the disparity is small – and perhaps not perceivable – but it is still surprising that we arrive at slightly different values when we take different progressions through the model. This situation is further complicated if the 2:3 ratio progression at the measure level is added. The measure level moves to notated quarter note equals 141.75 while the subdivided levels ends up at quarter note equals 140. Figure 14 outlines the “bug’ by comparing Figure 2 with the subdivided level in Figure 7, and the measure level in Figure 8. Notice the difference between 186.67 and 189 and 141.75 and 140.

Figure 12

The reason for this discrepancy lies with the changing relationship between the Parts A and B at the beat levels. As the ratio changes from 8:9 in 141.75 (or 140) to 9:10 at quarter note equals 126, it influences the relationship between the rhythms on all levels. Rather than gloss over this discrepancy and try to argue that it is almost the same, this feature is used in *Force* to create tension / release. It will be shown that these imperceptible changes shape the continuities as rhythmic dissonance is resolved through a metric modulation.

(b) Applications

Now let us turn to applications of the rhythmic design as outlined in Figure 2. Firstly, the “bug” can be seen in a musical context at the climax of Section A in *Force*.

(i) The “bug” and the Section A climax

In measures 49-56 there is the climax to Section A, which is resolved by a metric modulation at measure 57. Even though the rhythmic material at the measure level in Parts A and B is virtually unchanged, the use of the “bug” has major ramifications on the relationship between Parts A and B and therefore on the musical surface. Measures 49-60 are contained in Example 9.

Example 9

Force, mm. 49-60

Cassette: Side 2, (e)

The instrumental ensemble is divided into two parts as flute 1, violin, double bass, tom-tom and keyboard 2 play the dotted eighth note beat or Part A, and flute 2, cello and keyboard 1 Part B. All levels of the hierarchy are presented: in Part A flute 1 plays the subdivision of the beat or the fastest level (567) and the others play a cell comprising the dotted eighth note beat which groups into both 3 (or 63) and 4 (47.25); likewise, in Part B the fastest level (425.25) is played by flute 2, and the cello and keyboard 1 play a cell based on triplet quarter note rhythms which group into 5 (or 42.525) and 3 (70.875). As discussed in (a) (i) above, the Part B beat slows from 212.625 to 210 in the metric modulation to 126 and therefore there is a corresponding change at the measure level from 42.525 and 70.875 to 42 and 70. In Figure 13 I have provided a reduction of this section in which it is easier to see the relationship between the two parts.

Figure 13

Figure 13 shows two things: first, the cycle between the parts is much longer in the 141.75 section (24 beats or 5.9 beats per minute), than in the 126 (6 beats or 21 beats per minute); and second, the measure groupings are changeable in the 141.75 tempo and fixed in the 126. Cycle lengths are dictated by the ratio

between Parts A and B and therefore it is not surprising that 63 (the prominent measure of Part A) and 42.525 of Part B are related by a 27:40 ratio. By contrast after the metric modulation in measure 57, the ratio between Parts A (63) and B (42) becomes 2:3. This subtle shift at the measure level of Part B (42.525 to 42) completely changes the relationship between the two Parts – from a 27:40 ratio to a 2:3 ratio as shown in Figure 14.

Figure 14

In measures 49 to 56 variable measure sizes also contribute to the sense of tension. Part A moves in a pattern of two groups of three (63) and then two groups of four (47.25). Part B is more fixed with three statements of five quarter note triplets (42.525) and one of three (70.875).[8]

Figure 14 also shows that the movement to a more "consonant" 2:3 ratio on the measure level is mirrored on the beat level. The cello slows down so that 42.525 which was subdivided into five (212.625) in measures 49 to 56 divides into 3 (126) at measure 57. What is stressed is the polyrhythmic link with the violin, as there

[8]There is a practical reason for the variable nature of the measure size in 141.75 (measures 49-56). A 27:40 ratio would have taken 90 beats to complete.

is a move on all levels from rhythmic dissonance to consonance. In this example the “bug” in the design is used to invest metric modulation and by extension the notated meter with the power to shape the flow of the music.

This feature is used in the last section of *Force* (Section F, measures 524 to 611) to create an ebb and flow. In this section the complex ratio between the parts 27:40 in both 141.75 (or 140) and 126 is presented differently. Rather than shorten the cycle from ninety beats to twenty-four by varying the measure sizes (as found in Section A), only the last part of the cycle is presented so that Parts A and B meet at the point of metric modulation. This application of the “bug” retains the integrity of the polyrhythmic relationship between the two parts. In Example 10 measures 565 to 575 are presented. Flute 2 and the cello play quintuplets which are grouped into three (70) from measure 566 onwards and which are fixed over the metric modulation. Flute 1 and the violin play groups of four triplets (46.67 at the measure level) which are subdivided into three when the music modulates to quarter note equals 140. The measure level is fixed and the beat slows by a ratio of 4:3 causing the beat polyrhythm to “resolve” from a 9:10 ratio in measures 565-570 to 2:3 at measure 571.

Example 10

Force, mm. 565-575

(ii) Polyrhythm as process: *Piano Piece '98*

In this and the following section two formal ideas suggested by the rhythmic model will be discussed.

A sense of development comes from how the various rhythmic cells relate to each other and not from the change within an individual cell. Just as in *Einstein*, context creates rhythmic complexity as cells of different lengths are superimposed, thereby creating composite polyrhythms.

Both of the examples in this section come from *Piano Piece '98*, which makes use of only the left section of the rhythmic model of Figure 2. This piece, unlike *Force*, is not concerned with metric modulation, but with the construction of larger formal shapes from cycles.

In the opening section Parts A and B are present. Figure 15 shows how the parts are organized.

Figure 15

The dotted eighth note beat of Part A is always presented as a “hyper-measure” of nine quarter notes, which can be grouped into three groups of four (47.25)[9] or four groups of three (63). Likewise, the triplet quarter note beat of Part B is in a “hyper-measure” of ten beats, which can be arranged into five groups of three (70.875) or three groups of five (42.525).

Superimposed over Parts A and B is a figure sixty-five beats long. The line is characterized by a fixed two note figure of three quarter notes (47.25) and a triplet quarter note figure (70.875), which is contracting.

Figure 16

Continuity is constructed from the clash of the various elements as they create a complex composite rhythmic texture.

[9]Even though the design is realized at a faster tempo in *Piano Piece ‘98* (168 as opposed to 141.75), I retain the original values so that the relationship to the rhythmic design in clear.

Example 11

Piano Piece '98, opening section

Cassette: Side 2, (f)

(iii) Continuity as isorhythm: last section *Piano Piece ‘‘98*

Another, and more abstract method of constructing sections is derived from what I call “isorhythmic” techniques. Essentially it is an amplification of cyclic processes. Just as cycles produce sections of rhythmic complexity from inert material, so isorhythm is applied to harmony, gesture as well as rhythm to create textures that are constantly changing. In the last section of *Piano Piece ‘98* we can see an isorhythmic continuity.

Example 12

Section H

Piano Piece ‘98, final section

Cassette: Side 2, (g)

Example 12 continued

The basic hypermetric unit is 10 beats which can be grouped into three 2/4 + 2/6 (or two quarter note triplets) measures, or two 4/4 and one 2/4 measures. (The ten beat unit is always indicated by barline, as opposed to dotted barline for the smaller measure subdivisions.)

Texture comprises two cells: one is the chords, which enfold the texture, and the other is the repeating C and falling half step figure from F through E to E flat. Figure 17 identifies the two independent elements.

Figure 17

The various isorhythmic components are:

• Time signature pattern of 2 units of 2/4+2/6 measures (20 beats), and 1 unit of 4/4 and 2/4 measures (10 beats).

• The chords as outlined in Figure 19 are in a 5:6 slow moving polyrhythm, which unfolds over two statements of the unit (20 beats).

• The actual chord progression is 40 beats in duration (or four statements of the unit).

• The chords can be notated in both the 2/4 + 2/6 or the 4/4 and 2/4 subdivision. In either case they mark every downbeat. Accents and groupings of chords change to reinforce the measure subdivision (compare measures 1-5 with measure 16-21).

• The other cell alternates two gestures, the repeating C and falling half step from F to E Flat (three units or thirty beats), and a rising scale in octaves (two units or twenty bars).

Figure 18 shows how the various lengths of these five components create a shifting continuity that is always changing even though it comprises static materials.

Figure 18

(iv) Written out accel and rit: Section F, *Force*

Lastly, I want to include an example of the polyphonic rhythmic processes available from the rhythmic design in Figure 2 as found at the beginning of Section F of *Force.*

It can be seen in Example 13 that the subdivided level is slowing down in a 2:3 ratio played by the flutes and the keyboards, the beat level is fixed played by the violin and cello, and the double bass, percussion and keyboard play a 2:3 accelerando at the measure level.[10] At measure 541 the subdivided and measure levels fuse with the beat level which propels the music into Section F and the climax of the whole piece.

[10] As indicated in Example 11, the first rhythmic value of the measure level (measure 532) is 42.525 and not 42. The relationship between 42.525 and 63 is not an exact 2:3 ratio.

Example 13

mm 532-542

(c) Conclusion

In this chapter I have shown how polyrhythmic techniques and ideas found in the music of Carter, Stravinsky and Glass have been incorporated into my music.

While the independence of the lines in Carter's String Quartet and the resulting lack of hierarchy is not of interest to me, the use of metric modulation and its ability to shape rhythmic progressions is central to my polyrhythmic thinking. Metric modulation is essentially a systemization of additive and divisive processes. I combine metric modulation with additive processes such as those found in Stravinsky's music and the rhythmic designs of Glass's music to create a hierarchy using both additive and divisive processes. By synthesizing metric modulation with the ideas of these two composers, I replace the static and unpredictable nature of the continuities in Stravinsky and Glass with musical progressions that build to large climaxes.

The other result of this synthesis is that I can create a rhythmic language that is contrapuntal. The music of both Stravinsky and Glass is monophonic in conception. Stravinsky is concerned with articulating meter through additive processes, while Glass's continuities are formed by consecutive polyrhythms where the quality of various polyrhythms dictate the ebb and flow of tension. By contrast the rhythmic design, as shown in Figure 4, offers the possibility of polyphonic progressions.

Lastly, one aim of this extended discussion on polyrhythm is to suggest that this approach to rhythm is by no means exhausted. Polyrhythmic techniques offer many possibilities not yet realized.

EPILOGUE

This epilogue serves as an introduction to *Force*. The discussion will touch on my approach to the text, formal design, text setting and ensemble type.

(i) The Text

The text, which is taken from Leonardo DaVinci's Notebooks, is included below:

> … an invisible power which is stored up within bodies that are turned aside from their natural uses, imparting an active life of marvelous power. It constrains all created things to change form and position and in so doing hastens furiously to its own destruction.
>
> It is only a desire for flight.
> It is born in violence and dies in liberty.
> It is always in opposition to its natural desires.
> It desires to conquer and slay the cause of opposition, and in conquering destroys itself.
> It drives away in fury whatever opposes its destruction.
>
> Without it nothing moves.
> Without it no sound or voice is heard.

What attracted me to this text is the abstract nature of the subject matter. DaVinci is referring to some kind of physical power, some life force that drives nature. But he never specifies what it is. The elusive nature of the subject matter is reinforced by the fact that the word "force" is never used in the excerpt above. Instead DaVinci becomes poetic, stressing contradictory nature of force – that it "hastens furiously to its own destruction," that it is "born in violence and dies in liberty."

In this piece I interpret "force," the energy which imparts "an active life," to be rhythm – rhythm as process and the dynamic element in music. The traditional text / music relationship, therefore, is switched. Music does not becomes a

metaphor for the subject matter of the text – as is normally the case for vocal music – but the text casts light back on the rhythmic processes. This idea influences the formal design, the text setting and the relationship between the instrumental ensemble and the choir.

(ii) Formal Design

Force is organized into six sections as outlined below:

Section A	mm 1-64	Instrumental ensemble
Section B	mm 65-147	Choir & Ensemble, section 1 of text
Section C	mm 148-217	Instrumental Ensemble
Section D	mm 218-340	Choir & Ensemble, sections 2 & 3 of text
Section E	mm 341-523	Choir & Ensemble, text fragments, section 1
Section F	mm 524-611	Choir & Ensemble, section 3 of text

The choir and the instrumental ensemble have different roles in the piece: the choir is the vehicle for presenting the text while the instrumental ensemble presents rhythmic ideas as found in Figure 2.

Over the course of the piece the text becomes swallowed up by the music. After presenting the text in Sections B and D, the text fragments in Section E and becomes a resource of vowel colors. As attention gradually moves away from the meaning of the text to rhythmic and other musical characteristics, the choir assumes a supporting role to the instrumental ensemble. Towards the end of Section E, therefore, the choir disappears as the instrumental ensemble asserts itself. When the choir reenters in Section F, it is subservient to the ensemble serving as an accompaniment to the complex rhythmic processes played by the instruments.

(iii) Text Setting and Choral Writing

As the choir's role changes so does the choral writing. In Sections B and D the choir declaims the text in rhythmic unison. In Section E this monophonic texture is replaced by more polyphonic vocal writing mirroring the fragmentation of the text. The vocal writing further emphasizes the idea that there is movement from presenting the text to musical concerns.

A feature of my text setting is that it does not seem natural. Often the musical rhythm contradicts the rhythm of the words. There are two reasons for this decision. Firstly, I have tried to highlight the awkwardness of the text itself. Because it is a translation, there is an ungainly quality to the text. Also, while there are poetic aspects, it is not meant as literature. It is ostensibly scientific.

Second, successful prosody is dependent on supple rhythms mirroring the nuances of the text. Because this is incompatible with my rhythmic ideas, I decided to superimpose the text onto the rhythmic design so that there is often a clash between the natural stress of the words and the setting. In Section B the choir declaims the text using cells from the rhythmic model with seemingly no regard for the words and sometimes making their meaning unintelligible. One result of this is that it reinforces the mechanical, impersonal quality of the rhythm.

For these reasons I feel no need to "respect" the text. Instead the text is used to support my musical goals.

(iv) Instrumental Ensemble

The instrumental ensemble set up is shown below:

Choir

Percussion Double Bass

Keyboard 2 Keyboard 1

Violin Cello

Flute 1 Flute 2

This seating arrangement reflects the two part rhythmic design as found in Figure 2. The trio on the left (flute 1, violin and keyboard 2) plays material from Part A of the rhythmic design, and on the right trio (flute 2, cello and keyboard 1) plays Part B. Because all instruments – and the choir – are amplified Part A comes from the left speaker and Part B from the right.

The dynamic nature of the formal design, where the text becomes subsumed to musical ideas and the instrumental ensemble comes to dominate the choir, creates an accumulation of energies leading to the climax in the last section, Section F. Suddenly the ensemble starts playing dovetailed scales suggesting an unending rising material. Up to this point the melodic material has consisted of two or even single note ostinatos and therefore the scales feel like a release of energies, a culmination of pent up tension created by the rhythmic techniques. As the choir intones the last two lines of the text, the process is complete. The rhythmic progression first introduced in measures 49-56 of Section A now repeats many times as the music is in a constant state of metric modulation. Waves of tension provide a musical celebration of the last line of the text: “Without it [Force or rhythm] no sound or voice is heard.”

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