

SYMPHONY NO. 1

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Symphony No. 1 is an orchestral composition for twenty-four instrumental groups without percussion instruments. It was composed with Algorithmic Composition System software, which gives driving forces for composition to the composer through the diverse compositional methods largely based on physical phenomena.

The symphony consists of three movements. It lasts about sixteen minutes and twenty-six seconds--five minutes and twenty-two seconds for the first movement, five minutes and forty seconds for the second movement, five minutes and twenty-four seconds for the third movement. Most musical components in the first movement of the symphony are considered embryos, which gradually begin developing through the second and third movements.

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CHAPTER ONE

BACKGROUND: ALGORITHMIC COMPOSITION

Early Compositional Algorithms

Presumably, Guido d'Arezzo started the first example of compositional algorithm in 1026.¹ *Micrologus*, one of the chapters of his treatise for singers, contains a practical scheme for composing music along with his compositional algorithm. His method was to use correspondences between the vowels of the text and the pitches of the scale. Because the algorithm was used only for melody regarding employing pitches into a Latin text, Guido took a Latin text and extracted the vowels from each word and looked up corresponding pitches from his table. His method must be an algorithm because the process includes the construction of the table and the lookup operation.²

In the fourteenth century, Philippe de Vitry developed a unifying device using a rhythmic formula called *isorhythm*. His motet tenors were often made of a slow repeating rhythmic pattern. This consists of *color* as the repeating series of pitches and *talea* as the long recurring rhythmic unit. De Vitry incorporated the technique into tenors of his motets, which functioned as a foundation for the entire polyphonic structure.

Other examples related to formalizable music include canons, fugues, rounds, and variations. W. A. Mozart's *Musikalischs Wurfelspiel* is a famous example of algorithmic composition, which requires dice play to assemble minuets from the prewritten measures

¹ Gareth Loy, "Composing with Computers—a Survey of Some Compositional Formalisms and Music Programming Language," in *Current Directions in Computer Music Research*, eds. Max V. Mathews and John R. Pierce (Cambridge: MIT Press, 1991), 297.

² *Ibid.*, 298.

of music. Thus the order of measures is determined by a set of dice throws before a performance.

In the twentieth century, Arnold Schoenberg developed the innovative twelve-tone serial technique using a uniform distribution of the twelve pitches as a simple deterministic method, in which the original row could be transformed into three different rows. They are called inversion, retrograde and retrograde-inversion, respectively. The four rows and their forty-four transpositions yield an important structure called *set-complex*. Later, Schoenberg invented hexachordal combinatoriality to make closer relationships between two different rows possibly to provide stronger unity to the *set-complex*. However, he used only semi-combinatoriality usually from the original and fifth inversion rows through his serial compositions.

Xenakis: Stochastic Music

When the total serialism emerged, the totally controlled deterministic compositions could be little distinguished from utter randomness. By this point of view, Iannis Xenakis started developing stochastic methods³ for his compositions while composers such as Karlheinz Stockhausen, Pierre Boulez, John Cage, Earle Brown and others experimented with aleatoric methods of composition to break out the extreme determinism of serial compositions. Xenakis' stochastic music originated from the

³ Stochastic methods can guarantee overall trends according to the probability tables. In general stochastic procedures include the decision-making process as well as the random choice. They generate musical events according to probability tables that weight the occurrence of certain events over others. For example, a basic stochastic generator produces a random number and compares it to values associated with the probability table. If the random number belongs to a certain range of values in the probability table, the algorithm generates the event associated with that range.

principle of indeterminism, which started as a result of the impasse in serial music as well as other causes.⁴ Xenakis thought that *it was necessary to replace it by a more general causality, by a probabilistic logic which would contain strict serial causality as a particular case.*⁵ In the 1960s, Xenakis developed the Stochastic Music Program (SMP) with Fortran language to realize probabilistic logic to his compositions. The formulas of SMP were originally developed by scientists to describe the behavior of particles in gases.⁶ To create music, Xenakis provided SMP with data such as the average duration of sections, minimum and maximum density of notes for a section, instrumental groupings for timbre classes, timbre classes for a function of density, probabilities to each instrument, longest duration for each instrument, and so forth. Xenakis created a number of important works with SMP such as *ST/10-1* and *Atrées* for ten soloists, both in 1962, and *Eonta* in 1964. In general, to complete compositions, Xenakis has rearranged and modified the raw output generated by the SMP program. Later the SMP program was improved by mathematician-composer John Myhill in 1979 and has been re-coded for personal computers since then.⁷

Lejaren Hiller

Lejaren Hiller was the first person who composed music entirely with a computer. The first work was *The Illiac Suite for String Quartet*, which was created by Hiller and his collaborator Isaacson in 1956 using the Illiac computer at the University of Illinois.

⁴ Iannis Xenakis, *Formalized music* (Bloomington: Indiana University Press, 1971), 8.

⁵ *Ibid.*, 8.

⁶ Curtis Roads, *The computer music tutorial* (Cambridge: The MIT Press, 1996), 837.

⁷ *Ibid.*, 838.

Hiller and Isaacson transformed rules of various compositional styles into a great number of conditions. The composition process thus consisted in checking procedures whether the random number chosen suits all conditions. For example, if a pitch doesn't suit any condition, another number is selected and compared again. If a pitch suits all conditions, the pitch is selected as output. Hiller's approaches to *The Illiac Suite for String Quartet* differ from the stochastic or probabilistic procedures. They consist of mostly deterministic procedures. For example, if a pitch is needed, the pitch is not selected randomly but the pitch comes from the seed data that is decided by the checking process.

Soon, Hiller and Robert Baker set up a compositional programming language called MUSICOMP with assembly language in 1963, which provided basic techniques for generating original musical scores. Hiller and Baker divided the source decks into three basic parts, System Regulatory Routines, Compositional and Analytical Subroutines, and Sound Synthesis Routines. The Compositional Subroutines contain many stochastic routines to select musical elements such as rhythmic durations, pitches and pitch ranges. Since then, Hiller started to compose experimental compositions such as *Computer Cantata* (1963), *Algorithm I* (1969), and *Algorithm II* with increased stochastic procedures.

Other Composition Programs

Besides Xenakis' SMP and the MUSICOMP of Hiller and Baker, Gottfried Michael Koenig created a program named Project 1 at the Institute of Sonology, Utrecht, in 1970. Project 1 mainly consists of seven selection principles and a database for five musical parameters such as instrument, rhythm, harmony, register, and dynamics. As

input a composer provides data such as a set of chords, the total number of events to be generated, tempos, and a random number.

The MIDIDESK created by Clarence Barlow in 1989 is a recent example of an algorithmic composition program. It processes note files or digital scores using a multitude of modules, ranging from typical sequencer tools to Markov analysis / synthesis⁸ and efficient N-tuplet quantization. However, the main purpose of the program is to manipulate MIDI data that is entered as input. Barlow has used the program to compose from solo piano to large orchestral compositions. The following are some of the noticeable MIDIDESK commands: VARY, RIDE, TIDY, FADE, MOCK, and PART. The VERY command consists of three modes including shift, spread, and slide. The shift mode transposes a sequence, the spread mode expands the range of the sequence, and the slide mode applies a continuous change between values in the sequence. The RIDE substitutes many notes for one note. The TIDE is used to eliminate any portion of the sequence. The FADE interpolates between two sequences. Finally the MOCK imitates a sequence using a Markov chain based on a statistical analysis of the sequence.

Phil Winsor: His Programming Examples and MusicSculptor

Phil Winsor wrote a great number of algorithmic composition programs during the 1980s. Many of them are included in his three invaluable books: *Computer Composer's Toolbox* in 1987, *Automated Music Composition* in 1989, and *ComputerMusic in C* in 1991. The programs in those three books deal with all kinds of

⁸ The Markov chain is one of the stochastic processes and has been used popularly for a strategy in algorithmic compositions. It's a probability system, in which the likelihood of a future event is determined by the state of one or more events in the past.

problems including mathematical formulas and graphics functions as well as deterministic and probabilistic / stochastic processes. His focus is very clear. He teaches how to adapt them to create and modify music, and to solve problems with the computer. As well, Winsor wrote many programs that are long and complex for his own compositions or sometimes for demonstration. Soon, many of the programs he had written were merged and integrated into a larger program called MusicSculptor.

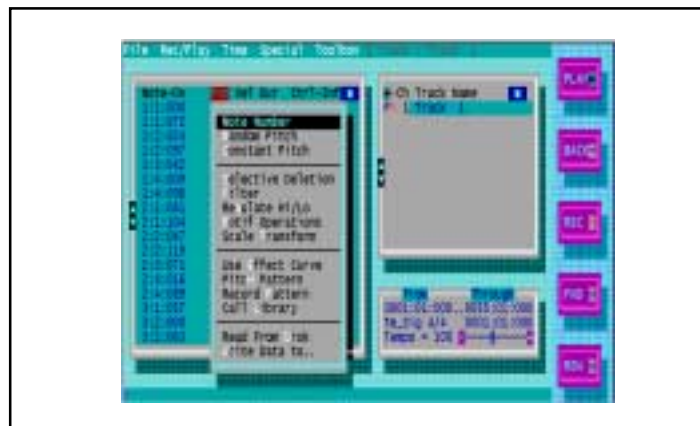


Fig. 1. A screen of MusicSculptor with menu commands for pitch. The largest box on the left side is *Note-List window*, the box in the upper right corner is *Tracks Window*, and the below is for real-time sequencer.

In 1991 Winsor developed interactive algorithmic composition software named MusicSculptor, with his assistant Kuo-Lung Chang. MusicSculptor works for any personal computer using the DOS operating system with a midi interface card. It's a real-time midi environment with integrated algorithmic composition procedures. As the name MusicSculptor implies, users cannot merely generate music, but also sculpt existing pieces using diverse algorithmic procedures such as *Motif Operations*, *Filter*, *Selective Deletion*, *Regulate Hi/Lo*, *Scale Transformation* and so forth.

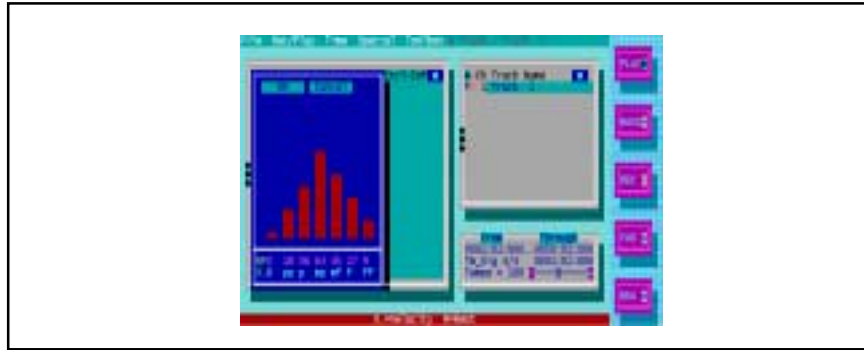


Fig. 2. A screen showing the stochastic distribution table for dynamics.

One noticeable feature of the program is that users can design contouring curves using *Design Effect Curve window*, and then they can generate new musical elements or pattern current musical elements after the contouring curves using *Use Effect Curve* command.

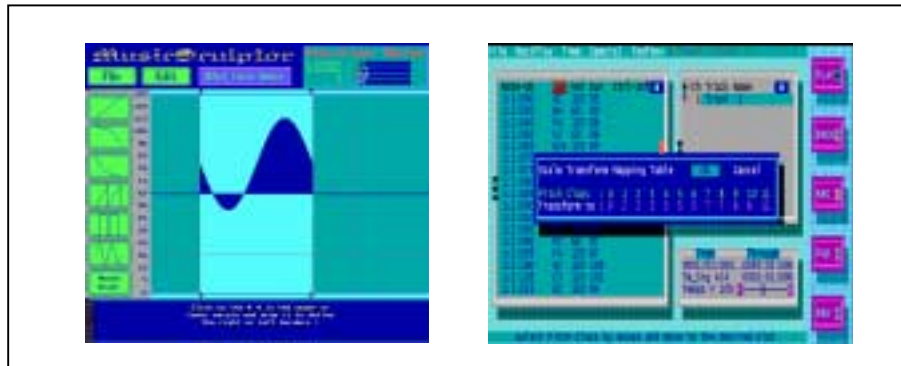


Fig. 3. *Design Effect Curve window* and *Scale Transform Mapping Table* of MusicSculptor. Users can design any contouring lines for new musical elements or for any preexisting musical elements to reshape.

CHAPTER TWO

ABOUT *SYMPHONY NO. 1*

Algorithmic Composition System v.2.2

I have been thinking and looking for a new way of composing music using microtones after composing several atonal compositions myself. I composed the first microtonal work named *Heartburning* in 1993. I chose a multichannel synthesizer as a medium for the sound. To create microtonal sounds for the composition, I had to add numerous pitchband messages to the corresponding notes and then I changed the pitchband values with the mouse and keyboard. It was a very tedious and time-consuming job. When I took Prof. Phil Winsor's second algorithmic composition class in 1994, he taught algorithmic composition with Visual Basic; during the first class he used GW basic. As a final project, I composed a tape piece named *A Life*, for which I used Visual Basic to make several short programs to generate microtonal passages and tone clusters. Both the process and the result were interesting and satisfying experiments to me. Soon after that, I started my own algorithmic composition program named ACS (Algorithmic Composition System) to experiment with other musical elements from time to time since 1995.



Fig. 4. An ACS screen showing *Track List*, *Event List*, and *Piano Roll* windows.

Specification of ACS

I started writing algorithmic composition programs with Visual Basic from the beginning. While programming, I faced Visual Basic's limitations, which made me dive into the C world to solve problems such as building the sound system part. After struggles, I found a way to make a MIDI sequencer with the support of DLL files that interact with the Visual Basic program. The DLL files mainly consist of functions that cannot be performed or created with Visual Basic. Examples are the timer functions, the functions sending MIDI messages directly to MIDI ports, and other time-critical calculating functions. As ACS is based on Visual Basic, it works only on 32-bit Microsoft Window systems. Fig. 5 shows a simple description of ACS.

- Algorithmic Composition Environment with a real-time MIDI sequencer.
- Provides 32 compositional tracks currently.
- Supports up to 10 MIDI devices simultaneously for playing sounds, so that the composer utilizes up to 160 channels if he combines many MIDI devices such as synthesizers and sound cards.
- Music editor that operates in real-time.
- Imports and exports standard MIDI files.

Fig. 5. Specification of ACS.

Structure of ACS

ACS consists of five basic parts: Foundation Routines, Algorithmic Composition Routines, Analysis Routines, Editing Routines, and Sound System Routines (real-time MIDI sequencing part).

Foundation Routines enable the composer to build basic musical parameters and retain data for Algorithmic Composition Routines. Algorithmic Composition Routines consist of a great number of deterministic and stochastic procedures to create music based on instructions and data the composer provides. Sound System Routines and Analysis Routines allow the composer to inspect the result. If he/she feels the output needs corrections or arrangements, he/she may use Editing Routines to correct, refine, or rearrange the raw output.

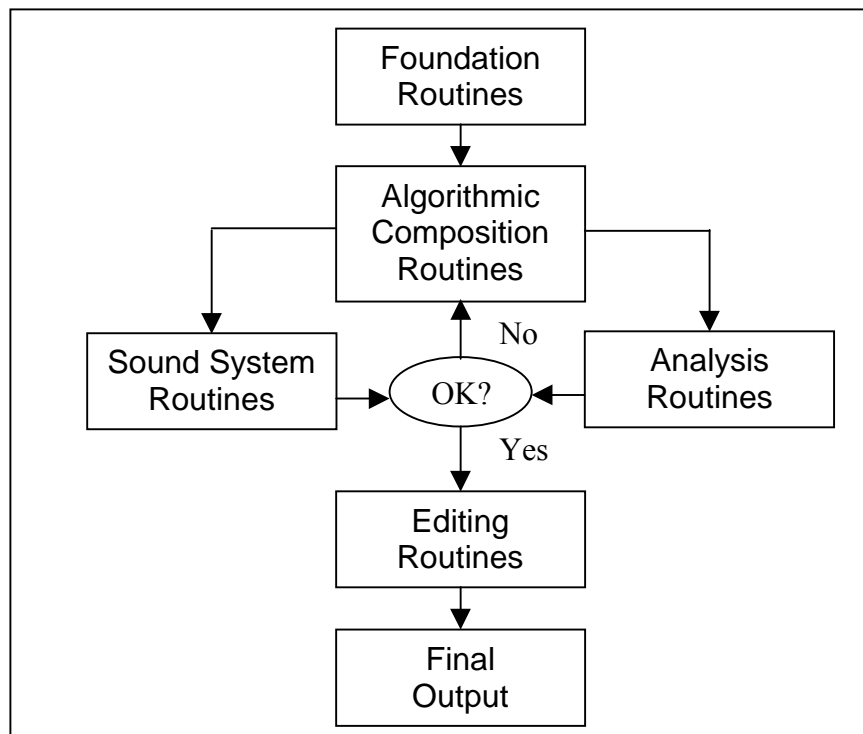


Fig. 6. Logic of five basic parts of ACS.

Functions of ACS

Foundation Routines

Foundation Routines provide the composer with tools to design common musical data, such as pitch contents, interval patterns, rhythmic elements, rhythmic patterns, rhythmic groupings, data for note distribution, and the ranges for output. Once the data are constructed, they can be called from any function in ACS.

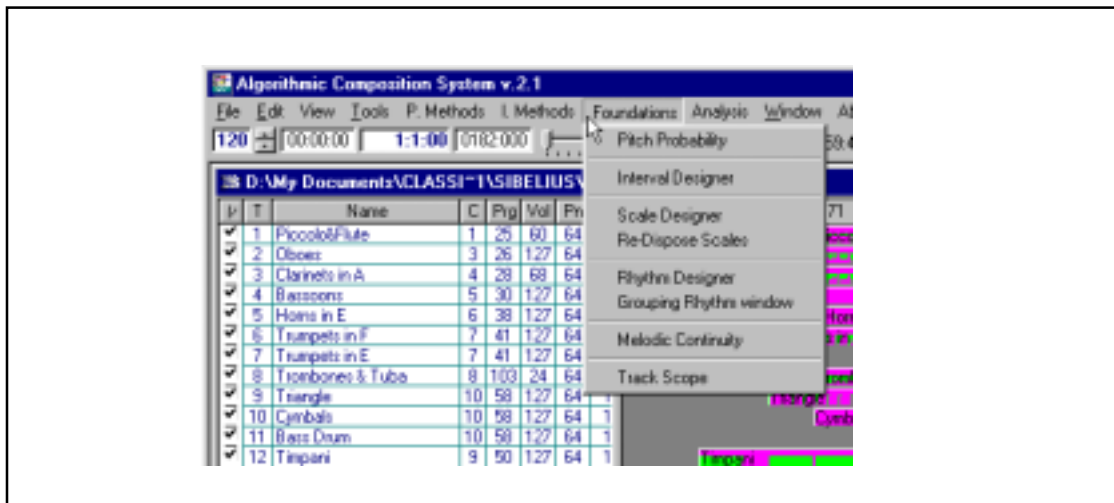


Fig. 7. *Foundations* menu commands.

Pitch Probability window provides a probability distribution table for the simple random functions based on stochastic processes, which produce random pitches.

Interval Designer window provides tools to build intervals with their probability data, which are employed exclusively for *Interval Method* that can generate multi-voice output.

Scale Designer window provides tools for the composer to build scales or pitch series. For example, when the composer designs a scale or a series, he/she can build

scales with tools to copy, paste, delete, invert, retrograde, transpose, and so forth. While building scales, he/she can play them using the sound functions.

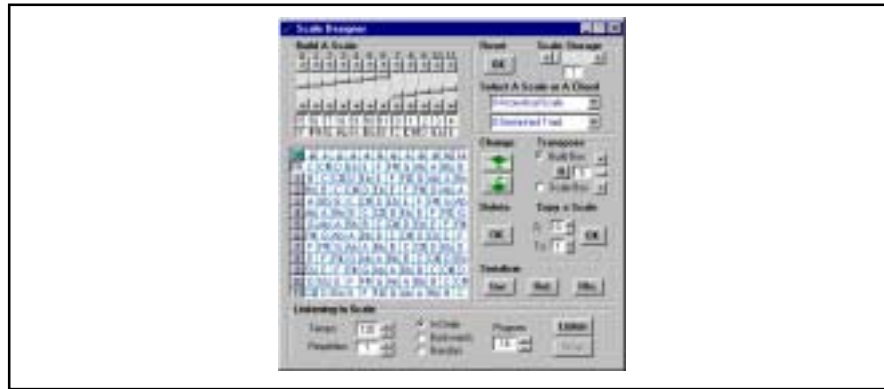


Fig. 8. *Scale Designer window* in Foundation Routines.

Rhythm Designer window provides tools for the composer to build rhythms, rhythmic patterns, and rhythmic groupings for each individual track.

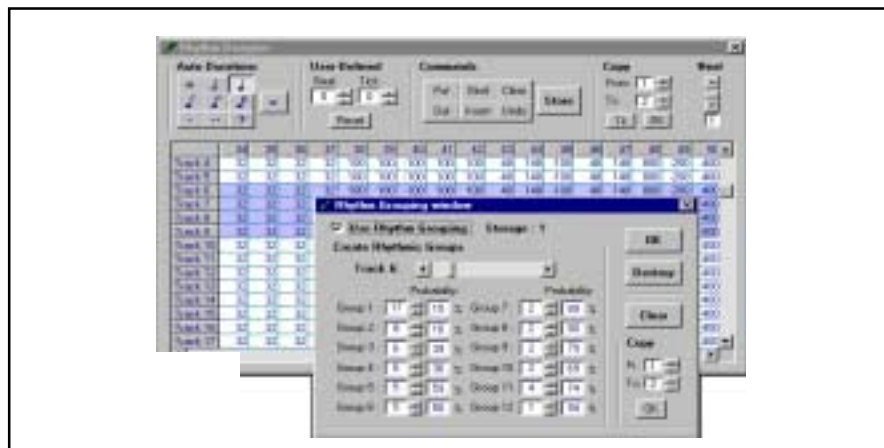


Fig. 9. *Rhythm Designer window* in Foundation Routines.

The role of *Melodic Continuity window* is to control the probability of the occurrence of notes. These settings can be distributed into many sections of output with different data for each section, which makes various distributions of notes for the output.

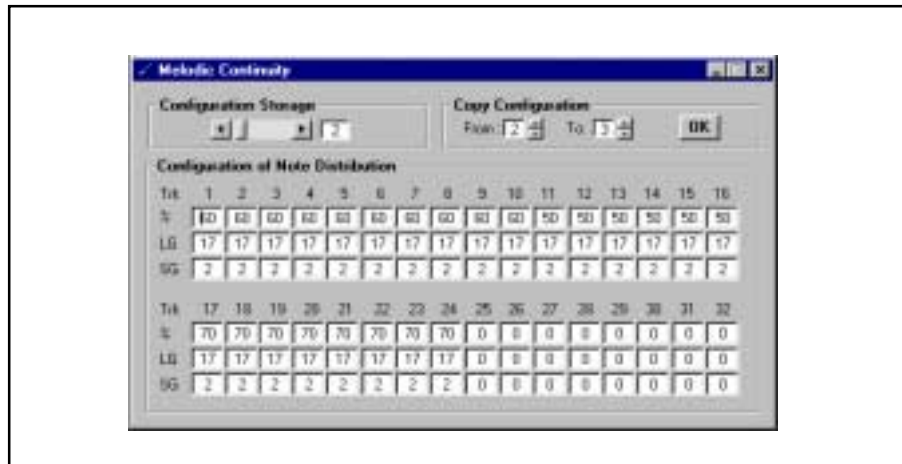


Fig. 10. *Melodic Continuity window*.

Algorithmic Composition Routines

Algorithmic Composition Routines are divided into three categories according to the processing size and their roles. They are named *Partial Methods*, *Integrated Methods*, and *Tools*, respectively.

Partial Methods of Version 2.2 consist of *Serialism*, *Directionism*, *Scale Transformer*, *Remodel Pitch Content*, *Linear Shaper*, and *Curvilinear Shaper*. These methods normally target a single track rather than multi-tracks of those of *Integrated Methods*. Consequently, output sizes are in general smaller than the ones from *Integrated Methods*.

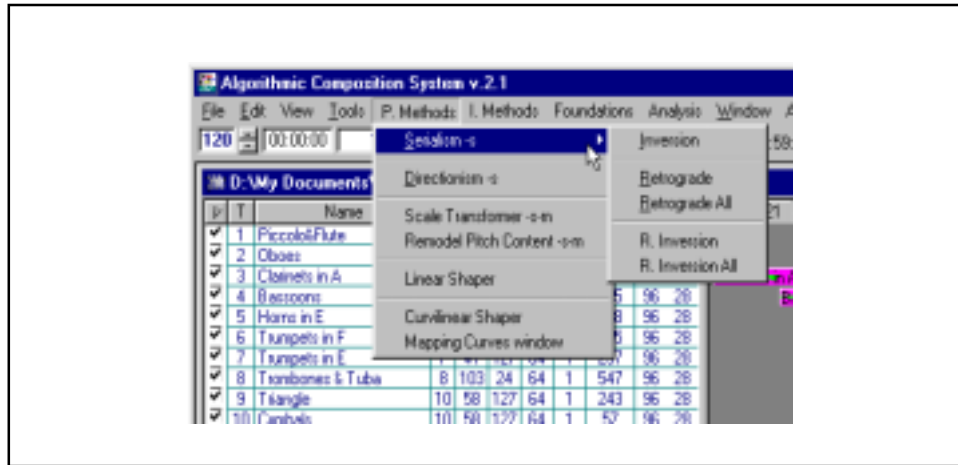


Fig. 11. The menu commands of *Partial Methods*.

The five *Serialism* commands modify what the composer selects for inversion, retrograde and retrograde inversion. They are transference of the basic twelve-tone techniques.

The second menu command *Directionism* is my own term. I discovered the directions of pitches are very notable, whether they occur in tonal or atonal music. In general, the ascending melody produces more energy and stronger tension than the descending one does, and so does the phenomenon between the skip and step motion of notes. When we have a melody, we can transform it using the directions of the pitches. As we did in the twelve-tone music, we also can transform it into a mirror motion, a backward motion, and the mirror of the backward motion. This way, the techniques of *Directionism* provide the composer with more freedom by increasing the range of the choice of pitches but still providing clear order to the composition, which drives the composer to continue the composition to the end with motivation. Whether it is a twelve-tone scale or not, it can be adapted into any style of music. I applied this concept to my

handicraft works in the past such as *Lines* (1994), *Waves* (1995), and *My Load is God* (1995).

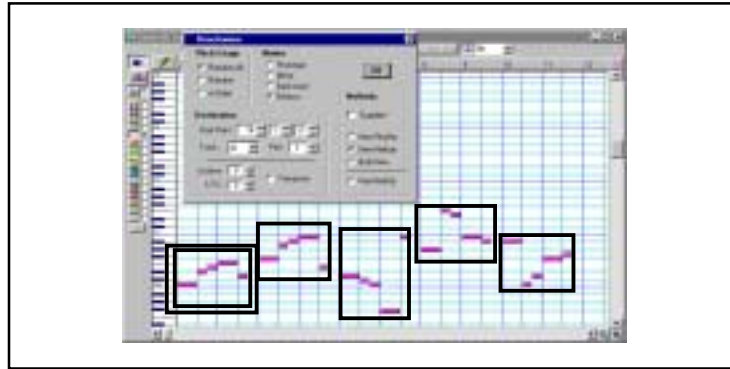


Fig. 12. An example using *Directionism* showing the original, *Prototype*, *Mirror*, *Backward*, *Backward-Mirror* starting from the left rectangle box.

Scale Transformer, *Remodel Pitch Contents*, and *Temper Pitch Range* in *Tools* menu originate with Winsor’s *MusicSculptor*, in which most functions are suitable for any kind of music elements for transformation, modification, and altering through sculpturing functions such as filtering, congruence, mapping, and so forth.

Scale Transformer function of ACS does a similar job. It replaces current pitches with pitches in the new scale. *Remodel Pitch Contents* is a kind of filter that replaces or subtracts specific pitches.

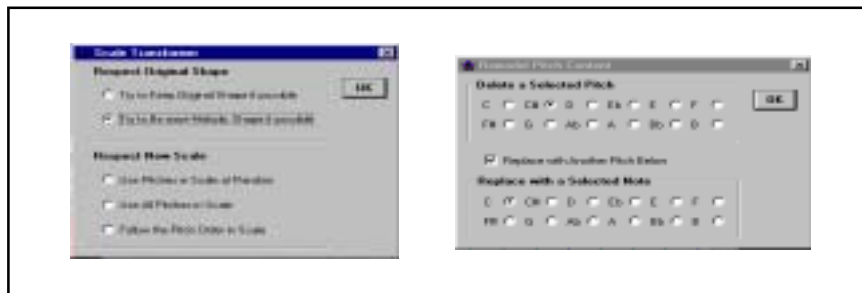


Fig. 13. *Scale Transformer* and *Remodel Pitch Contents* windows.

Linear Shaper enables the composer to pattern music after a drawing as Fig. 14 shows. The example here is a patterned fragment after a drawing. The first is without adapting pitch range congruence, and the latter adapting the 8-semitone pitch range congruent function.

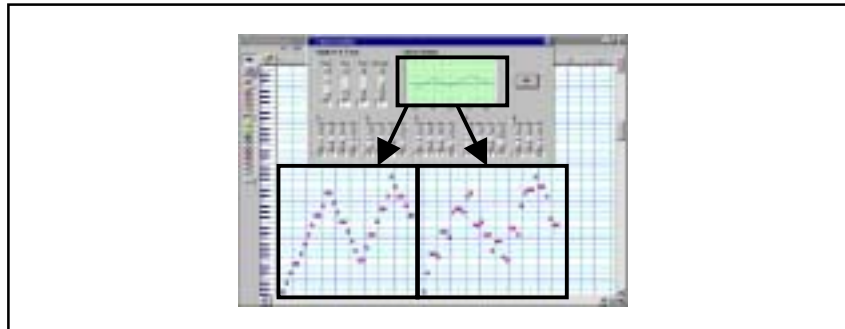


Fig. 14. An example of *Linear Shaper*.

Curvilinear Shaper enables the composer to pattern music after curvilinear motion. Then the composer can refine raw output using the mapping functions as shown in Fig. 15.

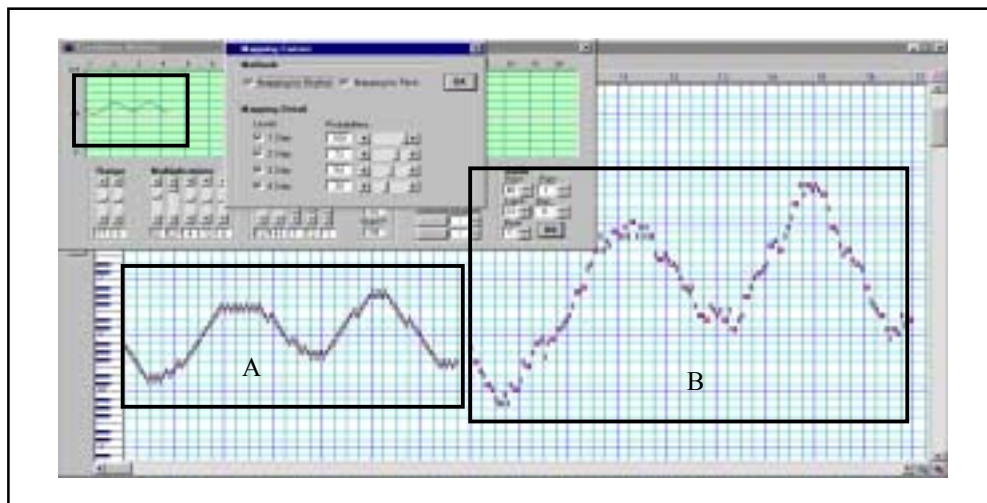


Fig. 15. The rectangle box in the upper left corner shows a curvilinear vector graphic. Rectangle box A is raw output patterned after the vector graphic, and box B is the refined one with mapping functions in *Mapping Curves* window.

Integrated Methods are comprised of *Serial*, *Interval*, *Harmonizing*, *Matrix & Vector*, *Extended Serial*, and *Chordal Phrasing Methods*. All of them are capable of multi-track processing up to 32 tracks simultaneously.

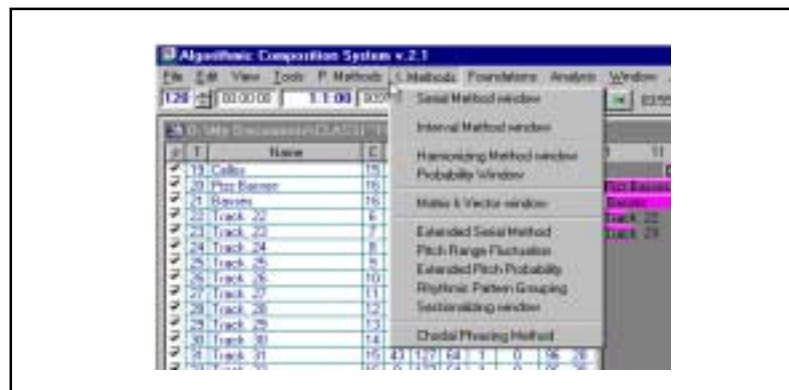


Fig. 16. *Integrated Methods* menu commands.

Serial Method is a similar transference of the twelve-tone techniques. As the method requires only a single pitch range data for the entire output, the overall result is much rawer than those from other methods.



Fig. 17. *Serial Method* window.

Interval Method is a kind of transference of the pitch set theory, in which interval relationships between pitch sets are significant while the relationships between pitches in the scale are meaningless. The following is an example of the output based on interval 0 (including the same pitches and octave equivalents), 1, 2, 3, and with *Chord Progress Generator*, which will create chords that contain the same interval contents.

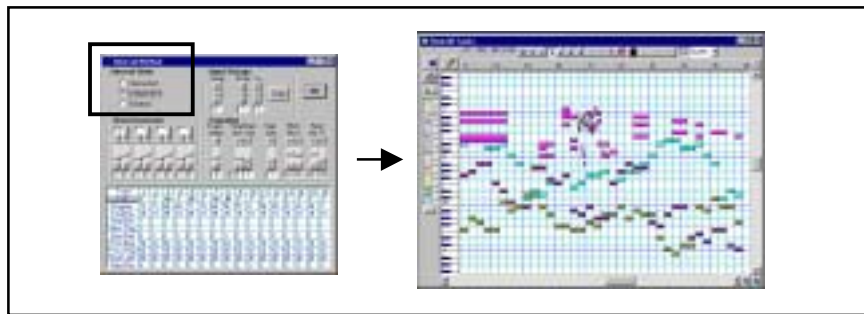


Fig. 18. An example of the output from *Interval Method*.

Harmonizing method has the capability of generating simple tonal as well as atonal output. For tonal output the composer feeds in chords, harmonic rhythms, and other basic musical data. The method includes tools controlling the overall contouring motions of the output as shown in Fig. 19.

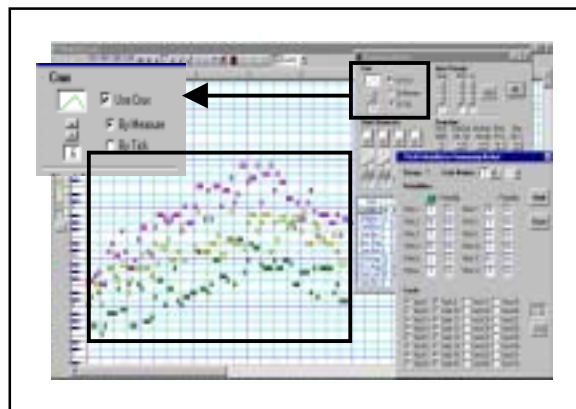


Fig. 19. An example of *Harmonizing Method*.

I devised *Matrix & Vector Method* to simulate textural music like Penderecki's *Threnody for the Victims of Hiroshima* (1960) for fifty-two string instruments, Ligeti's *Atmosphères* (1961), and the like. Although the method may look similar to *Curvilinear Method* in *Partial Methods*, *Matrix & Vector Method* originates from the two-dimensional distortion of a matrix while *Curvilinear Method* is uni-dimensional. *Matrix & Vector Method* thus creates much more diverse shapes for a multi track as well as a single track.

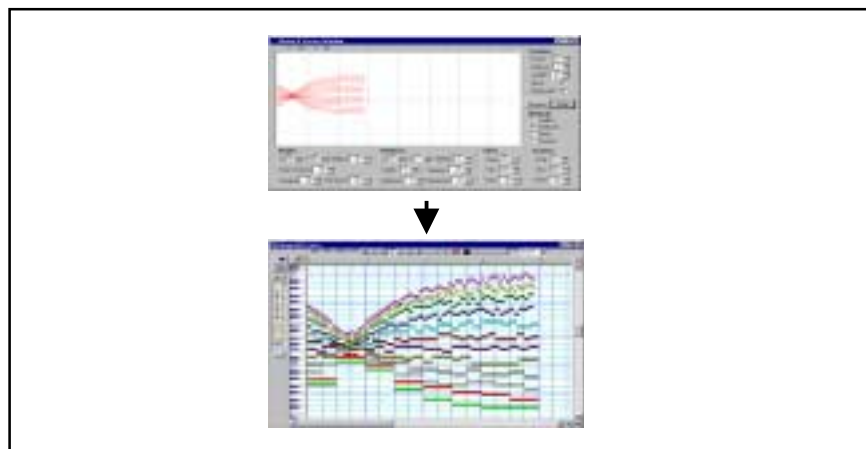


Fig. 20. An example using *Matrix & Vector Method*.

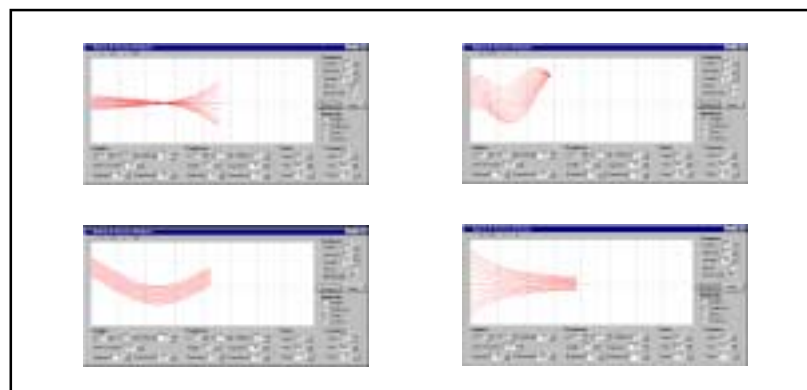


Fig. 21. Diverse vector graphics created using *Matrix & Vector Method*.

Extended Serial Method is an extension of *Serial Method* in ACS. It has increased deterministic algorithmic procedures, which allow the composer to have more control over the process. For example, *Extended Serial Method* helps the composer group tracks by rhythmic pattern so that he can apply the same rhythmic pattern to specific tracks.

The method also allows the composer to control other musical data by sections. For example, because all tracks can be divided up into 10 sections freely without time range limits, the composer can provide each section with different configurations for *Pitch Range Fluctuation*, *Extended Pitch Probability*, *Rhythmic Pattern Grouping*, and *Melodic Continuity*.

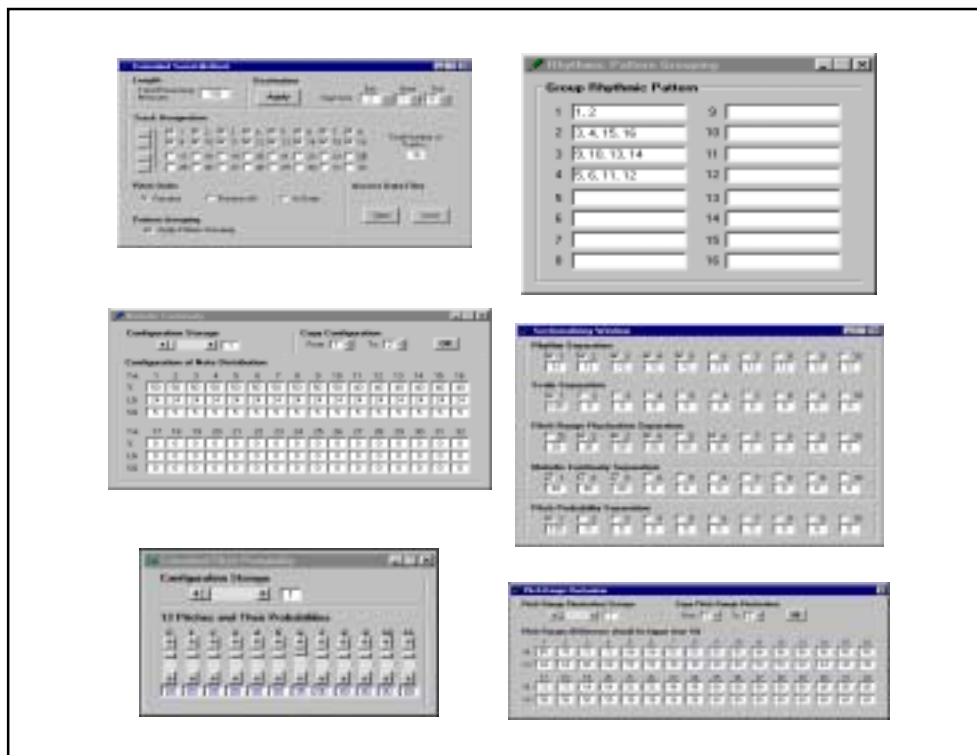


Fig. 22. The main window and other configuration windows of *Extended Serial Method*.

Chordal Phrasing Method is an algorithm using simple stochastic procedures that generate chords or static tone clusters like noises. The composer provides a rough pitch range and rhythms, and the procedure randomly selects pitches from the range.

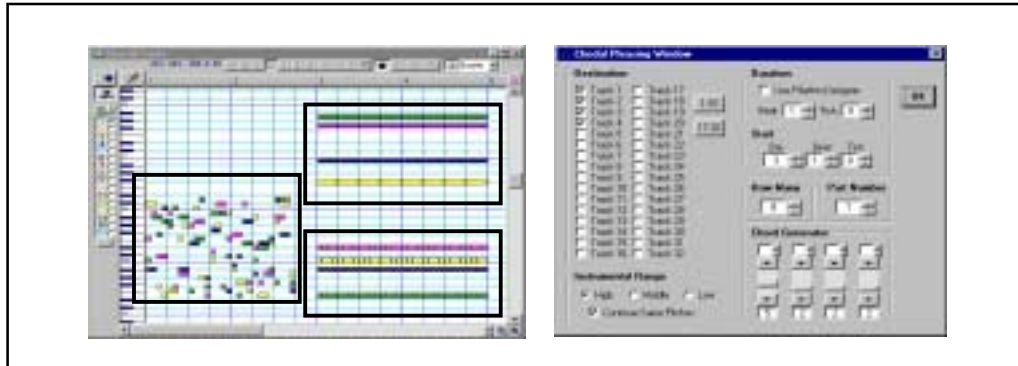


Fig. 23. An example of *Chordal Phrasing Method*.

The functions in *Tools* menu do not create any musical output but modify existing data, and some tools are used as utilities to support a better compositional environment. The modifying tools include *Transpose*, *Temper Pitch Range*, *Compress or Expand at a Note Position*, *Compress or Expand with Time Position*, *Change Durations*, *Quantization*, *Change Velocities*, and *Insert or Remove Rest*.

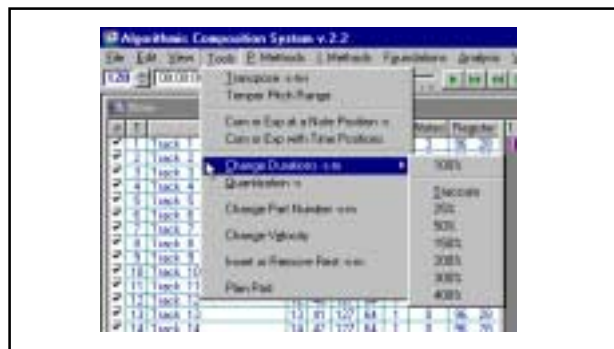


Fig. 24. *Tools* menu commands.

Temper Pitch Range changes current pitch ranges by shifting notes up or down to accommodate the selection to the new required pitch range. The two functions, *Compress or Expand at a Note Position* and *Compress or Expand with Time Position*, change the time positions of the selection. The latter changes both note-on and note-off time while the former changes only the note-on time of the selection.



Fig. 25. *Compress or Expand at a Note Position* and *Compress or Expand with Time Position* windows.

Plan Pad window provides a simple word processor and drawing tools. It helps the composer put notes and ideas together while composing. The window saves notes as a separate file automatically, which can be opened from any word processor.

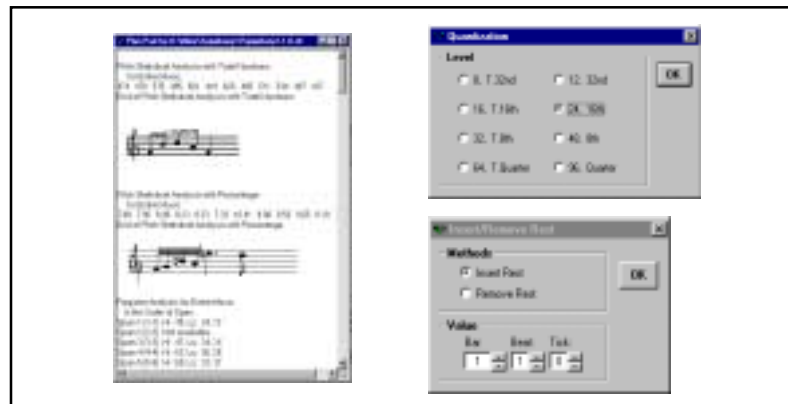


Fig. 26. *Plan Pad*, *Quantization*, and *Insert or Remove* windows.

Analysis Routines

ACS currently includes fourteen analysis functions, which can be divided into six categories such as pitch, register, rhythm, harmony, interval and dynamics analyses.

Some windows use a measuring unit called *span* for better presentation, which can range from a single-measure to 100-measures at maximum.

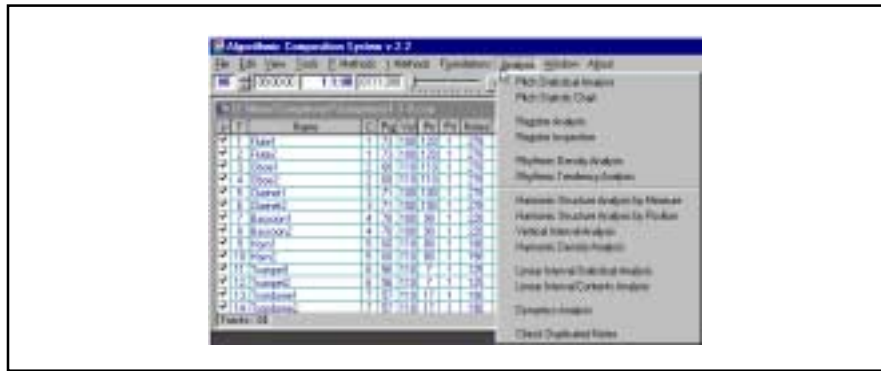


Fig. 27. Analysis menu functions.

Pitch Statistical Analysis shows the total frequencies of each pitch by spans or by a single-span specified, which can be done for a track as well as entire piece of music.



Fig. 28. An example of *Pitch Statistical Analysis* function.

Pitch Statistical Chart window provides the composer with information on the frequency of each pitch. This window shows the result as a graphic chart, in which the rectangular bars represent ratios between pitch numbers. The composer can compare a time range to another time range regarding pitch frequency using the analysis.

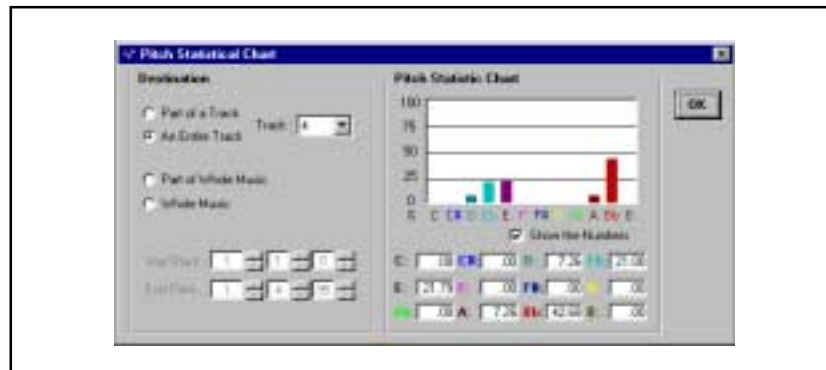


Fig. 29. An example of *Pitch Statistical Chart* analysis.

Register Analysis presents each track's pitch range or register by the following three different aspects: the measure order, the widths of the pitch ranges, and the highest and lowest pitches.



Fig. 30. An example of *Register Analysis*.

The role of *Register Inspection* window is to check if pitches are in the corresponding instrumental register. If certain pitches are out of range, the upper box shows the track number and the lower box shows the location with a measure number.

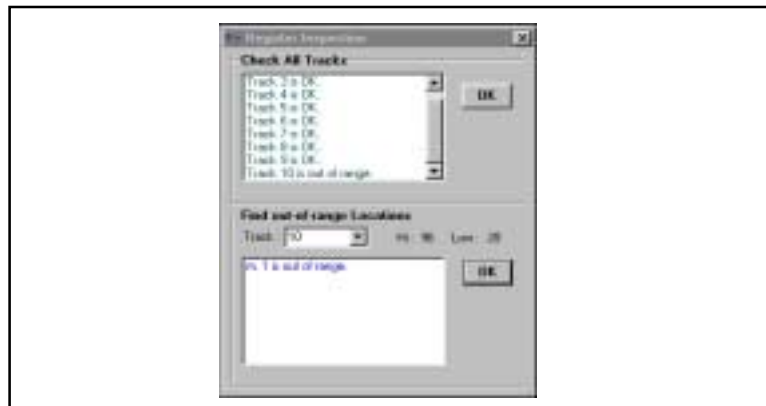


Fig. 31. An example of *Register Inspection*.

Rhythmic Density Analysis presents the total number of occurrences of notes in a period of time.

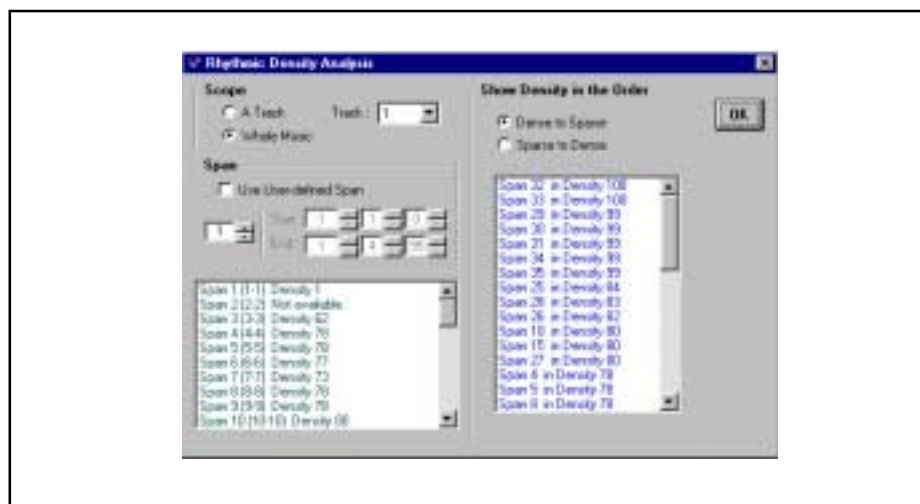


Fig. 32. An example of *Rhythmic Density Analysis*.

Rhythmic Tendencies Analysis presents the total frequency of each rhythm.

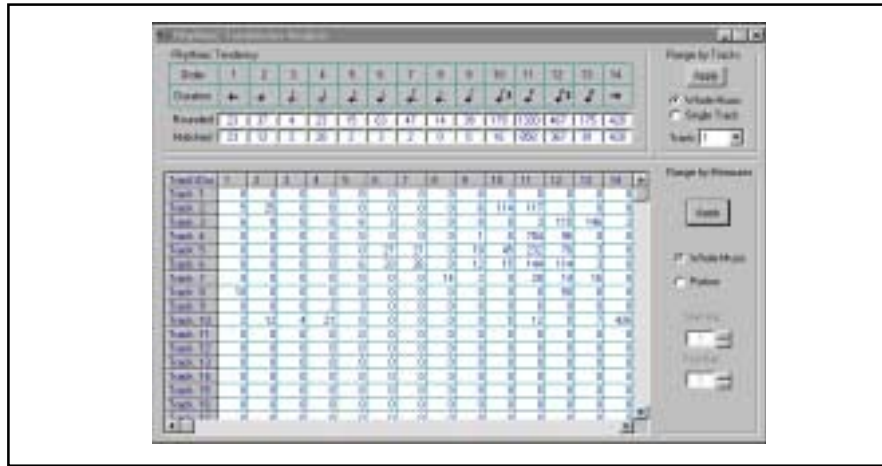


Fig. 33. An example of *Rhythmic Tendencies Analysis*.

Harmony Structure Analysis by Measure Span produces the vertical interval contents of music. In the analysis, the tensivity degree of each chord is decided by the accumulated tensivity of total intervals in a chord.

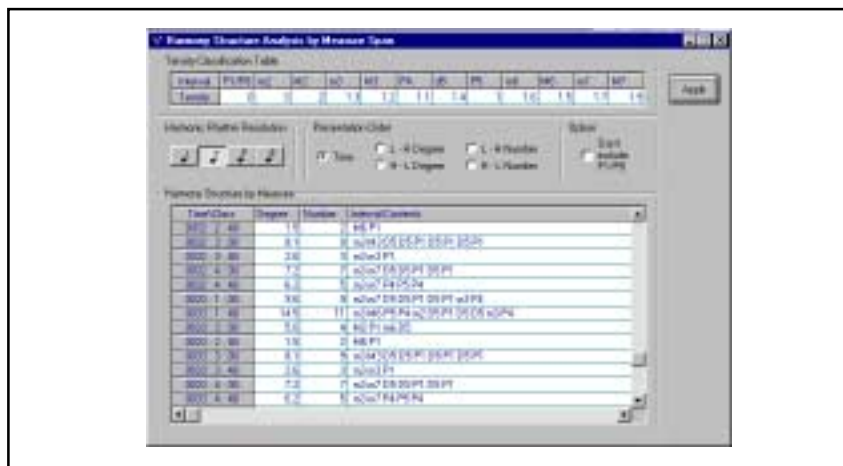


Fig. 34. An example of *Harmony Structure Analysis by Measure Span*.

Harmony Structure Analysis by Time Position is similar to *Harmony Structure Analysis by Measure Span*. The latter analyzes only chords that appear in the first time positions of the harmonic rhythm, while the former takes care of all chords. *Harmony Structure Analysis by Time Position* thus takes more time for the same target.

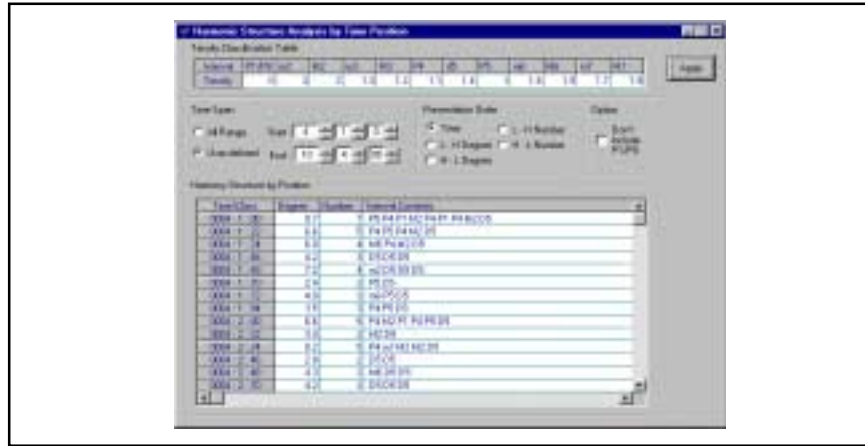


Fig. 35. An example of *Harmony Structure Analysis by Time Position*.

Vertical Interval Statistical Analysis presents the frequencies of the twelve intervals by spans.

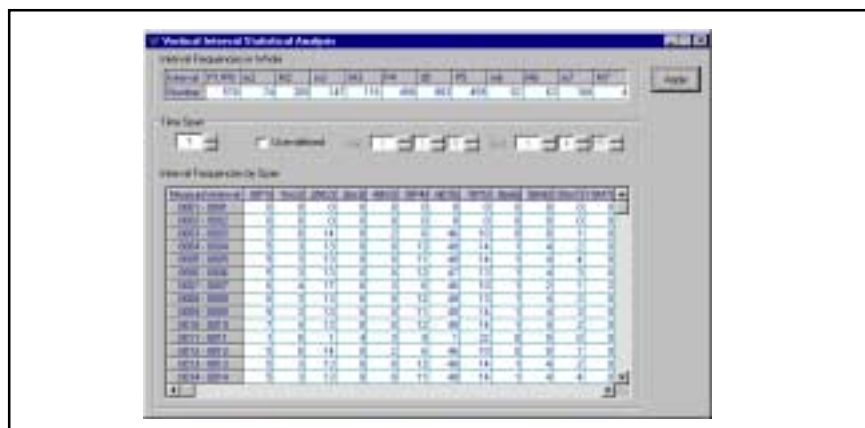


Fig. 36. An example of *Vertical Interval Statistical Analysis*.

Harmonic Tensity Analysis presents frequency, tensity degree, and contents of the intervals in each span. The composer can exclude the Perfect 1st and 8th degrees in the analysis.



Fig. 37. An example of *Harmonic Tensity Analysis*.

Linear Interval Statistical Analysis presents the horizontal intervals by spans. It includes a routine that excludes specific intervals regarding the time gap.

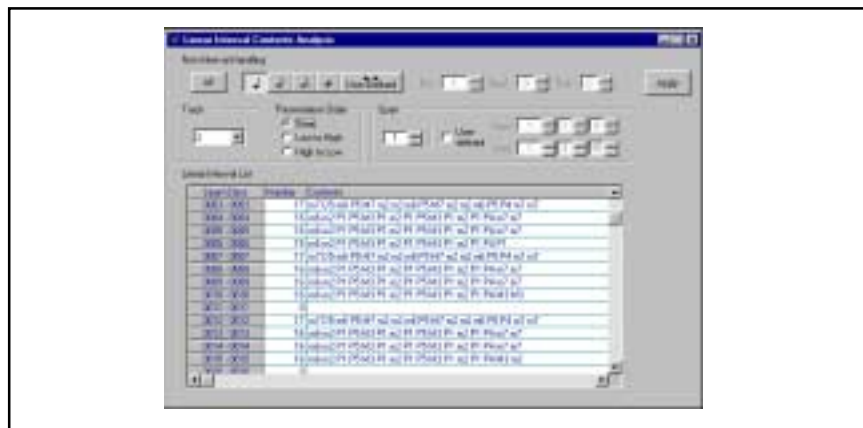


Fig. 38. An example of *Linear Interval Statistical Analysis*.

Linear Interval Contents Analysis presents the horizontal interval contents of music by spans. It includes a routine that excludes specific intervals regarding the time gap.

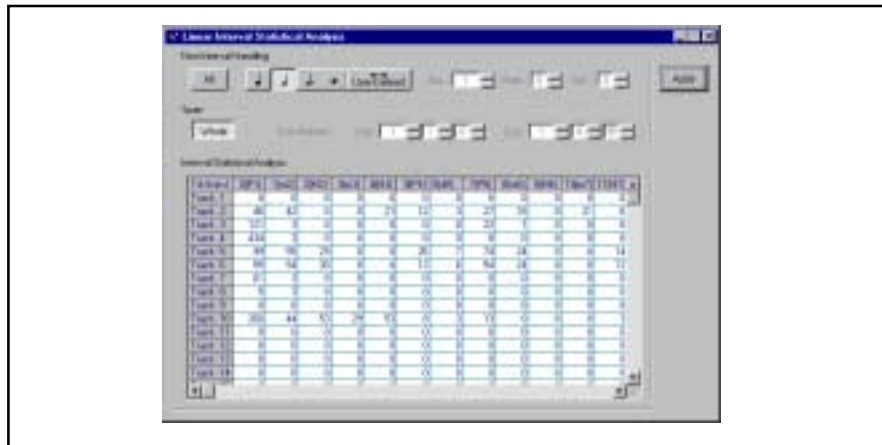


Fig. 39. An example of *Linear Interval Contents Analysis*.

Dynamics Analysis is accomplished by the following three MIDI elements: the volume messages, expression messages, and velocity values belonging to note messages.

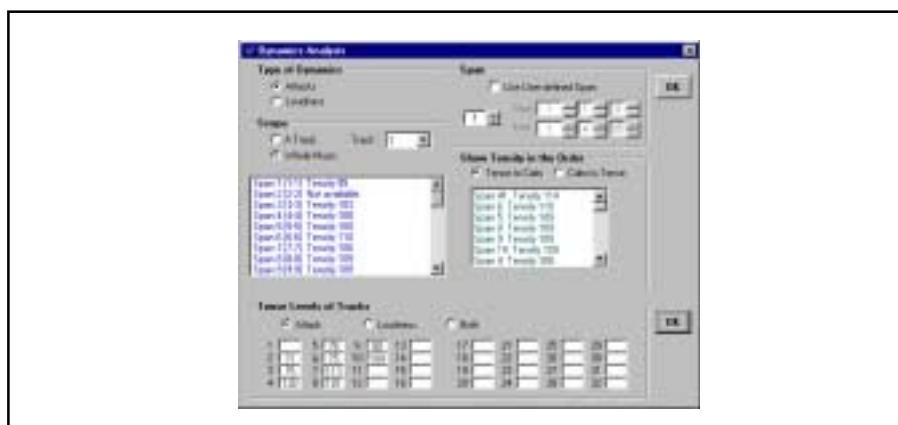


Fig. 40. An example of *Dynamics Analysis*.

The role of *Check Duplicated Notes* window is to find and remove duplicated notes.



Fig. 41. *Check Duplicated Notes* window.

Other menu commands

The commands in *File* menu handle file input and output routines. Among them, *Merge* command allows the composer to merge another file into the currently opened file.

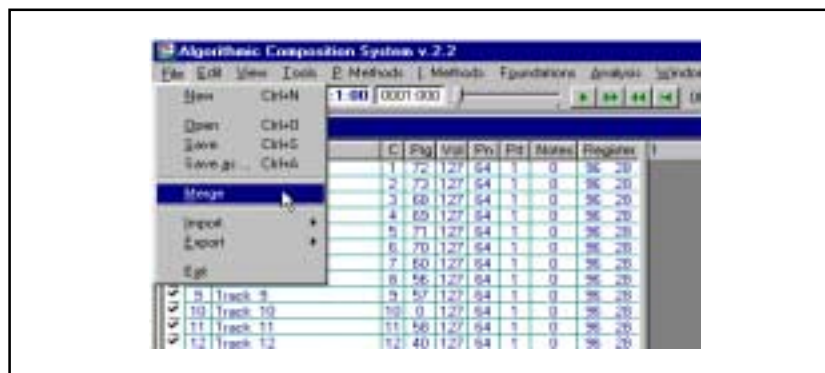


Fig. 42. *File* menu commands.

The commands in *Edit* menu include both single-track and multi-track editing features.

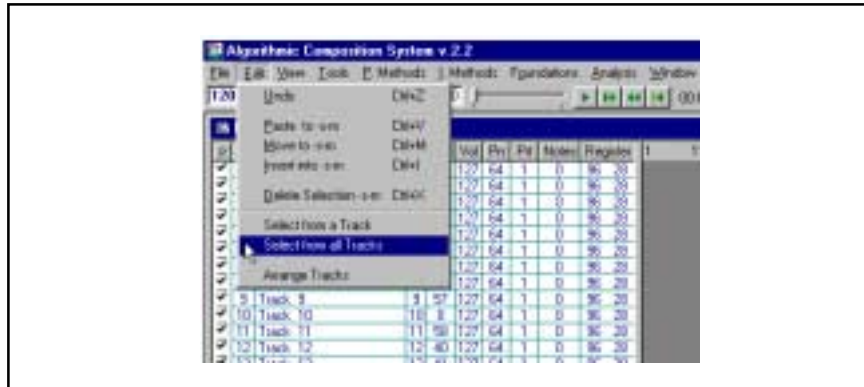


Fig. 43. *Edit* menu commands.

The commands in *View* menu consist of several diverse commands, including MIDI message editing windows, commands to the sequencer, and other miscellaneous configuring options.

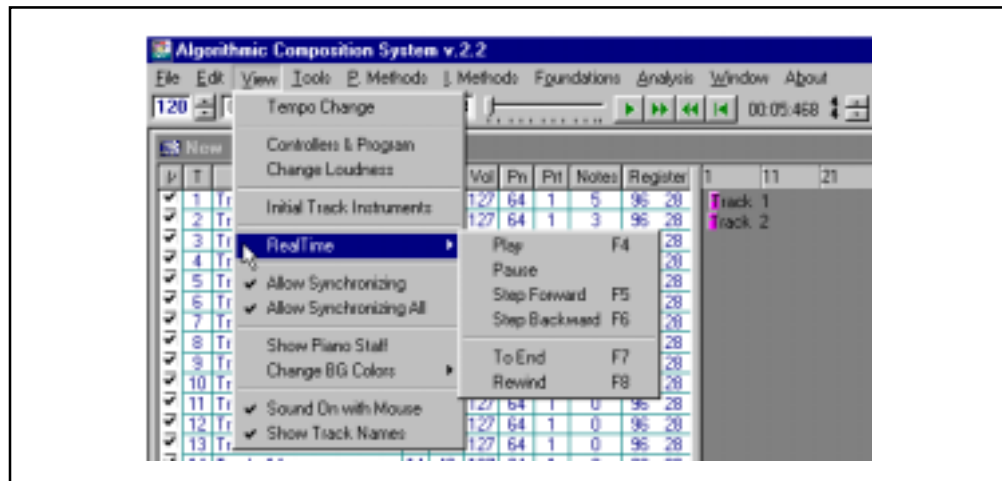


Fig. 44. *View* menu commands.

Window menu mainly consists of commands opening each corresponding window.

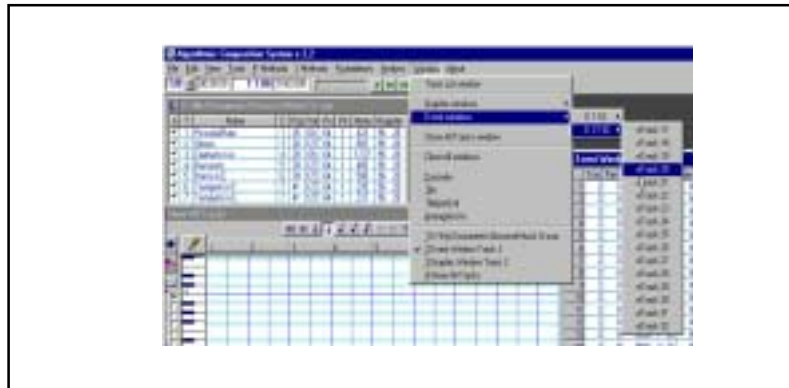


Fig. 45. The commands of *Window* menu.

Plan Pad submenus appear when *Plan Pad window* becomes active. The menus consist of *File*, *Edit*, *Format*, and *Tools* menus.



Fig. 46. A screen of *Plan Pad* submenus.

Analysis of *Symphony No. 1*

I composed *Symphony No. 1* using *Extended Serial* method that belongs to *Integrated Methods* of ACS. It is the newest algorithmic composition procedure that I added. Immediately beginning composing *Symphony No. 1*, I planned strategies and structures for the composition, and then I started coding, testing and debugging the algorithmic composition procedures. After finishing the method, I fed the input data for *Symphony No. 1* so that the program could write music as instructed.

I spent time collecting and constructing materials that would be used in the composition. The materials are rhythms, rhythmic patterns, rhythmic groupings, instrumental groupings, pitch ranges, pitch contents, pitch probabilities, note distributions, harmonic densities, harmonic tensity, rhythmic density, rhythmic tensity, tempos and dynamics. Constructing rhythmic structure was the most time consuming part of the composition.

Starting in the twentieth century, numerous things began to change in music. For example, the use of meter began to be loose and irregular, presumably to multiply the beauty of abstraction, which had been further widened along with tonality dissolved. At the same time, after Debussy's whole-tone scale, the Russian composer Skryabin's artificial scales resembling the octatonic scale, and the likes from others, finally the extreme pitch usage had come to the acme by the appearance of the equal distribution of pitches of Schoenberg's twelve-tone composition in 1923. The exhaustion of pitch usage and scales made a big impact on musical history along with the development of the science of time, so that it made many new branches of music, and composers started turning their focus to different directions of music. Many music scholars were worried

about the future of music, which brought so many arguments and writings involving tonality and atonality. Some composers like the American Harry Partch completely abandoned equal temperament system. Some composers like Ben Johnston went for micro tonality. A composer like Pierre Schaeffer, who was a sound technician, opened a complete different genre of music in 1948 called *concrète* music—now commonly called tape music--based on the transformation of natural sounds and artificial noises with the aid of the spiritual background of futurism in Italy in 1910. Others like Penderecki, Ligeti, Varese, Xenakis, Elliott Carter, and Cage had to start searching for new idioms from other musical components such as rhythms, tempos, dynamics, timbres, and even indeterminate elements as well as developing different concepts to pitches.

Symphony No. 1 follows the same traditional background since it used the equal temperament system, whether the media for soundings are traditional or electronic instruments. What I have really struggled with was how I should construct materials. As I composed *Symphony No. 1* using my own Algorithmic Composition System from the scratch to the final, I will explain about the symphony through the *Analysis functions* in the program. The *analysis functions* in ACS are founded on pure substantial phenomena, which will reveal some tendencies that gravitate materials in low probabilities.

Pitch Employment

The pitches in the low probabilities of occurrence tend to gravitate toward the ones in the high probabilities of occurrence. When we create a musical structure using pitch relationships as a unifying device, it is possible that we can achieve that by

manipulating the probability ratios of a pitch group and then by patterning the others after the original probability ratios. This will create consistency and unity of the composition.

| | | | | | | | | | | | | |
|--------------|------|------|------|------|------|------|--------------|------|------|------|------|------|
| Pitch Number | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Pitch Name | C | C# | D | Eb | E | F | F# | G | Ab | A | Bb | B |
| Percentage | 7.88 | 7.95 | 8.90 | 8.23 | 8.33 | 7.33 | 10.41 | 8.06 | 8.50 | 9.05 | 8.10 | 7.27 |
| Note Number | 474 | 478 | 535 | 495 | 501 | 441 | 626 | 485 | 511 | 544 | 487 | 437 |

| | | | | | | | | | | | | |
|--------------|------|------|------|------|------|------|-------------|------|------|------|------|------|
| Pitch Number | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Pitch Name | C | C# | D | Eb | E | F | F# | G | Ab | A | Bb | B |
| Percentage | 8.00 | 8.32 | 8.07 | 8.11 | 7.91 | 7.64 | 9.38 | 8.72 | 8.66 | 8.55 | 8.53 | 8.12 |
| Note Number | 593 | 617 | 598 | 601 | 586 | 566 | 695 | 646 | 642 | 634 | 632 | 602 |

| | | | | | | | | | | | | |
|--------------|------|------|------|------|------|------|--------------|------|------|------|------|------|
| Pitch Number | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| Pitch Name | C | C# | D | Eb | E | F | F# | G | Ab | A | Bb | B |
| Percentage | 8.14 | 8.32 | 8.23 | 8.13 | 8.49 | 8.07 | 10.49 | 8.10 | 7.25 | 8.63 | 8.24 | 7.91 |
| Note Number | 639 | 653 | 646 | 638 | 666 | 633 | 823 | 636 | 569 | 677 | 647 | 621 |

Table 1. *Pitch Statistical Analysis* with percentages and total numbers for entire movement. The first, second, and third movements (From top).

In the above Table 1 the F# made the most frequent occurrence in all three movements since I decided the F# would have the highest probability among the twelve pitches.

Pitch Range Employment

As pitch probability became important, so has pitch range in modern compositions. This is because the probabilities of certain pitch ranges could bring significance to music as the textural music of Penderecki, Ligeti and others. If pitches lose their functions forming a melody, the pitch ranges will get more focused in practical situations. This will indicate that a position of a pitch in a certain range will have more weight than being a member of a scale, a member of a pitch set, or a member of a melody. We thus can think of specific pitch ranges as centers of controlling pitch clusters or sound masses that appear in the composition and consider the other pitch ranges to be subsidiary.

| | | | | | | | | | | | | | | | |
|---------------|----|-----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Measure | 99 | 93 | 89 | 92 | 98 | 82 | 84 | 90 | 94 | 85 | 91 | 79 | 83 | 95 | 96 |
| Highest Pitch | 95 | 94 | 93 | 93 | 93 | 92 | 92 | 92 | 92 | 91 | 91 | 90 | 90 | 90 | 90 |
| Measure | 97 | 100 | 75 | 76 | 86 | 88 | 64 | 65 | 66 | 71 | 72 | 74 | 78 | 80 | 73 |
| Highest Pitch | 90 | 90 | 88 | 88 | 88 | 88 | 86 | 86 | 86 | 86 | 86 | 86 | 86 | 86 | 85 |

| | | | | | | | | | | | | | | | |
|---------------|----|----|----|----|----|----|----|----|-----|----|----|----|----|----|----|
| Measure | 87 | 90 | 92 | 95 | 96 | 85 | 91 | 94 | 100 | 77 | 86 | 93 | 97 | 64 | 67 |
| Highest Pitch | 96 | 96 | 96 | 96 | 96 | 95 | 95 | 95 | 95 | 94 | 93 | 93 | 93 | 92 | 92 |
| Measure | 84 | 61 | 63 | 65 | 66 | 68 | 69 | 70 | 71 | 75 | 76 | 78 | 79 | 80 | 82 |
| Highest Pitch | 92 | 91 | 91 | 91 | 91 | 91 | 91 | 91 | 91 | 91 | 91 | 91 | 91 | 90 | 89 |

| | | | | | | | | | | | | | | | |
|---------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Measure | 87 | 88 | 90 | 95 | 98 | 71 | 89 | 91 | 92 | 99 | 83 | 93 | 94 | 70 | 82 |
| Highest Pitch | 96 | 96 | 96 | 95 | 95 | 94 | 94 | 94 | 94 | 94 | 93 | 93 | 92 | 92 | 92 |
| Measure | 87 | 88 | 90 | 95 | 98 | 71 | 89 | 91 | 92 | 99 | 83 | 93 | 94 | 70 | 82 |
| Highest Pitch | 96 | 96 | 96 | 95 | 95 | 94 | 94 | 94 | 94 | 94 | 93 | 93 | 92 | 92 | 92 |

Table 2. A presentation by order of highest to lowest pitch occurrence for the first, second, and third movements (from top) up to thirty measures.

The above Table 2 presents only the top thirty measures in order of highest to lowest frequency in each movement. Since the total measures of the three movements are 110 for the first, 120 for the second and 120 for the third, we can notice that the top 30 high pitches appeared between measures 61 to 100, which means that the weight of the pitch range is in the second half of each movement. I didn't classify the pitch ranges in detail in this composition, but I disposed the high pitch ranges in the middle of the latter half of each movement as a turning point.

Rhythmic Employment

Constructing rhythmic structures became a highly time consuming portion in composition since composers turned their focuses to rhythm. The extreme case was made by Varèse with the composition *Ionisation* (1931), well known by the use of the screams of two sirens. The work is scored entirely for percussion instruments. Carter is famous for his rhythmic modulation using thoughtful combinations of metric rhythms through his compositions. Ligeti's *Atmosphères* (1961) presented the use of floating rhythms and fluctuating sounds with many paralleled percussive sounds on consistent changing rhythms.

As rhythms and rhythmic patterns have potential capabilities to generate infinite permutations without duplication, it seems they would never be exhausted unlike the pitches. Controlling rhythms thus became the most important concern to composers in the twentieth century.

Rhythmic Structure

In *Symphony No. 1*, I attempted rhythmic inheritance, so that the third twelve-rhythmic pattern inherits from the second, and the second inherits from the first movement. Each time the inheritor inherits, it inherits the same numbers of patterns with increased rhythmic density and faster rhythms. Each movement thus comprises the same number of rhythmic patterns. The introducing movement starts unfolding with the slowest and most sparse rhythmic patterns.

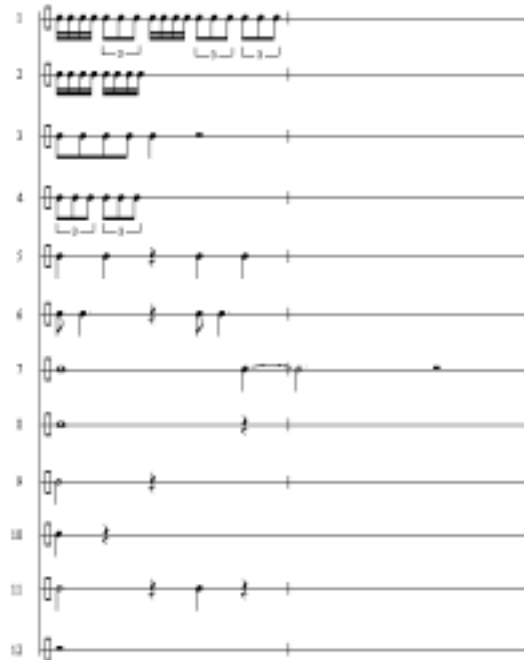


Fig. 47. The twelve rhythmic patterns used in the first movement.

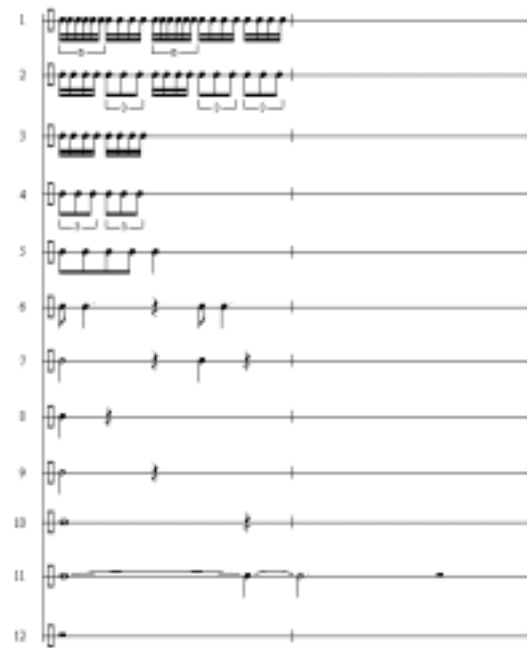


Fig. 48. The rhythmic patterns of the second and third movements from the top, which inherited from the ones in the first movement.

Rhythmic Density

The controlled rhythmic density will help establish a better formation for the composition. For example, if a composition consists of five or six sections like a suite, we may gradually increase the rhythmic density by sections. When performed, it will generate consistent focuses from the audience.

Rhythmic density is the total number of occurrences of notes in a period of time under a condition of the same or similar tempos. If notes occur more often in a period of time, the period will create more tension than other time periods.

Table 3 shows the rhythmic densities in order of dense to sparse for the top 30 measures for each movement. The *Density* value indicates the total note number in a *span*. The length of a *span* used for Table 3 is 5 measures. In the analysis we can find the peak periods of rhythmic densities: 71-100 for the first, 76-110 for the second, and 56-105 measures for the third movement respectively. As it shows, the spans for the peak periods are getting wider until the last movement, which means that the tensional weight is increasing gradually to the last movement.

| DENSE TO SPARSE (FIRST MOVEMENT) | |
|----------------------------------|-------------|
| Span 17 (81-85) | Density 504 |
| Span 19 (91-95) | Density 496 |
| Span 16 (76-80) | Density 462 |
| Span 18 (86-90) | Density 450 |
| Span 15 (71-75) | Density 388 |
| Span 20 (96-100) | Density 360 |

| DENSE TO SPARSE (SECOND MOVEMENT) | |
|-----------------------------------|-------------|
| Span 21 (101-105) | Density 692 |
| Span 19 (91-95) | Density 540 |
| Span 16 (76-80) | Density 526 |
| Span 18 (86-90) | Density 492 |
| Span 17 (81-85) | Density 454 |
| Span 22 (106-110) | Density 442 |

| DENSE TO SPARSE (THIRD MOVEMENT) | |
|----------------------------------|-------------|
| Span 21 (101-105) | Density 634 |
| Span 18 (86-90) | Density 622 |
| Span 12 (56-60) | Density 614 |
| Span 13 (61-65) | Density 502 |
| Span 16 (76-80) | Density 470 |
| Span 15 (71-75) | Density 454 |

Table 3. *Rhythmic Density Analysis* in order of dense to sparse rhythms.

Rhythmic Tendency

Rhythmic Tendency and *Rhythmic Density Analyses* help the composer level the overall rhythmic distributions of a composition. Fast rhythms stimulate and drive our mind unstable with distraction. This factor is very important as long as music exists for mankind. If one fills a specific time period with music, he/she needs a large number of notes if he places very short notes. Otherwise the time will be monotonous. It is thus important to observe rhythmic tendencies of the composition.

Rhythmic Tendency analysis can present the rhythmic similarity between movements. Table 4 shows the tendencies of rhythms used in *Symphony No. 1*. The two arrows in the top of the analysis indicate the notes longer than whole note and the notes smaller than 32nd notes, respectively. The analysis shows both rounded and matched note numbers for some irregular rhythms that don't fall in the default 14 rhythms of the top row in Table 4. The numbers after the top shown in the analysis mean the total numbers

of each rhythm that were employed for each movement. Table 5, 6 and 7 after Table 4 are *Rhythmic Tendency Analyses* for each instrument of each movement.

| Rhythm | ← | ○ | ♩. | ♩ | ♩. | ♩ | ♩. | ♩. | ♩ | ♩ ³ | ♩ [♩] | ♩ ³ | ♩ [♩] | → |
|--------|-----|-----|----|-----|-----|-----|----|----|------|----------------|----------------|----------------|----------------|---|
| 1 Mov. | 130 | 134 | 0 | 244 | 268 | 762 | 0 | 0 | 748 | 1848 | 1880 | 0 | 0 | 0 |
| 2 Mov. | 174 | 178 | 0 | 210 | 276 | 372 | 0 | 0 | 936 | 1796 | 2728 | 742 | 0 | 0 |
| 3 Mov. | 104 | 222 | 0 | 142 | 236 | 676 | 0 | 2 | 1532 | 2718 | 1468 | 748 | 0 | 0 |

Table 4. *Rhythmic Tendency Analysis* for each entire movement. The numbers in the table are the total numbers of each rhythm that occurred in each movement.

| Rhythm | ← | ○ | ♩. | ♩ | ♩. | ♩ | ♩. | ♩. | ♩ | ♩ ³ | ♩ [♩] | ♩ ³ | ♩ [♩] | → |
|----------|---|----|----|----|----|----|----|----|----|----------------|----------------|----------------|----------------|----|
| Rhythm | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Track 1 | 7 | 10 | 0 | 10 | 12 | 35 | 0 | 0 | 28 | 91 | 85 | 0 | 0 | 0 |
| Track 2 | 7 | 10 | 0 | 10 | 12 | 35 | 0 | 0 | 28 | 91 | 85 | 0 | 0 | 0 |
| Track 3 | 7 | 10 | 0 | 10 | 12 | 35 | 0 | 0 | 28 | 91 | 85 | 0 | 0 | 0 |
| Track 4 | 7 | 10 | 0 | 10 | 12 | 35 | 0 | 0 | 28 | 91 | 85 | 0 | 0 | 0 |
| Track 5 | 7 | 10 | 0 | 10 | 12 | 35 | 0 | 0 | 28 | 91 | 85 | 0 | 0 | 0 |
| Track 6 | 7 | 10 | 0 | 10 | 12 | 35 | 0 | 0 | 28 | 91 | 85 | 0 | 0 | 0 |
| Track 7 | 4 | 3 | 0 | 7 | 10 | 25 | 0 | 0 | 41 | 74 | 56 | 0 | 0 | 0 |
| Track 8 | 4 | 3 | 0 | 7 | 10 | 25 | 0 | 0 | 41 | 74 | 56 | 0 | 0 | 0 |
| Track 9 | 4 | 3 | 0 | 12 | 6 | 23 | 0 | 0 | 19 | 60 | 63 | 0 | 0 | 0 |
| Track 10 | 4 | 3 | 0 | 12 | 6 | 23 | 0 | 0 | 19 | 60 | 63 | 0 | 0 | 0 |
| Track 11 | 4 | 5 | 0 | 2 | 6 | 18 | 0 | 0 | 24 | 23 | 43 | 0 | 0 | 0 |
| Track 12 | 4 | 5 | 0 | 2 | 6 | 18 | 0 | 0 | 24 | 23 | 43 | 0 | 0 | 0 |
| Track 13 | 4 | 3 | 0 | 12 | 6 | 23 | 0 | 0 | 19 | 60 | 63 | 0 | 0 | 0 |
| Track 14 | 4 | 3 | 0 | 12 | 6 | 23 | 0 | 0 | 19 | 60 | 63 | 0 | 0 | 0 |
| Track 15 | 4 | 3 | 0 | 7 | 10 | 25 | 0 | 0 | 41 | 74 | 56 | 0 | 0 | 0 |
| Track 16 | 4 | 3 | 0 | 7 | 10 | 25 | 0 | 0 | 41 | 74 | 56 | 0 | 0 | 0 |
| Track 17 | 6 | 5 | 0 | 11 | 13 | 39 | 0 | 0 | 38 | 75 | 61 | 0 | 0 | 0 |
| Track 18 | 6 | 5 | 0 | 11 | 13 | 39 | 0 | 0 | 38 | 75 | 61 | 0 | 0 | 0 |
| Track 19 | 6 | 5 | 0 | 11 | 13 | 39 | 0 | 0 | 38 | 75 | 61 | 0 | 0 | 0 |
| Track 20 | 6 | 5 | 0 | 11 | 13 | 39 | 0 | 0 | 38 | 75 | 61 | 0 | 0 | 0 |
| Track 21 | 6 | 5 | 0 | 15 | 17 | 42 | 0 | 0 | 35 | 105 | 141 | 0 | 0 | 0 |
| Track 22 | 6 | 5 | 0 | 15 | 17 | 42 | 0 | 0 | 35 | 105 | 141 | 0 | 0 | 0 |
| Track 23 | 6 | 5 | 0 | 15 | 17 | 42 | 0 | 0 | 35 | 105 | 141 | 0 | 0 | 0 |
| Track 24 | 6 | 5 | 0 | 15 | 17 | 42 | 0 | 0 | 35 | 105 | 141 | 0 | 0 | 0 |

Table 5. *Rhythmic Tendency Analysis* for each track of the first movement. The numbers in the top column are equal to the rhythms in the top column of Table 4.

| Rhythm | ← | ○ | ♩. | ♩ | ♩. | ♩ | ♩. | ♩. | ♩ | ♩ ³ | ♩ | ♩ ³ | ♩ | → |
|----------|----|----|----|----|----|----|----|----|----|----------------|-----|----------------|----|----|
| Rhythm | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Track 1 | 8 | 4 | 0 | 5 | 15 | 9 | 0 | 0 | 29 | 43 | 127 | 70 | 0 | 0 |
| Track 2 | 8 | 4 | 0 | 5 | 15 | 9 | 0 | 0 | 29 | 43 | 127 | 70 | 0 | 0 |
| Track 3 | 8 | 4 | 0 | 5 | 15 | 9 | 0 | 0 | 29 | 43 | 127 | 70 | 0 | 0 |
| Track 4 | 8 | 4 | 0 | 5 | 15 | 9 | 0 | 0 | 29 | 43 | 127 | 70 | 0 | 0 |
| Track 5 | 8 | 4 | 0 | 5 | 15 | 9 | 0 | 0 | 29 | 43 | 127 | 70 | 0 | 0 |
| Track 6 | 8 | 4 | 0 | 5 | 15 | 9 | 0 | 0 | 29 | 43 | 127 | 70 | 0 | 0 |
| Track 7 | 7 | 6 | 0 | 8 | 0 | 16 | 0 | 0 | 31 | 70 | 103 | 0 | 0 | 0 |
| Track 8 | 7 | 6 | 0 | 8 | 0 | 16 | 0 | 0 | 31 | 70 | 103 | 0 | 0 | 0 |
| Track 9 | 5 | 12 | 0 | 12 | 17 | 21 | 0 | 0 | 46 | 78 | 71 | 0 | 0 | 0 |
| Track 10 | 5 | 12 | 0 | 12 | 17 | 21 | 0 | 0 | 46 | 78 | 71 | 0 | 0 | 0 |
| Track 11 | 5 | 2 | 0 | 7 | 3 | 7 | 0 | 0 | 25 | 45 | 71 | 53 | 0 | 0 |
| Track 12 | 5 | 2 | 0 | 7 | 3 | 7 | 0 | 0 | 25 | 45 | 71 | 53 | 0 | 0 |
| Track 13 | 5 | 13 | 0 | 13 | 17 | 21 | 0 | 0 | 46 | 78 | 71 | 0 | 0 | 0 |
| Track 14 | 5 | 13 | 0 | 13 | 17 | 21 | 0 | 0 | 46 | 78 | 71 | 0 | 0 | 0 |
| Track 15 | 7 | 6 | 0 | 8 | 0 | 16 | 0 | 0 | 31 | 70 | 103 | 0 | 0 | 0 |
| Track 16 | 7 | 6 | 0 | 8 | 0 | 16 | 0 | 0 | 31 | 70 | 103 | 0 | 0 | 0 |
| Track 17 | 11 | 8 | 0 | 11 | 14 | 18 | 0 | 0 | 38 | 119 | 168 | 54 | 0 | 0 |
| Track 18 | 11 | 8 | 0 | 11 | 14 | 18 | 0 | 0 | 38 | 119 | 168 | 54 | 0 | 0 |
| Track 19 | 11 | 8 | 0 | 11 | 14 | 18 | 0 | 0 | 38 | 119 | 168 | 54 | 0 | 0 |
| Track 20 | 11 | 8 | 0 | 11 | 14 | 18 | 0 | 0 | 38 | 119 | 168 | 54 | 0 | 0 |
| Track 21 | 6 | 11 | 0 | 10 | 14 | 21 | 0 | 0 | 63 | 95 | 114 | 0 | 0 | 0 |
| Track 22 | 6 | 11 | 0 | 10 | 14 | 21 | 0 | 0 | 63 | 95 | 114 | 0 | 0 | 0 |
| Track 23 | 6 | 11 | 0 | 10 | 14 | 21 | 0 | 0 | 63 | 95 | 114 | 0 | 0 | 0 |
| Track 24 | 6 | 11 | 0 | 10 | 14 | 21 | 0 | 0 | 63 | 95 | 114 | 0 | 0 | 0 |

Table 6. *Rhythmic Tendency Analysis* for each track of the second movement

| Rhythm | ← | ○ | ♩. | ♩ | ♩. | ♩ | ♩. | ♩. | ♩ | ♩ ³ | ♩ | ♩ ³ | ♩ | → |
|----------|---|----|----|---|----|----|----|----|----|----------------|----|----------------|----|----|
| Rhythm | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Track 1 | 4 | 7 | 0 | 6 | 10 | 20 | 0 | 0 | 49 | 108 | 51 | 57 | 0 | 0 |
| Track 2 | 4 | 7 | 0 | 6 | 10 | 20 | 0 | 0 | 49 | 108 | 51 | 57 | 0 | 0 |
| Track 3 | 4 | 7 | 0 | 6 | 10 | 20 | 0 | 0 | 49 | 108 | 51 | 57 | 0 | 0 |
| Track 4 | 4 | 7 | 0 | 6 | 10 | 20 | 0 | 0 | 49 | 108 | 51 | 57 | 0 | 0 |
| Track 5 | 4 | 7 | 0 | 6 | 10 | 20 | 0 | 0 | 49 | 108 | 51 | 57 | 0 | 0 |
| Track 6 | 4 | 7 | 0 | 6 | 10 | 20 | 0 | 0 | 49 | 108 | 51 | 57 | 0 | 0 |
| Track 7 | 1 | 10 | 0 | 7 | 7 | 32 | 0 | 0 | 80 | 97 | 66 | 0 | 0 | 0 |
| Track 8 | 1 | 10 | 0 | 7 | 7 | 32 | 0 | 0 | 80 | 97 | 66 | 0 | 0 | 0 |
| Track 9 | 4 | 8 | 0 | 3 | 2 | 24 | 0 | 0 | 38 | 104 | 47 | 0 | 0 | 0 |
| Track 10 | 4 | 8 | 0 | 3 | 2 | 24 | 0 | 0 | 38 | 104 | 47 | 0 | 0 | 0 |
| Track 11 | 4 | 6 | 0 | 3 | 10 | 28 | 0 | 1 | 65 | 105 | 51 | 41 | 0 | 0 |
| Track 12 | 4 | 6 | 0 | 3 | 10 | 28 | 0 | 1 | 65 | 105 | 51 | 41 | 0 | 0 |
| Track 13 | 4 | 8 | 0 | 3 | 2 | 24 | 0 | 0 | 38 | 104 | 47 | 0 | 0 | 0 |
| Track 14 | 4 | 8 | 0 | 3 | 2 | 24 | 0 | 0 | 38 | 104 | 47 | 0 | 0 | 0 |
| Track 15 | 1 | 10 | 0 | 7 | 7 | 32 | 0 | 0 | 80 | 97 | 66 | 0 | 0 | 0 |
| Track 16 | 1 | 10 | 0 | 7 | 7 | 32 | 0 | 0 | 80 | 97 | 66 | 0 | 0 | 0 |
| Track 17 | 7 | 11 | 0 | 7 | 18 | 29 | 0 | 0 | 77 | 141 | 77 | 81 | 0 | 0 |
| Track 18 | 7 | 11 | 0 | 7 | 18 | 29 | 0 | 0 | 77 | 141 | 77 | 81 | 0 | 0 |
| Track 19 | 7 | 11 | 0 | 7 | 18 | 29 | 0 | 0 | 77 | 141 | 77 | 81 | 0 | 0 |
| Track 20 | 7 | 11 | 0 | 7 | 18 | 29 | 0 | 0 | 77 | 141 | 77 | 81 | 0 | 0 |
| Track 21 | 6 | 13 | 0 | 8 | 12 | 40 | 0 | 0 | 82 | 123 | 75 | 0 | 0 | 0 |
| Track 22 | 6 | 13 | 0 | 8 | 12 | 40 | 0 | 0 | 82 | 123 | 75 | 0 | 0 | 0 |
| Track 23 | 6 | 13 | 0 | 8 | 12 | 40 | 0 | 0 | 82 | 123 | 75 | 0 | 0 | 0 |
| Track 24 | 6 | 13 | 0 | 8 | 12 | 40 | 0 | 0 | 82 | 123 | 75 | 0 | 0 | 0 |

Table 7. *Rhythmic Tendency Analysis* for each track of the third movement

Harmonic Structure

Harmonic Structure Analysis presents the colors of parallel pitches—here I exclude the colors from instrumental timbres like Schoenberg's *Klangfarbenmelodien*. Harmonic colors touch our emotion and mood. Even if many different pitches are overlapped, we can notice the subtle differences or changes as long as the vertical contents are different. *Symphony No. I* has the high tense parts in the range from 7 to 8/10^{ths} of each movement. The peak part is almost at the end of the movements. The longer the music, the more detailed schemes of harmonic tension would be required to sustain attention from the audience to the end of music.

Harmonic Structure Analysis supports the composer to equalize or examine the overall harmonic deposition in the composition. Table 8 shows the tension levels of each interval. The tension values in *Interval Tension Classification Table* are not from scientific measurements but from my own musical experiences, which can be changed.

I assigned the tension value 0 for the interval perfect 1st (unison) and 8th degrees, the tension value 1 for perfect 5th, the tension value 2 for the major 2nd, and the tension value 3 for the minor 2nd, and so forth. The analysis helps the composer find chords that hold certain specific tension levels so that he/she can compare and stabilize the output. Table 9, 10, and 11 present the chords in the top 14 of high tense chords for each movement in order of highest to lowest tension level.

| Interval | P1/P8 | m2 | M2 | m3 | M3 | P4 | d5 | P5 | m6 | M6 | m7 | M7 |
|----------|-------|----|----|-----|-----|-----|-----|----|-----|-----|-----|-----|
| Tensity | 0 | 3 | 2 | 1.3 | 1.2 | 1.1 | 1.4 | 1 | 1.6 | 1.5 | 1.7 | 1.9 |

Table 8. *Interval Tensity Classification Table* for the presentation of the harmonic tensity degree.

| Measure | Tensity Degree | Interval Number | Interval Contents |
|---------------|----------------|-----------------|--|
| 0079 : 2 : 00 | 44.0 | 19 | M7 M2 M2 M2 M2 M3 M2 M2 M2 M3 M2 M3 M3 M2 M3 M2 M2 M2 |
| 0078 : 3 : 00 | 41.2 | 19 | m2 m3 M3 M2 m3 M2 m2 P5 m2 M2 m2 m2 m2 m2 M2 M2 m2 P4 m3 |
| 0079 : 4 : 48 | 35.4 | 16 | m3 m2 m2 m3 m2 m2 m2 m2 m3 m3 M2 m2 M3 M2 P5 m2 |
| 0074 : 4 : 00 | 34.3 | 17 | D5 m3 m2 m3 M2 m3 m2 m2 m2 m2 m2 m3 m3 m3 P4 M2 M2 |
| 0079 : 4 : 00 | 33.2 | 17 | m7 m2 m3 M3 M2 m2 M3 M3 M2 m2 m3 M2 M2 M2 m3 m2 M2 |
| 0062 : 3 : 48 | 31.5 | 14 | m2 M2 m2 m2 P4 M3 M2 M2 m2 m2 M2 M3 M2 m2 |
| 0074 : 4 : 48 | 31.4 | 15 | M3 M2 M3 m3 m2 m2 m2 M2 M2 m2 M3 M3 m3 m2 m2 |
| 0072 : 4 : 00 | 30.5 | 15 | P5 P4 m2 m2 M2 m2 M2 M2 P5 M2 m2 m3 P4 m2 M2 |
| 0063 : 2 : 00 | 30.4 | 15 | M3 m3 m2 m2 M2 m2 m2 P4 M2 M2 m2 m3 m3 M2 M3 |
| 0062 : 3 : 00 | 29.6 | 14 | m2 M2 M2 m6 M2 m3 m2 m2 m2 m2 M2 m3 P4 m3 |
| 0078 : 3 : 48 | 29.6 | 13 | m3 M2 m2 m2 D5 m2 m2 m3 m2 m2 D5 M3 m2 |
| 0074 : 1 : 48 | 29.5 | 13 | m2 m2 P5 M2 m2 M2 m2 m2 M3 m2 M2 M2 m3 |
| 0074 : 2 : 48 | 29.1 | 14 | m3 M2 M2 M2 m2 M2 m3 m2 M2 M3 m2 m2 M2 m3 |
| 0090 : 4 : 00 | 28.7 | 14 | M3 m6 M2 m2 M2 m2 m3 m2 M3 M3 M3 M2 m2 m2 |

Table 9. The top 14 high tense chords for each movement in order of highest to lowest tensity level for the first movement by 8th step of the harmonic resolution excluding P1/P8.

| Measure | Tensity Degree | Interval Number | Interval Contents |
|---------------|----------------|-----------------|---|
| 0042 : 4 : 00 | 33.9 | 15 | m7 m2 m2 M2 m2 M2 M2 M2 m2 m2 m2 M6 m3 D5 M2 |
| 0107 : 4 : 48 | 33.5 | 16 | m2 m3 M3 m3 m2 m2 m2 m2 M2 m2 D5 m3 m2 m3 m3 D5 |
| 0039 : 3 : 00 | 31.8 | 13 | m2 m7 M2 m2 m2 M2 M2 P4 m2 m2 m2 m2 M2 |
| 0043 : 1 : 00 | 31.6 | 15 | m3 M2 m2 m2 M2 m2 M2 m2 M2 m2 M3 m6 m3 M2 M3 |
| 0109 : 1 : 00 | 31.4 | 15 | M2 m3 m2 m2 M2 m2 m3 M2 m2 P5 M3 m2 m2 D5 M3 |
| 0117 : 1 : 48 | 31.2 | 14 | D5 m2 M2 m2 m2 P4 m3 m2 m2 m2 M2 P4 m3 m2 |
| 0066 : 4 : 00 | 31.2 | 15 | m2 M3 m2 D5 m2 M2 P5 P4 m2 m2 M2 M2 M3 m2 m3 |
| 0061 : 2 : 00 | 30.5 | 16 | M3 P4 m2 M2 M3 M2 m2 m2 M2 m3 M2 m3 M3 m2 M2 M3 |
| 0029 : 1 : 00 | 30.3 | 15 | m3 m2 m3 m3 m2 M3 m2 M2 M2 m2 M2 P4 M2 m2 P4 |
| 0064 : 2 : 48 | 30.2 | 15 | M3 M2 m2 P4 D5 M2 M3 M2 m2 m2 m2 M3 M2 P4 m2 |
| 0113 : 3 : 00 | 30.2 | 14 | M2 M6 M7 M2 m2 m2 m2 M3 m2 m2 M2 m3 M2 m3 |
| 0060 : 1 : 48 | 29.3 | 15 | M3 M3 m2 m2 m3 M2 m2 m2 M2 m3 P5 M2 M2 M2 m3 |
| 0104 : 4 : 00 | 29.2 | 14 | m3 M2 m2 m3 M2 m2 m3 M2 m2 M3 M2 P4 m2 m2 |
| 0095 : 4 : 48 | 28.9 | 14 | m3 M3 M2 m2 M2 m3 M2 m2 D5 m2 m2 m2 M6 M3 |

Table 10. The top 14 high tense chords for each movement in order of highest to lowest tensity level for the second movement by 8th step of the harmonic resolution excluding P1/P8.

| Measure | Tensity Degree | Interval Number | Interval Contents |
|---------------|----------------|-----------------|--|
| 0087 : 2 : 00 | 44.2 | 20 | P4 D5 M2 M2 M2 M2 M3 M3 P4 M2 M2 M2 M2 M2 M2 M2 M2 M2 M2 M2 M2 |
| 0061 : 1 : 00 | 42.3 | 17 | m2 m2 m2 m2 m2 m3 m2 M6 M2 m2 M2 m2 m2 P4 m2 m2 D5 |
| 0089 : 1 : 48 | 41.8 | 20 | m2 m2 P4 M2 m2 m3 M2 m2 M2 m3 M2 m2 m3 m2 m2 P4 M3 m2 M3 m3 |
| 0078 : 1 : 48 | 38.2 | 17 | m2 M3 m2 M2 m2 D5 m2 m2 M2 M2 m2 m2 M2 m2 P4 M3 m3 |
| 0059 : 3 : 00 | 38.1 | 17 | M2 m2 m2 M6 P4 M2 M2 M2 m2 m2 M2 P4 M2 m2 D5 m2 m2 |
| 0060 : 1 : 48 | 37.1 | 18 | M2 m2 M3 m3 M2 m3 M3 m2 M3 m2 M2 m2 m2 m2 m3 D5 m2 M3 |
| 0104 : 1 : 00 | 36.8 | 18 | P5 m2 m2 M3 m2 M3 m2 M3 M2 m3 m2 m3 m3 M2 m2 m2 m3 M2 |
| 0060 : 2 : 00 | 35.7 | 16 | m2 m2 M3 m3 m2 m2 m3 m2 M3 m2 m2 M2 D5 m2 M2 m3 |
| 0077 : 4 : 00 | 35.6 | 17 | m2 m3 m2 M3 m2 m2 M2 m3 M2 M2 M2 M2 m2 M2 M2 D5 D5 |
| 0092 : 1 : 00 | 35.6 | 15 | M6 P5 m2 m2 m2 M2 m2 P4 m2 m2 M2 m2 m2 P5 m2 |
| 0099 : 1 : 00 | 35.6 | 16 | P4 M2 M3 P4 M2 m2 m2 M3 m2 m2 m2 m2 m3 m2 m2 m7 |
| 0060 : 4 : 48 | 35.6 | 15 | m2 M2 m3 m2 m7 m2 m2 m2 M3 m2 M2 D5 m2 M2 m2 |
| 0032 : 2 : 48 | 34.9 | 16 | M2 M3 m2 m3 M2 m2 M2 m2 M2 M2 m2 M2 M3 M3 m2 m2 |
| 0078 : 1 : 00 | 34.9 | 16 | m3 P4 m2 M2 M3 m2 m2 m3 m2 m2 m2 m2 M3 M6 m3 m2 |

Table 11. The top 14 high tense chords for each movement in order of highest to lowest tensity level for the third movement by 8th step of the harmonic resolution excluding P1/P8.

Harmonic Tensity

Harmonic Tensity presents the tensity value created by each chord with its interval contents. When the harmonic tensity is low, the time period gets a low level of attention from the audience although occasionally this might get a high level of attention when the neighboring regions are in the same or a similar high level of tensity.

I present the harmonic tensity that occurred by periods of time for each movement through Tables 12 –14 in order of highest to lowest excluding unison and perfect 8th for each whole movement.

| Measure | Degree | Number | Interval Contents |
|----------------|--------|--------|--|
| 0079 – 0079 | 130.9 | 62 | M2 M2 M2 P5 M2 M2 M3 M2 M7 M2 M2 M6 M7 M2 M2 M2 M2 M3 M2 M2 M2 M3 M2 M3 M3 M2 M3 M2 M2 M2 M2 M3 M2 M3 M2 M3 M3 P5 M2 M2 M2 M3 M2 M2 M2 M7 M2 M3 M3 M2 M2 M3 M3 M2 M2 M3 M2 M2 M2 M3 M2 M2 |
| 0078 - 0078 | 109.1 | 52 | m2 m3 m3 m3 M2 M2 m2 m2 D5 m3 m2 m2 M3 P4 m2 m3 P4 m2 m3 M3 M2 m3 M2 m2 P5 m2 M2 m2 m2 m2 M2 M2 m2 P4 m3 M2 M3 m3 M2 m2 m2 M2 M3 m2 m2 m3 m2 m2 D5 M3 m2 |
| 0074 - 0074 | 103.5 | 52 | m2 m3 m2 P4 m3 m2 m2 M3 m3 M2 m3 M3 M3 M2 m2 M2 m3 m2 M2 M3 m2 m2 M2 m3 m3 m2 m3 m2 P4 m3 m2 D5 P4 m2 M2 D5 m3 m2 m3 M2 m3 m2 m2 m2 m2 m3 m3 m3 P4 M2 M2 |
| 0095 - 0095 | 101.6 | 48 | M6 m2 m2 M3 m2 m3 M2 m2 M2 m3 m3 P4 M6 m3 M2 M2 m2 M2 m2 M2 m2 m2 m6 m2 M2 m3 m3 m3 M3 M2 m2 m2 m2 m3 m2 P4 m2 m3 m2 M3 M3 M2 m2 m2 m2 M2 m3 m2 |
| 0090 - 0090 | 100.4 | 52 | m6 m2 m3 M2 m3 M2 M6 M2 M2 M6 M2 m3 D5 m2 m2 M3 m2 M2 m2 m3 M3 P4 P4 m2 m3 D5 m3 M2 M3 m2 P4 m3 m2 M2 m3 M2 m2 M2 M3 m6 M2 m2 M2 m2 m3 m2 M3 M3 M3 M2 m2 m2 |
| 0092 - 0092 | 96.1 | 45 | M2 m2 m2 m2 m2 P4 M2 M2 m2 D5 m2 M3 M2 m6 M2 m2 m2 D5 m2 P4 m2 m2 M3 m2 m3 m2 m3 m3 M2 m3 m6 m3 m3 M2 M2 M7 P4 m2 D5 m3 m2 M2 m2 m2 m2 |
| 0098 - 0098 | 93.3 | 49 | M2 M3 M3 P4 m2 M3 m2 m3 m3 m2 m2 M3 m3 M2 M2 M3 M2 m3 m2 M2 M2 P4 m2 M2 m2 m2 m2 M2 M3 P5 M3 m3 m2 M2 m2 m2 m3 P4 m3 m2 P4 m2 M2 P5 P4 M2 P5 m3 |
| 0089 - 0089 | 91.4 | 44 | m3 m3 M2 P4 M2 m2 m2 M2 M2 M2 M2 m6 M6 M2 m2 m2 m2 P4 M2 m2 M7 M2 P4 M2 M2 m2 m2 m2 M3 m2 M2 m3 M2 m2 M2 m3 m2 m2 m2 m3 P5 P4 |
| 0059 - 0059 | 79.3 | 41 | m2 M2 P4 m7 M2 M2 M2 M2 M2 m2 m2 m3 m3 M2 m6 m2 P4 m2 P4 D5 m2 m3 D5 m3 m2 m3 M2 m2 m3 D5 P4 M2 m3 m2 m3 m2 M2 m2 M6 m3 M3 |
| 0041 - 0041 | 78.9 | 43 | m2 m2 m3 m2 P5 m2 P4 m3 P4 M3 M2 m2 m6 M2 M2 M2 m6 D5 P5 M3 m3 m3 M2 m2 D5 P4 M2 M3 M3 M2 M2 m3 m2 M6 M2 M2 m2 M3 m3 m2 m3 P5 m2 |

Table 12. *Harmonic Tensity Analysis* of the first movement on a quarter note step resolution up to top 10 measures in highest to lowest order excluding P1/P8.

| Measure | Degree | Number | Interval Contents |
|-------------|--------|--------|--|
| 0108 - 0108 | 95.8 | 46 | M6 M2 M2 M2 M2 M3 M2 P4 M2 M3 M2 M3 M2 P4 M2 M3 M3 M2 D5 M2 M3 M3 M2 M2 M2 M2 M7 M2 M2 M3 M2 M2 M2 M2 M6 M2 M2 M3 D5 M2 M7 M2 M2 M3 M2 M6 |
| 0113 - 0113 | 94.8 | 47 | P5 M2 m2 P4 m2 m6 m3 P5 M2 m3 m2 m3 M2 M2 m2 m2 M2 D5 M2 m2 m6 m3 P5 m2 M2 m2 m2 m2 M3 m2 m2 M2 m3 M2 m3 M2 M6 M6 M2 m2 D5 M2 M2 D5 m2 M2 m3 |
| 0117 - 0117 | 93.5 | 49 | M3 M2 m3 m2 m2 M2 m3 m2 M2 m2 M6 M3 P4 m3 m2 P4 m3 m2 M2 M2 m2 M2 P4 m3 m2 M6 M2 m3 M2 m2 D5 M2 D5 m2 M3 P5 M3 m2 M3 M2 m2 M2 P5 M2 M2 D5 m2 M3 P5 |
| 0105 - 0105 | 89.5 | 47 | m2 m3 M2 M3 M2 M2 M2 M2 m3 m2 M3 M3 D5 M3 m2 M2 M2 m3 M2 M3 m2 m2 D5 M2 M3 m3 P5 m3 m2 M2 m2 m3 M2 M2 m2 m6 M2 M2 m2 M3 D5 M2 M2 M3 m2 m3 M2 |
| 0060 - 0060 | 88.9 | 48 | m2 M2 m3 M3 M3 m2 m2 D5 m3 m2 M2 m2 P4 M3 m3 m2 M2 M7 M2 M2 P5 D5 M3 M2 M2 M2 P4 M2 M2 P5 D5 m2 M3 M3 M3 M2 P4 m2 m3 m3 m3 D5 m3 M2 m2 m2 m2 m6 |
| 0079 - 0079 | 88.5 | 44 | m3 m2 M7 m2 m2 M6 M3 M2 M2 M3 m2 m2 M2 M6 M3 m2 m3 m3 P4 m2 m3 M2 m2 m2 m2 m3 M2 M6 M3 m2 m3 M2 M2 M3 M2 m3 m2 M2 P4 m2 M2 m2 M3 m6 |
| 0109 - 0109 | 88.1 | 43 | M2 m3 m2 m2 M2 m2 m3 M2 m2 P5 M3 m2 m2 D5 M3 P4 M3 m2 m3 M2 m2 M2 m6 M3 m2 M3 D5 D5 m3 P5 m7 m2 m2 m2 D5 m3 P5 m2 m2 m6 m2 m2 m2 |
| 0104 - 0104 | 87.9 | 45 | m7 M2 m2 P4 m2 M2 M2 P4 M2 m3 M2 D5 m3 m2 P5 D5 D5 m2 M3 P4 M2 m2 m2 m3 m2 m6 m2 m3 M2 m3 M3 m2 m2 m3 M2 m2 m3 M2 m2 M3 M2 P4 m2 m2 |
| 0064 - 0064 | 86.9 | 43 | M2 M2 m2 P4 m2 m2 M2 D5 M2 m3 m2 M2 m2 M2 m3 M2 m2 M2 m6 P4 M2 m3 m2 M2 M2 m2 m3 D5 m3 m3 m2 P4 D5 P4 P4 m2 m2 m3 m2 m6 m2 M2 M7 |
| 0080 - 0080 | 84.6 | 43 | m3 M2 m2 M2 m3 m2 M3 m3 m2 M3 M2 M3 m2 m3 m2 M3 m2 M2 m2 P4 P4 M2 m2 P5 m3 m6 D5 m3 m2 m2 P4 M3 m2 P5 M2 M2 m2 m2 m2 M2 M2 M3 m3 |

Table 13. *Harmonic Tensity Analysis* of the second movement on a quarter note step resolution up to top 10 measures in highest to lowest order excluding P1/P8.

| Measure | Degree | Number | Interval Contents |
|-------------|--------|--------|--|
| 0087 - 0087 | 130.7 | 63 | m2 P4 M3 M2 P5 M2 m3 M3 M2 M2 m2 m2 P4 D5 m2 M2 m2 M2 m3 m3 P4 m2 m2 m2 m2 M2 m2 M2 M2 M2 M2 m2 m6 m3 m2 M2 M2 m2 M2 M3 M2 m3 M3 m3 m2 m2 m2 m6 P4 m2 M2 m2 M3 P4 M3 m3 m2 M2 M2 m2 m3 m2 m2 |
| 0059 - 0059 | 123.7 | 58 | m2 m2 m3 m2 m2 M2 M2 D5 m3 m3 m2 m2 m2 M3 D5 D5 M2 m3 P4 m2 M2 m2 M2 P4 M2 m3 D5 M2 m2 m2 M6 P4 M2 M2 M2 m2 m2 M2 P4 M2 m2 D5 m2 m2 m3 M2 m2 m2 D5 D5 P5 m2 m2 m2 m2 m2 M2 M2 |
| 0060 - 0060 | 119.9 | 58 | m7 M2 m2 P4 M3 M2 M2 m2 m2 m2 M2 M3 M3 m3 m2 m3 m2 m2 M3 m3 m2 m2 m3 m2 M3 m2 m2 M2 D5 m2 M2 m3 M2 m2 m2 M2 m6 m2 M2 M6 P5 m2 D5 M2 M2 M3 m2 M2 M3 D5 m2 D5 m2 M2 m2 M2 M3 M2 m3 |
| 0104 - 0104 | 117.4 | 57 | P5 m2 m2 M3 m2 M3 m2 M3 M2 m3 m2 m3 m3 M2 m2 m2 m3 M2 D5 M3 m2 m2 M3 M2 m2 M2 m3 m2 m3 P5 m3 m2 M2 M2 m3 m3 m2 m2 m2 M3 m3 m3 m2 m2 M2 M2 m6 m2 M2 m2 P4 m3 m2 M2 M2 M6 m2 |
| 0061 - 0061 | 112.1 | 54 | m2 m2 m2 m2 m2 m3 m2 M6 M2 m2 M2 m2 m2 P4 m2 m2 D5 M2 M2 m2 P4 m2 M6 M3 m2 M2 m3 M2 M2 M2 D5 D5 M3 m2 M3 m3 M2 m2 m2 D5 P4 m2 P4 D5 D5 M3 M2 D5 M3 M2 m2 m2 D5 m6 |
| 0099 - 0099 | 109.6 | 50 | m3 M2 M2 M2 M2 P4 M2 m2 m2 M3 m2 m2 m2 m2 m3 m2 m2 m7 M3 m6 m2 m2 D5 M2 M3 m2 M2 m3 m2 m3 M2 m2 m2 m2 M2 D5 D5 m2 M2 m2 M2 m2 M3 m3 M2 m2 m2 m2 m7 P5 |
| 0030 - 0030 | 105.7 | 55 | m3 M2 m2 m2 m2 P4 m2 m3 m3 m2 P4 m3 D5 m3 M2 M2 m3 M2 M2 m3 D5 m2 P4 m3 m2 m2 m2 M3 m3 m3 P4 M2 m3 m3 M3 M2 m2 m2 M3 M3 m2 M2 M3 M2 m2 M3 m2 P4 m3 m2 M2 M2 M2 m3 m2 |
| 0077 - 0077 | 103.3 | 50 | m2 m3 P5 m3 m7 M2 M3 M2 M2 D5 m2 M6 M2 m2 m2 M2 m2 m2 m2 m7 M3 M2 D5 M2 m3 m2 m2 M2 m2 P5 M3 m3 m2 m2 m3 m2 M3 m2 m2 M2 m3 M2 M2 M2 m2 m2 M2 D5 D5 |
| 0057 - 0057 | 96.4 | 50 | m2 m2 m2 m2 M2 m3 m2 M2 D5 M2 D5 P4 m3 D5 M3 D5 m3 M2 P5 m3 m2 m2 P5 D5 m3 m3 M2 m3 m2 M2 D5 M2 m2 M2 m2 m3 m2 m2 m3 M2 M2 M2 M2 M3 m3 M2 m3 M3 m2 |
| 0089 - 0089 | 95.4 | 51 | m2 P4 m2 m3 D5 m2 M3 m2 M2 M2 m2 M2 P4 m3 M3 m2 M2 m2 m3 m3 M3 m3 M2 m2 m3 m2 m7 P5 M3 M2 m6 M2 M2 m6 m3 m3 m2 P5 M3 M3 M2 P4 m2 P5 M2 M3 M2 M2 m2 M7 |

Table 14. *Harmonic Tensity Analysis* of the third movement on a quarter note step resolution up to top 10 measures in highest to lowest order excluding P1/P8.

Linear Interval Statistics

Linear Interval Statistics Analysis presents the contents of horizontal intervals.

These horizontal interval contents determine the overall tendency of the melodic shapes in the composition. Table 15 is from *Brandenburg Concerto No. 1* (1721) of J. S. Bach.

The analysis shows that most frequent intervals are between P1/P8 (unison or octave) and minor 3rd, which means that a majority of the melodies move in step motion. Looking at Tables 16 through 18, we can assume that *Symphony No. 1* employed all 12 intervals in similar frequency, which implies that the music is not a tonal composition.

| Intervals | 0 (P1) | 1 (m2) | 2 (M2) | 3 (m3) | 4 (M3) | 5 (P4) | 6 (D5) | 7 (P5) | 8 (m6) | 9 (M6) | 10 (m7) | 11 (M7) |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|------------|
| Track 1 | 319 | 306 | 476 | 222 | 118 | 103 | 28 | 79 | 22 | 22 | 42 | 2 |
| Track 2 | 313 | 148 | 232 | 216 | 116 | 132 | 30 | 70 | 36 | 40 | 44 | 4 |
| Track 3 | 294 | 156 | 218 | 178 | 98 | 150 | 12 | 50 | 36 | 32 | 40 | 4 |
| Track 4 | 344 | 209 | 354 | 203 | 122 | 114 | 28 | 102 | 22 | 26 | 41 | 2 |
| Track 5 | 336 | 197 | 306 | 199 | 122 | 78 | 26 | 90 | 32 | 44 | 37 | 8 |
| Track 6 | 348 | 183 | 268 | 189 | 98 | 114 | 6 | 78 | 30 | 38 | 35 | 10 |
| Track 7 | 189 | 218 | 426 | 98 | 56 | 108 | 4 | 83 | 6 | 4 | 4 | 2 |
| Track 8 | 189 | 218 | 426 | 98 | 56 | 108 | 4 | 83 | 6 | 4 | 4 | 2 |

Table 15. *Linear Interval Statistics Analysis* for *Brandenburg Concerto No. 1* of J. S. Bach.

| Intervals | 0 (P1) | 1 (m2) | 2 (M2) | 3 (m3) | 4 (M3) | 5 (P4) | 6 (D5) | 7 (P5) | 8 (m6) | 9 (M6) | 10 (m7) | 11 (M7) |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|------------|
| Track 1 | 12 | 39 | 34 | 30 | 35 | 32 | 32 | 17 | 17 | 15 | 7 | 7 |
| Track 2 | 11 | 38 | 46 | 33 | 36 | 24 | 24 | 23 | 10 | 15 | 8 | 9 |
| Track 3 | 5 | 42 | 41 | 36 | 32 | 25 | 39 | 19 | 18 | 11 | 7 | 2 |
| Track 4 | 1 | 35 | 51 | 47 | 36 | 29 | 25 | 13 | 9 | 11 | 9 | 11 |
| Track 5 | 10 | 26 | 27 | 50 | 28 | 43 | 35 | 12 | 12 | 16 | 8 | 10 |
| Track 6 | 11 | 29 | 33 | 38 | 24 | 23 | 26 | 22 | 16 | 26 | 14 | 15 |
| Track 7 | 8 | 23 | 23 | 24 | 24 | 22 | 19 | 14 | 18 | 20 | 13 | 10 |
| Track 8 | 15 | 28 | 26 | 28 | 25 | 15 | 19 | 20 | 11 | 14 | 8 | 9 |
| Track 9 | 5 | 21 | 27 | 22 | 24 | 23 | 14 | 12 | 19 | 8 | 10 | 3 |
| Track 10 | 7 | 24 | 12 | 24 | 25 | 22 | 19 | 18 | 15 | 8 | 6 | 8 |
| Track 11 | 0 | 23 | 13 | 21 | 11 | 19 | 5 | 8 | 7 | 4 | 6 | 5 |
| Track 12 | 7 | 17 | 14 | 13 | 11 | 18 | 16 | 6 | 9 | 8 | 2 | 1 |
| Track 13 | 3 | 24 | 23 | 26 | 27 | 21 | 20 | 16 | 11 | 8 | 7 | 2 |
| Track 14 | 3 | 24 | 24 | 23 | 41 | 14 | 15 | 20 | 5 | 10 | 6 | 3 |
| Track 15 | 8 | 30 | 26 | 32 | 21 | 27 | 16 | 17 | 16 | 8 | 11 | 6 |
| Track 16 | 11 | 22 | 22 | 25 | 27 | 33 | 19 | 18 | 16 | 11 | 10 | 4 |
| Track 17 | 7 | 18 | 34 | 34 | 28 | 21 | 33 | 24 | 17 | 11 | 4 | 16 |
| Track 18 | 10 | 23 | 18 | 38 | 39 | 34 | 28 | 17 | 15 | 7 | 14 | 4 |
| Track 19 | 14 | 26 | 36 | 23 | 35 | 25 | 18 | 21 | 15 | 11 | 11 | 12 |
| Track 20 | 9 | 36 | 25 | 28 | 26 | 26 | 21 | 20 | 17 | 20 | 12 | 7 |
| Track 21 | 17 | 36 | 34 | 38 | 37 | 47 | 33 | 29 | 33 | 20 | 23 | 18 |
| Track 22 | 17 | 41 | 34 | 35 | 37 | 38 | 43 | 20 | 30 | 31 | 20 | 19 |
| Track 23 | 7 | 40 | 46 | 47 | 52 | 39 | 36 | 37 | 26 | 15 | 9 | 11 |
| Track 24 | 11 | 32 | 45 | 55 | 44 | 44 | 43 | 35 | 23 | 18 | 6 | 9 |

Table 16. *Linear Interval Statistical Analysis* for the first movement excluding intervals made by gaps longer than 10 measures.

| Intervals | 0 (P1) | 1 (M2) | 2 (M2) | 3 (M3) | 4 (M3) | 5 (P4) | 6 (D5) | 7 (P5) | 8 (M6) | 9 (M6) | 10 (M7) | 11 (M7) |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|------------|
| Track 1 | 11 | 38 | 42 | 39 | 30 | 29 | 25 | 24 | 28 | 16 | 18 | 8 |
| Track 2 | 9 | 58 | 32 | 46 | 37 | 28 | 20 | 18 | 23 | 16 | 11 | 10 |
| Track 3 | 8 | 29 | 42 | 31 | 35 | 34 | 34 | 35 | 22 | 14 | 10 | 14 |
| Track 4 | 4 | 35 | 39 | 39 | 43 | 41 | 42 | 28 | 24 | 8 | 3 | 2 |
| Track 5 | 16 | 21 | 40 | 35 | 47 | 50 | 35 | 18 | 18 | 12 | 12 | 4 |
| Track 6 | 9 | 33 | 38 | 33 | 48 | 36 | 34 | 24 | 14 | 20 | 11 | 8 |
| Track 7 | 14 | 14 | 37 | 30 | 38 | 32 | 15 | 20 | 12 | 10 | 12 | 5 |
| Track 8 | 12 | 27 | 24 | 28 | 27 | 27 | 23 | 14 | 19 | 15 | 9 | 14 |
| Track 9 | 8 | 30 | 44 | 28 | 28 | 24 | 20 | 26 | 14 | 20 | 10 | 7 |
| Track 10 | 10 | 38 | 36 | 19 | 18 | 35 | 21 | 17 | 19 | 15 | 16 | 15 |
| Track 11 | 6 | 29 | 13 | 22 | 29 | 27 | 21 | 17 | 18 | 18 | 8 | 8 |
| Track 12 | 8 | 24 | 28 | 17 | 29 | 21 | 29 | 16 | 15 | 8 | 14 | 7 |
| Track 13 | 5 | 26 | 24 | 41 | 34 | 30 | 33 | 23 | 18 | 11 | 9 | 8 |
| Track 14 | 3 | 27 | 24 | 44 | 35 | 31 | 31 | 28 | 21 | 5 | 10 | 3 |
| Track 15 | 6 | 22 | 31 | 36 | 26 | 28 | 17 | 19 | 21 | 12 | 7 | 14 |
| Track 16 | 16 | 30 | 33 | 20 | 35 | 23 | 22 | 17 | 15 | 17 | 6 | 5 |
| Track 17 | 14 | 44 | 44 | 49 | 51 | 48 | 55 | 40 | 29 | 30 | 19 | 17 |
| Track 18 | 20 | 32 | 53 | 52 | 60 | 40 | 50 | 39 | 29 | 28 | 15 | 22 |
| Track 19 | 19 | 42 | 53 | 50 | 58 | 45 | 47 | 26 | 30 | 26 | 26 | 18 |
| Track 20 | 9 | 49 | 39 | 39 | 55 | 50 | 62 | 47 | 33 | 24 | 23 | 10 |
| Track 21 | 8 | 42 | 43 | 32 | 43 | 35 | 37 | 20 | 32 | 21 | 10 | 8 |
| Track 22 | 9 | 24 | 35 | 35 | 55 | 24 | 23 | 33 | 40 | 19 | 15 | 19 |
| Track 23 | 6 | 42 | 41 | 33 | 42 | 35 | 42 | 28 | 23 | 14 | 13 | 12 |
| Track 24 | 15 | 22 | 43 | 39 | 49 | 34 | 40 | 26 | 16 | 21 | 13 | 13 |

Table 17. *Linear Interval Statistical Analysis* for the second movement excluding intervals made by gaps longer than 10 measures.

| Intervals | 0 (P1) | 1 (m2) | 2 (M2) | 3 (m3) | 4 (M3) | 5 (P4) | 6 (D5) | 7 (P5) | 8 (m6) | 9 (M6) | 10 (m7) | 11 (M7) |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|------------|
| Track 1 | 9 | 55 | 52 | 41 | 30 | 27 | 23 | 19 | 19 | 15 | 11 | 9 |
| Track 2 | 10 | 47 | 35 | 43 | 39 | 32 | 23 | 13 | 28 | 12 | 15 | 13 |
| Track 3 | 13 | 36 | 37 | 42 | 42 | 28 | 31 | 25 | 18 | 18 | 14 | 6 |
| Track 4 | 4 | 40 | 49 | 43 | 33 | 31 | 20 | 21 | 24 | 21 | 11 | 13 |
| Track 5 | 11 | 41 | 35 | 33 | 36 | 21 | 26 | 24 | 23 | 13 | 30 | 17 |
| Track 6 | 23 | 40 | 37 | 26 | 23 | 19 | 40 | 31 | 21 | 16 | 16 | 18 |
| Track 7 | 7 | 27 | 38 | 30 | 36 | 32 | 25 | 33 | 20 | 18 | 17 | 15 |
| Track 8 | 6 | 32 | 42 | 31 | 38 | 33 | 25 | 29 | 18 | 17 | 15 | 12 |
| Track 9 | 13 | 23 | 33 | 26 | 25 | 22 | 22 | 15 | 18 | 13 | 5 | 12 |
| Track 10 | 18 | 35 | 23 | 26 | 25 | 24 | 10 | 17 | 16 | 12 | 15 | 6 |
| Track 11 | 9 | 46 | 41 | 35 | 43 | 29 | 28 | 20 | 19 | 20 | 10 | 12 |
| Track 12 | 7 | 59 | 45 | 39 | 35 | 37 | 20 | 20 | 21 | 19 | 4 | 6 |
| Track 13 | 4 | 34 | 30 | 29 | 31 | 16 | 17 | 17 | 18 | 8 | 9 | 14 |
| Track 14 | 8 | 39 | 28 | 32 | 37 | 17 | 17 | 9 | 15 | 9 | 7 | 9 |
| Track 15 | 6 | 41 | 38 | 26 | 33 | 41 | 23 | 25 | 21 | 16 | 22 | 6 |
| Track 16 | 3 | 49 | 32 | 40 | 33 | 32 | 25 | 22 | 19 | 15 | 15 | 13 |
| Track 17 | 21 | 64 | 43 | 45 | 42 | 52 | 44 | 38 | 32 | 22 | 28 | 16 |
| Track 18 | 15 | 56 | 53 | 52 | 50 | 49 | 44 | 31 | 26 | 25 | 25 | 21 |
| Track 19 | 8 | 78 | 49 | 53 | 47 | 37 | 47 | 44 | 24 | 15 | 30 | 15 |
| Track 20 | 14 | 66 | 37 | 57 | 55 | 64 | 43 | 31 | 34 | 26 | 12 | 8 |
| Track 21 | 19 | 54 | 36 | 34 | 26 | 39 | 28 | 34 | 28 | 17 | 22 | 21 |
| Track 22 | 12 | 51 | 47 | 31 | 35 | 38 | 38 | 23 | 28 | 18 | 18 | 19 |
| Track 23 | 8 | 47 | 43 | 46 | 43 | 33 | 42 | 30 | 21 | 21 | 11 | 13 |
| Track 24 | 5 | 50 | 49 | 37 | 45 | 37 | 33 | 42 | 26 | 10 | 11 | 13 |

Table 18. *Linear Interval Statistical Analysis* for the third movement excluding intervals made by gaps longer than 10 measures.

CONCLUSION

Symphony No. 1 is the first complete work I created using the Algorithmic Composition System software, except several fragmented works. I found that composing with the algorithmic composition program increases both productivity and creativity through the short processing time, instant performance, and the easy organization of compositional ideas and musical data. For example, after creating the fundamental musical data, the composer can access them and modify them whenever he needs. On occasion, the composer can use the algorithmic composition program as a modeler only for the complicated portions, or to simulate the outcome especially when various diverse rhythms and numerous instruments are overlapped. Otherwise the composer will have to leave it to his/her imagination until performed.

I will continue developing the software as long as I compose music. I have several plans for my future compositions. One is that I incorporate the use of microtones into the composition. The thought of using microtones was one of the significant reasons I started ACS. When I studied composing twelve-tone serial music and the like, my disappointment had arisen from the uninteresting sound. When I heard about microtones and micro tonality, I wished I could try them, and I dreamt that I could find a system that would replace current directions of music from them. Now I think that there seem to be no such undiscovered physical phenomena that can compete with the system having tonic and dominant relationships with its related triads in the aspect of people's flavor. Nevertheless, I believe there may be other concealed relationships yet, although they will

not be so popular as the system of tonality. The microtones won't generate the same flavor as tonality does either. However, I am sure it will enrich our musical resources at least only if they harmonize well with semitones.

Symphony No. 1 has an important meaning to me as the first complete composition composed using the Algorithmic Composition System. Along with this composition my main goal as a composer will be to find better ways of constructing musical materials through compositions and developing ACS. I believe beauty comes not from degradation, nonexistence, or chaos, but from robust, elaborate, restrained, and refined structure.

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Jongmoon Choi
Symphony No. 1

October 2000

Notes for Performance

1. Accidentals take effect only in a measure and only for the same pitches that are in the same frequency.
2. The articulation for *Symphony No. 1*: All note groups or phrases, which are formed by being separated by rest notes, should be played legato.

Symphony No.1

1.

Jongmoon Choi

$\text{♩} = 80$

Fl. 1
Fl. 2
Ob. 1
Ob. 2
Cl. 1 (Bb)
Cl. 2 (Bb)
Bn. 1
Bn. 2
Hrn. 1 (F)
Hrn. 2 (F)
Trp. 1
Trp. 2
Tbn. 1
Tbn. 2
Tb. 1
Tb. 2
Vn. 1
Vn. 2
Va. 1
Va. 2
Vc. 1
Vc. 2
Cb. 1
Cb. 2

This musical score is arranged in three systems, each containing a grand staff (treble and bass clefs) and a string quartet (two violins, two violas, and two cellos). The first system features a complex rhythmic pattern with frequent triplets and sixteenth-note runs, marked with a mezzo-piano (*mp*) dynamic. The second system continues this texture with some rests in the upper staves. The third system shows a change in the string parts, with some staves containing sustained notes or rests, while others continue with rhythmic patterns. The overall style is intricate and rhythmic.

This musical score is arranged in three systems. The first system consists of eight staves: four grand staff systems (treble and bass clefs) and two additional bass clef staves. The first system contains musical notation with dynamic markings of *p* (piano) and *mf* (mezzo-forte). It features complex rhythmic patterns, including triplets in the upper staves, and rests in the lower staves. The second system consists of six staves, with the top two being empty and the bottom four containing musical notation and dynamic markings. The third system consists of six staves, with the top two being empty and the bottom four containing musical notation and dynamic markings. The score concludes with a final *mf* marking.

This musical score is arranged in three systems. The first system consists of six staves, with the top two grouped by a brace and the bottom four by another. The first two staves of this system contain triplet markings and dynamic markings of *p* and *mp*. The second system consists of two staves, both with dynamic markings of *p*. The third system consists of six staves, with the top two grouped by a brace and the bottom four by another. The top two staves of this system contain triplet markings and dynamic markings of *mp*. The bottom four staves of this system contain dynamic markings of *p*. The score is written in a key signature of one flat and a 3/4 time signature.

This musical score is arranged in three systems. The first system consists of six staves, with the top two grouped by a brace. The second system has four staves, with the top two grouped by a brace. The third system has six staves, with the top two grouped by a brace. The notation includes various rhythmic patterns, such as eighth and sixteenth notes, and rests. Dynamics are indicated by *mf* (mezzo-forte) and *p* (piano). The score features several triplet markings over groups of notes. The key signature has two flats, and the time signature is 4/4. The piece concludes with a final cadence in the last measure of the third system.

This musical score is arranged in three systems. The first system consists of five staves, with the bottom two staves containing musical notation starting in the fourth measure, marked with a mezzo-forte (*mf*) dynamic. The second system consists of five staves, with the bottom two staves containing musical notation starting in the fourth measure, also marked with a mezzo-forte (*mf*) dynamic. The third system is the most complex, featuring seven staves. The top two staves contain melodic lines with dynamics of *f* and *mf*. The middle three staves contain a dense texture of chords and arpeggios, with dynamics of *f* and *mf*. The bottom two staves contain a bass line with dynamics of *f* and *mf*. The score includes various musical notations such as notes, rests, and articulation marks.

This musical score consists of three systems of staves. The first system includes five treble clef staves and two bass clef staves. The second system includes two treble clef staves and two bass clef staves. The third system includes two treble clef staves, two bass clef staves, and a grand staff (treble and bass clef). The score features dynamic markings of *mf* (mezzo-forte) and *mp* (mezzo-piano). Triplet markings are present throughout, particularly in the upper staves. The notation includes various rhythmic values, rests, and articulation marks.

Musical score system 1, featuring five staves. The first two staves are treble clef, and the last three are bass clef. The music includes dynamic markings *mp* and *mf*, and contains triplet markings (3).

Two empty musical staves, one treble clef and one bass clef.

Musical score system 2, featuring two staves. The top staff is treble clef and the bottom staff is bass clef. The music includes dynamic markings *mf*.

Musical score system 3, featuring seven staves. The top two are treble clef, the next three are bass clef, and the bottom one is a grand staff (treble and bass clef). The music includes dynamic markings *mf* and contains triplet markings (3).

This musical score is arranged in three systems, each containing five staves. The top two staves of each system are grouped by a brace on the left, indicating they belong to a single instrument, likely the piano. The bottom three staves of each system are grouped by a brace on the left, indicating they belong to another instrument, likely a string quartet. The score is written in a key signature of one flat (B-flat major or D minor) and a common time signature (C). The first system shows the piano playing a rhythmic pattern of eighth and sixteenth notes, while the strings play a sustained harmonic. The second system features a more active piano part with sixteenth-note runs and a string part with a melodic line. The third system shows the piano playing a complex rhythmic pattern with triplets and the strings playing a sustained harmonic. Dynamic markings include *mp* (mezzo-piano) and *mf* (mezzo-forte).

This page of musical notation is a score for a piano piece, consisting of multiple systems of staves. The notation is complex, featuring a variety of rhythmic patterns, including eighth and sixteenth notes, and several triplet markings. The dynamic marking *mf* (mezzo-forte) is used throughout the score. The piece is written in a key signature with one flat (B-flat major or D minor). The notation includes a variety of clefs: treble clefs for the upper staves and bass clefs for the lower staves. The score is organized into systems, with each system containing multiple staves. The first system includes a grand staff (treble and bass clefs) and a separate bass clef staff. The second system includes a grand staff and two bass clef staves. The third system includes a grand staff and two bass clef staves. The fourth system includes a grand staff and two bass clef staves. The fifth system includes a grand staff and two bass clef staves. The sixth system includes a grand staff and two bass clef staves. The seventh system includes a grand staff and two bass clef staves. The eighth system includes a grand staff and two bass clef staves. The ninth system includes a grand staff and two bass clef staves. The tenth system includes a grand staff and two bass clef staves. The notation is dense and detailed, with many notes and rests. The overall style is that of a classical piano score.

This page of musical notation is divided into three main systems. The first system consists of six staves, with the top two grouped by a brace and the bottom four grouped by another brace. The second system consists of four staves, with the top two grouped by a brace and the bottom two grouped by another brace. The third system is the most complex, consisting of eight staves. The top two staves are grouped by a brace, and the bottom six staves are grouped by another brace. This system features intricate rhythmic patterns, including many triplets marked with a '3' and a bracket. The notation includes various clefs (treble and bass), accidentals (sharps, flats, naturals), and rests. The overall style is that of a classical piano score.

This page of musical notation consists of several systems of staves. The first system includes five treble clef staves and two bass clef staves. The first four treble staves contain dense, rhythmic passages with frequent triplets, marked with a forte (*f*) dynamic. The fifth treble staff and both bass staves have a more sparse texture, marked with a mezzo-forte (*mf*) dynamic. The second system continues with similar textures, featuring a *f* dynamic in the first two bass staves and *mf* in the others. The third system shows a significant change, with the first two bass staves marked *f* and the remaining staves marked *mf*. The fourth system features a complex texture with multiple staves marked *f* and *mf*. The fifth system shows a transition to a *f* dynamic in the first two bass staves and *mf* in the others. The sixth system features a *f* dynamic in the first two bass staves and *mf* in the others. The seventh system features a *f* dynamic in the first two bass staves and *mf* in the others. The eighth system features a *f* dynamic in the first two bass staves and *mf* in the others. The ninth system features a *f* dynamic in the first two bass staves and *mf* in the others. The tenth system features a *f* dynamic in the first two bass staves and *mf* in the others.

This musical score is arranged in three systems. The first system consists of five staves: four for a string quartet (Violin I, Violin II, Viola, and Violoncello) and one for the piano. The second system consists of four staves: two for the string quartet and two for the piano. The third system consists of six staves: two for the string quartet and four for the piano. The score includes various musical notations such as dynamics (*mp*, *mf*), articulation marks, and triplets. The piano part features a complex rhythmic pattern with many triplets.

This page of musical notation is divided into three systems. The first system consists of six staves: two grand staves (treble and bass clef) and two single staves (treble and bass clef). The second system also consists of six staves, with the same layout. The third system is more complex, featuring eight staves: two grand staves and four single staves. The notation includes various musical symbols such as notes, rests, slurs, and triplets. Dynamic markings, specifically the fortissimo 'f', are placed throughout the score. The key signature is one flat (B-flat), and the time signature is 4/4. The piece concludes with a final cadence in the third system.

Musical score system 1, featuring five staves of treble clef and two staves of bass clef. The first five staves contain complex melodic lines with frequent triplets and slurs. The sixth and seventh staves provide a bass line with sustained notes and some melodic movement. A dynamic marking of *f* (forte) is present in the sixth staff.

Musical score system 2, featuring two staves of treble clef and four staves of bass clef. The first two staves are mostly rests. The third and fourth staves have sustained notes with a dynamic marking of *f*. The fifth and sixth staves contain rhythmic patterns with slurs and ties.

Musical score system 3, featuring two staves of treble clef and six staves of bass clef. The first two staves have simple melodic lines. The remaining four staves feature dense, rhythmic patterns with many triplets and slurs.

This musical score is arranged in three systems, each containing five staves. The top two staves of each system are for the piano, and the bottom three are for strings. The piano part features a melodic line with triplet markings and dynamic markings of *mp* and *mf*. The string part provides harmonic support with sustained notes and rhythmic patterns, also marked with *mp* and *mf*. The score includes various musical notations such as slurs, accents, and triplet markings.

This page of musical notation is divided into three systems. The first system consists of two systems of staves: the top system has five staves (treble and bass clefs) and the bottom system has two staves (bass clefs). The second system has two systems of staves: the top system has two staves (treble and bass clefs) and the bottom system has four staves (two bass clefs). The third system has two systems of staves: the top system has two staves (treble and bass clefs) and the bottom system has four staves (two bass clefs). The notation includes various rhythmic values, including eighth and sixteenth notes, and features several triplet markings (indicated by a '3' in a bracket) across multiple staves. The key signature is one flat (B-flat), and the time signature is 4/4. The music is written in a complex, multi-layered style, typical of a piano solo or a chamber piece.

This page of musical notation is a score for a piano piece, likely in a minor key given the presence of flats. The score is organized into several systems of staves. The first system consists of five staves, with the first two grouped by a brace. The second system has four staves, with the first two grouped. The third system has four staves, with the first two grouped. The fourth system has four staves, with the first two grouped. The fifth system has four staves, with the first two grouped. The sixth system has four staves, with the first two grouped. The seventh system has four staves, with the first two grouped. The eighth system has four staves, with the first two grouped. The ninth system has four staves, with the first two grouped. The tenth system has four staves, with the first two grouped. The notation includes various rhythmic values, including eighth and sixteenth notes, and rests. There are numerous triplet markings (indicated by a '3' in a bracket) throughout the score. Dynamic markings include *mp* (mezzo-piano) and *mf* (mezzo-forte). The score is written in a standard musical notation style with a treble and bass clef.

This page of musical notation is a score for a piano piece, likely in a minor key as indicated by the flat signs in the key signature. The score is organized into systems of staves. The first system consists of five treble clef staves and two bass clef staves. The second system consists of two treble clef staves and two bass clef staves. The third system consists of two treble clef staves and two bass clef staves. The fourth system consists of two treble clef staves and two bass clef staves. The fifth system consists of two treble clef staves and two bass clef staves. The sixth system consists of two treble clef staves and two bass clef staves. The seventh system consists of two treble clef staves and two bass clef staves. The eighth system consists of two treble clef staves and two bass clef staves. The ninth system consists of two treble clef staves and two bass clef staves. The tenth system consists of two treble clef staves and two bass clef staves. The notation includes various rhythmic values, including eighth and sixteenth notes, and rests. There are several triplet markings (indicated by a '3' in a bracket) throughout the score. Dynamic markings, including the forte 'f' marking, are present. The piece concludes with a final cadence in the last system.

This page of musical notation is a complex score for a piano piece, consisting of 18 staves. The notation is organized into several systems, with some staves grouped by brackets. The music features a variety of rhythmic patterns, including frequent triplets and sixteenth-note runs. Dynamic markings such as *f* (forte) are present, indicating sections of increased volume. The score includes a wide range of musical symbols, including notes, rests, and articulation marks, all set against a background of a key signature with two flats and a 3/4 time signature. The overall texture is dense and technically demanding.

This page of musical notation is a complex score for a piano piece, consisting of 18 staves. The notation is organized into three systems of six staves each. The first system (staves 1-6) features a treble clef and a key signature of one flat (B-flat). It contains intricate melodic lines with frequent triplets and slurs. The second system (staves 7-12) includes both treble and bass clefs, with the bass clef part showing more rhythmic complexity and triplets. The third system (staves 13-18) continues the melodic and rhythmic development, with the right hand (treble clef) playing more active lines and the left hand (bass clef) providing harmonic support. The score is densely packed with notes, rests, and articulation marks, indicating a technically demanding piece.

This page of musical notation is divided into several systems. The first system consists of five staves, with the top two staves grouped by a brace. The second system has two staves. The third system has four staves, with the top two grouped by a brace. The fourth system has four staves, with the top two grouped by a brace. The fifth system has four staves, with the top two grouped by a brace. The sixth system has four staves, with the top two grouped by a brace. The seventh system has four staves, with the top two grouped by a brace. The eighth system has four staves, with the top two grouped by a brace. The notation includes various rhythmic values such as eighth, sixteenth, and thirty-second notes, as well as rests and dynamic markings like *f*. Many passages are marked with triplet brackets and the number '3'.

This page of musical notation is a score for a piano piece, likely in a minor key given the presence of flats. The score is organized into systems of staves. The first system consists of five staves, with the first four grouped by a brace on the left, suggesting they are for the right hand. The second system has four staves, with the first three grouped by a brace. The third system has four staves, with the first three grouped by a brace. The fourth system has four staves, with the first three grouped by a brace. The fifth system has four staves, with the first three grouped by a brace. The sixth system has four staves, with the first three grouped by a brace. The seventh system has four staves, with the first three grouped by a brace. The eighth system has four staves, with the first three grouped by a brace. The notation is dense, featuring many triplets and sixteenth notes. There are various accidentals, including flats and naturals, and dynamic markings such as *mf* and *f*. The piece concludes with a final cadence in the eighth system.

This page of musical notation is a score for a piano piece, consisting of 18 staves. The notation is arranged in three systems of six staves each. The first system includes a grand staff (treble and bass clefs) and four individual staves. The second system continues with the grand staff and four individual staves. The third system features a grand staff with a complex rhythmic pattern, followed by four individual staves. The notation includes various rhythmic values, including eighth and sixteenth notes, and rests. There are several triplet markings (indicated by a '3' over a bracket) in the lower staves of the first and third systems. The dynamic marking *ff* (fortissimo) is present in the first system and is repeated in several measures throughout the page. The key signature is one flat (B-flat), and the time signature is 4/4. The piece concludes with a final *ff* marking at the bottom of the page.

This page of a musical score, page 27, features a piano accompaniment and string quartet. The piano part is written in a grand staff (treble and bass clefs) and includes dynamic markings such as *f* (forte) and *mf* (mezzo-forte). The string quartet consists of four staves (two violins, two violas, and two cellos/double basses). The score is organized into three systems, each containing five staves. The first system shows the initial entry of the piano and strings. The second system continues the development of the piano part, with the strings providing harmonic support. The third system features more complex piano textures, including triplets and a prominent melodic line in the right hand. The overall style is classical, with clear articulation and dynamic contrast.

Musical score system 1, featuring piano and bass staves. The piano part includes five treble clef staves and two bass clef staves. The bass part includes two bass clef staves. Dynamics include *mf*, *p*, and *pp*.

Musical score system 2, featuring piano and bass staves. The piano part includes two treble clef staves and two bass clef staves. The bass part includes two bass clef staves. Dynamics include *mf*, *mp*, *p*, and *pp*.

Musical score system 3, featuring piano and bass staves. The piano part includes two treble clef staves and two bass clef staves. The bass part includes two bass clef staves. Dynamics include *mp*, *p*, and *pp*.

♩ = 85

The image shows a musical score for piano and strings, consisting of three systems of staves. The first system has six staves (three treble clefs and three bass clefs). The second system has four staves (two treble clefs and two bass clefs). The third system has six staves (three treble clefs and three bass clefs). The tempo is marked as ♩ = 85. The score includes dynamic markings such as *mf*, *mp*, and *p*. The first system shows a piano part with *mf* dynamics and string parts with *mp* dynamics. The second system shows a piano part with *mp* dynamics and string parts with *p* dynamics. The third system shows a piano part with *mp* dynamics and string parts with *mf* and *p* dynamics. The score is written in a key signature of two flats and common time.

This musical score is arranged in three systems. The first system consists of five staves, with the first four grouped by a brace on the left. The second system has two staves. The third system has five staves, with the first four grouped by a brace on the left. The music is written in a key with two flats and a 4/4 time signature. Dynamic markings include *p* (piano), *mp* (mezzo-piano), and *pp* (pianissimo). The score includes various rhythmic patterns, including eighth and sixteenth notes, and rests. Some staves feature triplets and slurs. The piece concludes with a final cadence in the fifth staff of the third system.

This page of musical notation is divided into three systems. The first system consists of six staves: four treble clef staves and two bass clef staves. The second system consists of four staves: two treble clef staves and two bass clef staves. The third system consists of six staves: two treble clef staves and four bass clef staves. The notation includes various rhythmic values, rests, and dynamic markings such as *mf*. The key signature is one flat (B-flat). The piece features complex textures with multiple voices in both hands, including some triplets and sustained notes.

This page of musical notation consists of several systems of staves. The first system includes five treble clef staves and two bass clef staves. The second system has two bass clef staves. The third system features two treble clef staves and two bass clef staves. The fourth system includes two treble clef staves, two bass clef staves, and two additional bass clef staves. The fifth system has two treble clef staves, two bass clef staves, and two more bass clef staves. The notation includes various musical symbols such as slurs, triplets, and dynamic markings. The dynamic marking *mp* (mezzo-piano) is used throughout the piece. The key signature is one flat (B-flat major or D minor), and the time signature is 4/4.

Musical score system 1, featuring five staves. The first four staves are grouped by a brace on the left. The first staff contains a melodic line with eighth-note patterns and slurs. The second and third staves contain accompaniment with eighth-note chords and slurs. The fourth staff contains a bass line with eighth-note chords and slurs. The fifth staff is a grand staff with a treble clef and a bass clef, containing a melodic line with eighth-note patterns and slurs. The system concludes with a measure containing a *mf* dynamic marking.

Musical score system 2, featuring five staves. The first four staves are grouped by a brace on the left. The first staff contains a melodic line with eighth-note patterns and slurs, starting with a *p* dynamic marking. The second and third staves contain accompaniment with eighth-note chords and slurs, starting with a *p* dynamic marking. The fourth staff contains a bass line with eighth-note chords and slurs, starting with a *p* dynamic marking. The fifth staff is a grand staff with a treble clef and a bass clef, containing a melodic line with eighth-note patterns and slurs, starting with a *mf* dynamic marking. The system concludes with a measure containing a *mf* dynamic marking.

Musical score system 3, featuring five staves. The first four staves are grouped by a brace on the left. The first staff contains a melodic line with eighth-note patterns and slurs, starting with a *p* dynamic marking. The second and third staves contain accompaniment with eighth-note chords and slurs, starting with a *p* dynamic marking. The fourth staff contains a bass line with eighth-note chords and slurs, starting with a *p* dynamic marking. The fifth staff is a grand staff with a treble clef and a bass clef, containing a melodic line with eighth-note patterns and slurs, starting with a *mf* dynamic marking. The system concludes with a measure containing a *mf* dynamic marking.

This page of musical score consists of three systems of staves. The first system includes a grand staff (treble and bass clefs) and two additional staves below it. The second system also features a grand staff and two additional staves. The third system includes a grand staff and two additional staves. The score is characterized by complex rhythmic patterns, including triplets and sixteenth-note runs. Dynamics markings such as *f* (forte) and *mp* (mezzo-piano) are used throughout. There are also various articulation marks, including slurs and accents. The key signature is one flat (B-flat), and the time signature is 4/4.

This musical score is arranged in three systems. The first system consists of six staves: four treble clef staves (top two) and two bass clef staves (bottom two). The second system consists of four staves: two treble clef staves (top two) and two bass clef staves (bottom two). The third system consists of four staves: two treble clef staves (top two) and two bass clef staves (bottom two). The notation includes eighth and sixteenth notes, rests, and dynamic markings such as *mf* and *mp*. The key signature is one flat (B-flat major or D minor), and the time signature is 4/4. The score is written for piano and bass.

The image shows a page of musical notation, page 37. The score is organized into three systems of staves. The first system consists of five staves, the second of six, and the third of seven. The music is written in a key with one flat and a 3/4 time signature. Dynamics include *mp* (mezzo-piano) and *mf* (mezzo-forte). The notation features treble and bass clefs, rests, and various rhythmic values, including triplets and slurs.

System 1: A grand staff with five treble clefs and two bass clefs. The first four treble staves contain complex melodic lines with triplets and slurs. The fifth treble staff and both bass staves are mostly empty. Dynamics include *mp* and *mf*.

System 2: A grand staff with five treble clefs and two bass clefs. The first two treble staves have simple melodic lines. The third and fourth treble staves have more complex lines with triplets. The fifth treble staff and both bass staves are mostly empty. Dynamics include *p*, *mp*, and *mf*.

System 3: A grand staff with five treble clefs and two bass clefs. The first four treble staves contain melodic lines with triplets and slurs. The fifth treble staff and both bass staves are mostly empty. Dynamics include *mp* and *mf*.

This page of musical notation is divided into three main systems, each containing multiple staves. The notation is complex, featuring a variety of rhythmic patterns, including triplets and sixteenth-note runs. Dynamic markings such as *f* (forte) are used throughout. The piece is written in a key with two flats (B-flat and E-flat) and a common time signature. The first system consists of five staves, the second of four, and the third of five. The notation includes many slurs, ties, and articulation marks, indicating a highly technical and expressive performance. The overall structure is dense and intricate, typical of a late Romantic or early 20th-century piano work.

This page of musical notation is divided into three main systems. The first system consists of six staves, with the top five grouped by a brace on the left. It features a complex rhythmic texture with sixteenth-note runs and triplet markings. The second system consists of two staves, with the top one having a long rest. The third system consists of six staves, with the top five grouped by a brace on the left, continuing the intricate rhythmic patterns from the first system. The notation includes various articulation marks such as slurs and accents, and a key signature of one flat.

Musical score system 1, featuring six staves. The top five staves are grouped by a brace on the left. The music consists of complex rhythmic patterns, primarily eighth and sixteenth notes, with various accidentals (flats and naturals). The bottom two staves are empty.

Musical score system 2, featuring two staves. The top staff begins with a melodic line marked *mp* (mezzo-piano) and later transitions to a section marked *f* (forte). The bottom staff provides a bass line, also marked *mp* and *f*.

Musical score system 3, featuring six staves. The top two staves are empty. The middle two staves contain a melodic line marked *mp* and *f*. The bottom two staves contain a bass line marked *mp* and *f*.

Musical score system 4, featuring six staves. The top two staves contain complex rhythmic patterns with various accidentals. The bottom four staves contain a bass line with melodic and rhythmic elements.

A system of eight empty musical staves, consisting of four grand staff pairs (treble and bass clef). The staves are blank, indicating a section of the score that has not yet been written.

The first system of musical notation, consisting of two staves. The top staff is in treble clef and the bottom staff is in bass clef. The music begins with a rest, followed by a half note G4 in the treble and a half note F4 in the bass. The dynamic markings *mf* and *f* are present. The system concludes with a whole note G4 in the treble and a whole note F4 in the bass.

The second system of musical notation, consisting of two staves. The top staff is in treble clef and the bottom staff is in bass clef. The music begins with a rest, followed by a half note G4 in the treble and a half note F4 in the bass. The dynamic markings *mf* and *f* are present. The system concludes with a whole note G4 in the treble and a whole note F4 in the bass.

The third system of musical notation, consisting of two staves. The top staff is in treble clef and the bottom staff is in bass clef. The music begins with a rest, followed by a half note G4 in the treble and a half note F4 in the bass. The dynamic markings *mf* and *f* are present. The system concludes with a whole note G4 in the treble and a whole note F4 in the bass.

This page of musical notation consists of four systems of staves. Each system contains a grand staff (treble and bass clefs) and a piano part (treble and bass clefs). The music is written in a key signature of two flats (B-flat and E-flat) and a 3/4 time signature. The notation is highly detailed, featuring numerous slurs, ties, and articulation marks. The first system shows a complex rhythmic pattern in the piano part, with many sixteenth and thirty-second notes. The second system continues this pattern, with some notes marked with a '3' indicating a triplet. The third system features a more melodic line in the piano part, with some notes marked with a '3' and a '2' indicating a triplet and a dyad. The fourth system concludes the piece with a final cadence. The overall style is that of a classical piano work, possibly from the late 19th or early 20th century.

This page of musical score is divided into three systems. The first system consists of five treble clef staves and two bass clef staves. The upper staves feature intricate rhythmic patterns with frequent triplets and sixteenth notes, marked with a forte (*ff*) dynamic. The lower staves provide a more melodic and harmonic accompaniment. The second system continues the musical development with similar complexity in the upper staves. The third system shows a continuation of the dense rhythmic texture, with the lower staves playing a steady, rhythmic accompaniment. The score is written in a key signature of two flats and a common time signature.

This page of musical notation is a complex score for a piano piece, likely in a minor key given the presence of flats. The score is organized into several systems of staves. The first system consists of five staves, with the top two staves grouped by a brace. The second system has four staves, with the bottom two grouped by a brace. The third system has four staves, with the top two grouped by a brace. The fourth system has four staves, with the top two grouped by a brace. The fifth system has four staves, with the top two grouped by a brace. The notation includes a variety of rhythmic values, including eighth and sixteenth notes, and features several triplet markings. Dynamic markings such as *ff* (fortissimo) are used throughout the piece. The score concludes with a final cadence in the bottom right corner.

System 1 of a musical score, consisting of five staves. The top two staves are grouped by a brace on the left. The music begins with a whole rest in the first measure, followed by a series of eighth and sixteenth notes with various accidentals (flats and naturals) in the subsequent measures. The bottom three staves also contain musical notation, including some rests and notes.

System 2 of a musical score, consisting of two staves. Both staves contain whole rests for the entire duration of the system.

System 3 of a musical score, consisting of five staves. The top two staves are grouped by a brace on the left. The first two measures feature complex rhythmic patterns with triplets and sixteenth notes. The third measure contains a whole rest. The bottom three staves contain musical notation, including rests and notes.

System 4 of a musical score, consisting of eight staves. The top two staves are grouped by a brace on the left. The first two measures feature complex rhythmic patterns with triplets and sixteenth notes. The third measure contains a whole rest. The bottom six staves contain musical notation, including rests and notes.

This page of musical notation contains a complex arrangement of piano parts. It features multiple systems of staves, including grand staves (treble and bass clefs) and individual staves for different instruments or voices. The notation is dense, with many sixteenth notes and triplets. Dynamic markings such as *mf* (mezzo-forte) are present throughout the piece. The page is numbered 47 at the bottom center.

This page of musical notation is divided into three systems, each containing multiple staves. The notation is complex, featuring a variety of rhythmic patterns, including sixteenth and thirty-second notes, and rests. Dynamic markings such as *f* (forte) and *mf* (mezzo-forte) are used throughout. The piece is written in a key with two flats (B-flat and E-flat) and a common time signature. The notation includes numerous slurs, accents, and articulation marks, indicating a highly detailed and expressive performance. The first system shows a dense texture of notes in the upper staves, while the lower staves provide a more rhythmic foundation. The second system introduces more complex rhythmic figures, including triplets and sixteenth-note runs. The third system continues the intricate patterns, with some staves showing a more active melodic line. The overall impression is one of a technically demanding and musically rich composition.

This page of musical notation is divided into four systems. The first system consists of six staves: five treble clefs and one bass clef. The second system has two treble clefs and two bass clefs. The third system has two treble clefs and two bass clefs. The fourth system has two treble clefs and two bass clefs. The notation includes various rhythmic values, slurs, and dynamic markings such as *f* (forte). There are also some markings that look like '3' or '6' under certain notes, possibly indicating triplets or sextuplets. The key signature has one flat (B-flat).

This page of musical notation is a complex score for a piano piece, likely in a minor key given the prevalence of flats. The score is organized into several systems of staves. The first system consists of five staves, with the top two staves grouped by a brace. The second system has two staves. The third system has five staves, with the top two grouped by a brace. The fourth system has four staves, with the top two grouped by a brace. The fifth system has five staves, with the top two grouped by a brace. The notation is highly detailed, featuring numerous sixteenth notes, eighth notes, and triplets. Dynamic markings such as *mf* (mezzo-forte) are present at the end of several phrases. The overall texture is dense and rhythmic, characteristic of a virtuosic piano work.

This musical score is arranged in three systems. The first system consists of five staves: four treble clefs and one bass clef. The second system consists of two staves: one treble clef and one bass clef. The third system consists of six staves: two treble clefs, two alto clefs, and two bass clefs. The music is written in a key signature of two flats (B-flat and E-flat) and a common time signature. The dynamic marking *mf* (mezzo-forte) is used throughout. The notation includes various rhythmic values, slurs, and triplets. The first system shows a complex texture with multiple voices in the treble clefs and a supporting bass line. The second system features a more active treble part with triplets and a steady bass line. The third system introduces alto clefs, suggesting a string quartet or similar ensemble, with intricate rhythmic patterns and slurs across all parts.

The image displays a page of musical notation, page 52, featuring a piano and string arrangement. The score is organized into three systems, each containing eight staves. The first system includes a grand staff (treble and bass clefs) and six individual staves. The second system continues with the same grand staff and six individual staves. The third system consists of four grand staves and four individual staves. The notation includes various rhythmic values, accidentals, and dynamic markings such as *mp* (mezzo-piano) and *p* (piano). The key signature is one flat (B-flat), and the time signature is 4/4. The music shows a transition from a moderate dynamic to a softer one across the systems.

$\text{♩} = 90$

The musical score is written in common time (C) with a tempo marking of $\text{♩} = 90$. It consists of several systems of staves. The upper system features five treble clefs and two bass clefs. The lower system features two treble clefs, two bass clefs, and two alto clefs. The score includes various musical notations such as notes, rests, and dynamic markings (*mp*, *p*, *mf*). The piece concludes with a final chord in the bass clefs.

This page of musical notation consists of three systems of staves. The first system includes a grand staff (treble and bass clefs) and two additional staves, with dynamic markings of *f* and *mf*. The second system features a grand staff and two additional staves, with dynamic markings of *f* and *mf*. The third system includes a grand staff and two additional staves, with dynamic markings of *f* and *mf*. The notation is dense, with many triplets and complex rhythmic figures. The key signature has two flats, and the time signature is 3/4.

This musical score is arranged in three systems. The first system consists of five staves, with the bottom two staves containing musical notation starting at measure 1. The second system consists of five staves, with the top two staves containing musical notation starting at measure 1. The third system consists of seven staves, with the top four staves containing musical notation starting at measure 1. The notation includes various rhythmic values, accidentals, and dynamic markings such as *mp*. Articulation marks, including slurs and accents, are used throughout the score to indicate phrasing and emphasis. The overall structure suggests a complex, multi-layered musical piece.

System 1: A grand staff with five treble clefs and two bass clefs. The first four treble staves contain complex rhythmic patterns with sixteenth and thirty-second notes, marked with a forte (*f*) dynamic. The fifth treble staff and both bass staves contain simpler rhythmic accompaniment. The system concludes with a double bar line.

System 2: A grand staff with five treble clefs and two bass clefs. The first two treble staves feature melodic lines with dynamics of mezzo-piano (*mp*) and mezzo-forte (*mf*). The remaining three treble staves and both bass staves contain rhythmic accompaniment. The system concludes with a double bar line.

System 3: A grand staff with five treble clefs and two bass clefs. The first four treble staves contain complex rhythmic patterns with sixteenth and thirty-second notes, marked with a forte (*f*) dynamic. The fifth treble staff and both bass staves contain simpler rhythmic accompaniment. The system concludes with a double bar line.

This image displays a page of musical notation, likely for a piano piece, consisting of three systems of staves. The notation is written in a key signature of two flats (B-flat and E-flat) and a 3/4 time signature. The first system includes a grand staff (treble and bass clefs) and a separate bass line. The second system features a grand staff with a treble clef and a bass line. The third system includes a grand staff with a treble clef and a bass line, along with a separate bass line. The notation includes various musical symbols such as notes, rests, slurs, and dynamic markings.

This page of musical notation consists of several systems of staves. The top system includes five treble clef staves and two bass clef staves. The second system has two treble clef staves and two bass clef staves. The third system features two treble clef staves and two bass clef staves. The fourth system contains two treble clef staves and two bass clef staves. The fifth system has two treble clef staves and two bass clef staves. The sixth system includes two treble clef staves and two bass clef staves. The seventh system features two treble clef staves and two bass clef staves. The eighth system has two treble clef staves and two bass clef staves. The ninth system contains two treble clef staves and two bass clef staves. The tenth system includes two treble clef staves and two bass clef staves. The notation is dense with sixteenth and thirty-second notes, often grouped in triplets. Dynamic markings such as *mp* (mezzo-piano) and *mf* (mezzo-forte) are placed throughout the score. The key signature is one flat, and the time signature is 3/4.

This musical score is arranged in three systems, each containing five staves. The top two staves of each system are for the right hand, and the bottom three are for the left hand. The music is written in a key with one flat (B-flat) and a 3/4 time signature. The first system begins with a forte (*f*) dynamic in the right hand, while the left hand starts with a mezzo-forte (*mf*) dynamic. The second system features a dynamic shift in the left hand to mezzo-piano (*mp*) and piano (*p*). The third system returns to a mezzo-forte (*mf*) dynamic in the left hand. The score includes various musical notations such as triplets, slurs, and rests.

This page of musical notation is divided into three systems. The first system consists of six staves, with the top four staves grouped by a brace on the left. The second system consists of four staves, with the top two staves grouped by a brace on the left. The third system consists of six staves, with the top two staves grouped by a brace on the left. The notation includes various rhythmic values, slurs, and dynamic markings such as *mf* and *f*. There are also some unusual markings, such as a '3' in a box above a note in the second system. The piece concludes with a double bar line and a repeat sign at the end of the sixth staff in the third system.

This page of a musical score, page 61, features a complex arrangement of instruments. The top system consists of eight staves, likely for a string quartet or similar ensemble, with intricate melodic and rhythmic patterns. The middle system includes two staves for a piano, showing detailed chordal and melodic textures, and two staves for a bass instrument. The bottom system is a grand piano section with five staves, each containing dense, flowing musical passages. The score is written in a key with one flat and a 3/4 time signature. Dynamic markings such as *mp* (mezzo-piano) are used throughout to indicate volume. The notation includes various note values, rests, and articulation marks, with some passages featuring triplets and slurs.

This page of musical notation is divided into three systems, each containing multiple staves. The notation is complex, featuring various rhythmic patterns, including triplets and sixteenth notes. Dynamic markings such as *f* (forte) and *mf* (mezzo-forte) are used throughout. The first system includes a grand staff with five treble clefs and two bass clefs. The second system includes a grand staff with two treble clefs and two bass clefs. The third system includes a grand staff with two treble clefs and two bass clefs. The notation is dense and detailed, with many notes and rests.

This page of musical notation consists of 18 staves, organized into several systems. The notation is complex, featuring numerous triplets and sixteenth-note patterns. The key signature has two flats (B-flat and E-flat), and the time signature is 3/4. The dynamic marking *ff* (fortissimo) is used extensively throughout the piece. The notation includes various musical symbols such as notes, rests, and dynamic markings like *ff*. The piece appears to be a highly technical and expressive work, possibly a study or a short concert piece.

This page of musical notation is divided into three main systems. The first system consists of six staves, with the top two grouped by a brace. The second system consists of two staves. The third system consists of six staves, with the top two grouped by a brace. The notation is complex, featuring numerous triplets, sixteenth notes, and dynamic markings such as *f* (forte). The key signature is B-flat major, and the time signature is 4/4. The piece concludes with a final cadence on the last staff of the third system.

This musical score is arranged in a system of 18 staves. The top four staves are for a string quartet (Violin I, Violin II, Viola, and Cello). The next four staves are for a piano, with the upper two staves for the right hand and the lower two for the left hand. The bottom four staves are for a cello and double bass. The score is written in a key signature of two flats (B-flat and E-flat) and a 3/4 time signature. It features a variety of musical textures, including melodic lines, arpeggiated figures, and triplet patterns. Dynamic markings such as *mf* (mezzo-forte) and *mp* (mezzo-piano) are used throughout to indicate volume. The piece concludes with a final cadence in the last measure.

This page of musical notation is a complex score for a piano piece, likely in a minor key. It consists of multiple systems of staves. The first system includes five treble clef staves and two bass clef staves. The second system includes two treble clef staves, two bass clef staves, and two tenor clef staves. The third system includes two treble clef staves, two bass clef staves, and four tenor clef staves. The notation is highly rhythmic, featuring numerous triplets, sixteenth notes, and sixteenth rests. Dynamic markings such as *f* (forte) and *ff* (fortissimo) are used throughout. The score is written in a single system, with measures grouped by bar lines. The overall texture is dense and intricate.

This page of musical notation is divided into three systems. The first system consists of five treble clef staves and two bass clef staves. The second system consists of two treble clef staves, two bass clef staves, and two alto clef staves. The third system consists of two treble clef staves, two bass clef staves, and two alto clef staves. The notation is complex, featuring many sixteenth notes, triplets, and slurs. The key signature has one flat (B-flat), and the time signature is 3/4. The music is written in a style typical of a 20th-century piano work.

This page of musical score is a complex orchestral and piano arrangement. It features a variety of staves, including grand piano (GP), strings, woodwinds, and brass. The score is characterized by intricate rhythmic patterns, particularly in the piano part, which includes numerous triplets and slurs. Dynamic markings such as *ff* (fortissimo) and *f* (forte) are prominently used throughout. The notation includes a wide range of notes, rests, and articulation marks, creating a dense and detailed musical texture. The page is numbered 68 at the bottom center.

This page of musical notation consists of several systems of staves. The top system includes five treble clef staves and two bass clef staves. The middle system includes two treble clef staves and two bass clef staves. The bottom system includes two treble clef staves and four bass clef staves. The notation is complex, featuring many triplets, slurs, and dynamic markings such as *mf* and *f*. The piece is in a key with two flats (B-flat and E-flat) and a 3/4 time signature. The bottom system concludes with a final *f* dynamic marking.

This page of musical score is divided into two systems. The first system consists of 12 staves, and the second system consists of 12 staves. The notation includes various rhythmic values, such as eighth and sixteenth notes, often grouped in beams. Dynamic markings are prominent, including *ff* (fortissimo) and *fff* (fortississimo). The score features a variety of musical textures, with some staves showing dense, rhythmic patterns and others showing more melodic or harmonic lines. The overall style is characteristic of late 19th or early 20th-century classical music.

This page of musical notation is a complex score for a piano piece, consisting of multiple systems of staves. The notation includes various rhythmic patterns, such as eighth and sixteenth notes, often grouped with slurs and accents. Dynamic markings are prominent, with 'ff' (fortissimo) and 'f' (forte) appearing frequently. The score is written in a key signature with two flats (B-flat and E-flat) and a common time signature. The notation is dense and detailed, with many notes and rests across the staves. The page is numbered 71 at the bottom.

This page of musical notation is divided into three systems. The first system consists of five staves, with the first four grouped by a brace on the left. It features complex rhythmic patterns, including triplets and sixteenth-note runs, with a dynamic marking of *mf*. The second system consists of five staves, with the first two grouped by a brace. It continues the rhythmic complexity with more triplets and sixteenth-note passages, also marked *mf*. The third system consists of six staves, with the first four grouped by a brace. This system is characterized by dense sixteenth-note passages and triplets, with a dynamic marking of *mf*. The notation includes various musical symbols such as slurs, ties, and dynamic markings.

This page of musical notation contains a complex arrangement for piano. It features multiple staves, including grand staff systems (treble and bass clefs) and individual staves for various instruments or voices. The notation is dense, with frequent use of triplets and sixteenth-note patterns. Dynamic markings are present throughout, with 'f' (forte) appearing in several measures and 'mf' (mezzo-forte) in others. The key signature includes several flats, and the overall texture is highly rhythmic and intricate.

This page of musical notation is a score for a piano piece, likely in a minor key as indicated by the key signature (one flat). The score is arranged in three systems, each containing multiple staves. The first system consists of six staves, with the top two staves grouped by a brace. The second system consists of six staves, with the top two staves grouped by a brace. The third system consists of six staves, with the top two staves grouped by a brace. The notation is highly rhythmic, featuring many triplets and sixteenth notes. Dynamic markings include *ff* (fortissimo) and *f* (forte). The score is written in a standard musical notation style with a common time signature.

This page of musical notation is divided into three systems, each containing multiple staves. The notation is complex, featuring a variety of rhythmic patterns, including sixteenth and thirty-second notes, and rests. Dynamic markings such as *ff* (fortissimo) are prominently displayed throughout the score. The music is written in a key signature with one flat (B-flat) and a time signature of 3/4. The notation includes numerous slurs, accents, and other performance instructions. The first system consists of five staves, the second of four, and the third of five. The overall structure suggests a multi-movement or multi-section work, with each system representing a distinct part of the composition.

Musical score for piano and strings, page 76. The score is in 4/4 time and features a complex arrangement of piano and string parts. The piano part includes a right-hand melody with triplets and a left-hand accompaniment with triplets. The string part consists of four staves with various dynamics and articulations. The score is divided into four measures.

Measure 1: Piano right hand begins with a triplet of eighth notes (F4, E4, D4) marked *f*. Piano left hand has a triplet of eighth notes (F3, E3, D3) marked *f*. String parts are mostly silent.

Measure 2: Piano right hand continues with a triplet of eighth notes (C4, B3, A3) marked *mf*. Piano left hand continues with a triplet of eighth notes (C3, B2, A2) marked *mf*. String parts remain silent.

Measure 3: Piano right hand continues with a triplet of eighth notes (G3, F3, E3) marked *mp*. Piano left hand continues with a triplet of eighth notes (G2, F2, E2) marked *mp*. String parts remain silent.

Measure 4: Piano right hand concludes with a triplet of eighth notes (D3, C3, B2) marked *mf*. Piano left hand concludes with a triplet of eighth notes (D2, C2, B1) marked *mf*. String parts remain silent.

Musical score system 1, featuring five staves. The first four staves are grouped by a brace on the left. The first staff has a dynamic marking of *mf* in the second measure and *mp* in the fifth. The second staff has *mf* in the second measure and *mp* in the fifth. The third staff has *mf* in the second measure and *mp* in the fifth. The fourth staff has *mf* in the second measure and *mp* in the fifth. The fifth staff has *mf* in the second measure and *mp* in the fifth. The bottom two staves of this system are empty.

Musical score system 2, consisting of two empty staves.

Musical score system 3, consisting of six empty staves.

Musical score system 4, featuring six staves. The first four staves are grouped by a brace on the left. The first staff has dynamic markings of *mp* in the second measure, *mf* in the third, and *mp* in the fifth. The second staff has *mp* in the second measure, *mf* in the third, and *mp* in the fifth. The third staff has *mp* in the second measure, *mf* in the third, and *mp* in the fifth. The fourth staff has *mp* in the second measure, *mf* in the third, and *mp* in the fifth. The fifth staff has *mp* in the second measure, *mf* in the third, and *mp* in the fifth. The sixth staff has *mp* in the second measure, *mf* in the third, and *mp* in the fifth. The system includes various musical notations such as triplets and slurs.

Musical score system 1, featuring five staves. The first staff contains a melodic line with dynamic markings *mf*, *mp*, and *p*. The second and third staves contain complex rhythmic patterns with dynamic markings *mf*, *mp*, and *p*. The fourth and fifth staves contain rhythmic accompaniment with dynamic markings *mf*, *mp*, and *p*. The system concludes with a double bar line.

Musical score system 2, consisting of two empty staves.

Musical score system 3, consisting of six empty staves.

Musical score system 4, featuring five staves. The first staff contains a melodic line with dynamic markings *mf* and *mp*. The second and third staves contain complex rhythmic patterns with dynamic markings *mf* and *mp*. The fourth and fifth staves contain rhythmic accompaniment with dynamic markings *mf* and *mp*. The system concludes with a double bar line.