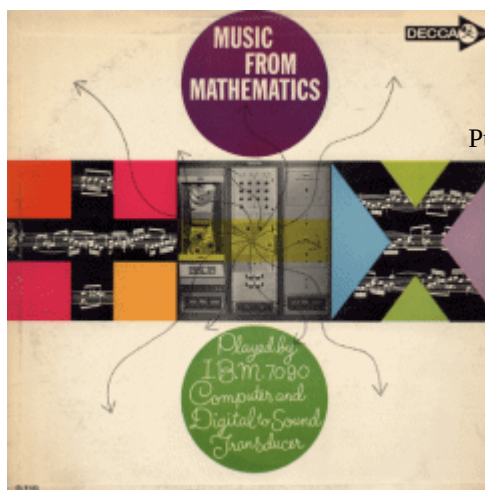


Musics from mathematics

- Vrac + ou - - Recensions d'albums -



Publication date: Monday 5 November 2007

Description:

premier disque de synthese musicale, informatique et musiques

The course of human development has always been marked by man's striving for new techniques and tools in pursuance of a better life. This is most dramatically manifested in the fields of science and technology. But this dissatisfaction with available materials and methods and the corresponding search for new ones is also evident in the arts, and artists have continually sought to improve the tools of their trade. Today's modern orchestral instruments, for example, hardly resemble their medieval ancestors. On this recording, we illustrate another advancement in the realm of tools available to the music-maker: the computer and the digital-to-sound transducer. This new "instrument" combination is not merely a gadget or a complicated bit of machinery capable of producing new sounds. It opens the door to the exploration and discovery of many new and unique sounds. However, its musical usefulness and validity go far beyond this. With the development of this equipment carried out at the Bell Telephone Laboratories, the composer will have the benefits of a notational system so precise that future generations will know exactly how the composer intended his music to sound. He will have at his command an "instrument" which is itself directly involved in

the creative process. In the words of three of the composers whose works are heard on this recording:

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[[[MUSIC FROM MATHEMATICS

Played by IBM 7090 COMPUTER and DIGITAL TO SOUND TRANSDUCER]]]

4Decca Records DL 91034

SIDE 1

[(Band 1: Frere Jacques (Common round)

Band 2: Fantasia (Orlando Gibbons)

Band 3: Bicycle Built for Two (arranged by M. V. Mathews)

Band 4: Molto Amoroso (J. R. Pierce)

Band 5: Variations in Timbre and Attack (J. R. Pierce)

Band 6: Stochatta (J. R. Pierce)

Band 7: Five Against Seven-Random Canon (J. R. Pierce)

Band 8: Beat Canon (J. R. Pierce)

Band 9: Melodie (J. R. Pierce)

Band 10: Numerology (M. V. Mathews))]

SIDE 2

[(Band 1: The Second Law (M. V. Mathews)

Band 2: May Carol (M. V. Mathews)

Band 3: Theme and Variations (S. D. Speeth)

Band 4: Study No. 1 (D. Lewin)

Band 5: Study No. 2 (D. Lewin)

Band 6: Pitch Variations (N. Guttman)

Band 7: Noise Study (J. Tenny)

Band 8: Joy to the World (M. V. Mathews))]

Texte du livret et présentation des morceaux par les auteurs eux-mêmes

[(The course of human development has always been marked by man's striving for new techniques and tools in pursuance of a better life. This is most dramatically manifested in the fields of science and technology. But this dissatisfaction with available materials and methods and the corresponding search for new ones is also evident in the arts, and artists have continually sought to improve the tools of their trade.

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Man's music has always been acoustically limited by the instruments on which he plays. These are mechanisms which have physical restrictions. We have made sound and music directly from numbers, surmounting conventional limitations of instruments. Thus, the musical universe is now circumscribed only by man's perceptions and creativity.

The process of composing music on and for the computer and transducer is highly complex: we shall attempt here only a brief and simplified description so that the listener may better understand what he is hearing. At the very heart of this type of composition rests this fundamental premise: *"Any sound can be described mathematically by a sequence of numbers."*

Our composer thus begins by determining what numbers specify the particular sounds in which he is interested. These numbers are then punched on IBM cards: the cards are fed into the computer and the digits recorded in the memory of the machine. The computer is thus able to generate limitless sounds, depending on the instructions given it by the composer. The latter, instead of writing the score in notes, programs his music by punching a second set of IBM cards, which when fed into the computer cause it to register on tape certain sounds from its vast storehouse. The composer may give the computer detailed instructions for every "note," or he may allow it varying degrees of freedom by asking it to select "notes" at random from a host of possibilities. The tape which emerges from the computer contains music in the form of magnetic impressions. To convert these impressions to actual sounds, the tape is run on a digital-to-sound transducer, which translates the digital indications to sounds, amplifies these sounds, and gives us the finished musical product.

As can be gleaned from the above description, the human element plays a large role in computer music, as in any art medium. The sounds and sound-producing methods are new; the composer's role is essentially that which it has always been. History tells us that whenever a new concept emerges, it is labeled revolutionary by either its proponents or the public at large. The new techniques and tools of computer music are not meant to replace the more traditional means of composition and performance. Rather, they are designed to enhance and enlarge the range of possibilities available to the searching imagination of musicians. Science has provided the composer with new means to serve the same ends - artistic excellence and communication.

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Side One:

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1. FRERE JACQUES (Common round)

Here is an example of what imagination and the computer can do with a familiar piece. The round is done with five voices, which have the following attacks and timbres.

1. Modified square waves; modified rectangular attack.

2. Random noise, narrow band; percussive attack.
3. Modified square wave; percussive attack.
4. Timbre and attack taken from the trombone.
5. Same as voice 1.

2. FANTASIA (Orlando Gibbons)

This work (composed in the 16th century) is played to demonstrate the performance of conventional music on the computer. The original score is for three recorders. The wave shape is sinusoidal (the shape of a tone which is a pure fundamental, without overtones or harmonics). The attack was copied from that of a recorder, and includes an initial burst simulating a tonguing noise.

3. BICYCLE BUILT FOR TWO (arranged by M. V. Mathews)

The computer can also be programmed to speak and sing, as is illustrated by the last verse of this familiar ditty. The patterns of human speech are analyzed in the same manner as the instrumental sounds. The computer is then programmed to speak the desired words. On this band the computer not only was programmed to sing but also to simulate a Honky Tonky type of piano accompaniment that was popular during the era when this song was a hit.

4. MOLTO AMOROSO (J. R. Pierce)

This piece features plucked tones. A squarish wave is modulated by a jagged attack which rises rapidly in a sequence of peaks, then falls slowly to zero at the end of the note, with decreasing jaggedness. Four different attacks are used for the four voices. The contrasting effect of similar attacks in long and short notes is of interest. This piece displays exaggerated variations of loudness and duration.

5. VARIATIONS IN TIMBRE AND ATTACK (J. K. Pierce)

This composition consists of a melody and various accompanying parts, making a total of five voices. Voice 2 was formed from selected notes in the melody (Voice 1). The frequencies used in Voice 3 were obtained as differences between the frequencies of the first two voices. The difference between the frequencies of Voices 4 and 5 is approximately the frequency of the melody. Thus a highly integrated musical texture was obtained. The composition is divided into live sections.

Section I Voice 1

Section II Voices 1 and 2

Section III Voices 1, 2 and 3

Section IV Voices 4 and 5 only

Section V All Voices

6. STOCHATTA (J. R. Pierce)

This is a very simple work originally composed for recorder and piano. The piece was programmed principally to show that the computer is capable of producing a pleasant timbre and harmonious music. The recorder timbre is that of a single sine-wave (sinusoidal), and the accompanying timbre is a smooth saw-tooth shape.

7. FIVE AGAINST SEVEN - RANDOM CANON (J. R. Pierce)

The first work is a study of rhythmic patterns, in this case, five against seven. The canon was composed by a random procedure. It is a two-voiced canon at the octave, composed by selecting rests and notes of a whole-tone scale. The notes and rests, of various lengths, were selected by chance. After the first measure, the subsequent measures are, by chance, either new music or repetitions of earlier bars.

8. BEAT CANON (J. K. Pierce)

In this work, certain timbre effects were studied. The first third of each treble note was emphasized by playing it at an amplitude four times that of the last two thirds. An envelope to the notes in the bass part was formed by striking

together neighboring frequencies.

9. MELODIE (J. R. Pierce)

This selection illustrates how the computer can be used to play rapidly and flawlessly two rhythms at once. The coda shows how the computer can execute an accent which would be difficult to achieve by conventional means.

10. NUMEROLOGY (M. V. Mathews)

This piece was produced as a demonstration of some of the special effects which can be achieved with the computer. It has eight sections.

Section I A long crescendo in which loudness is increased by raising vibrato frequency, vibrato amplitude, and pitch, as well as intensity.

Section II A duet in which the treble voice is gradually modulated in timbre from a percussive, piano-like sound to a slow-attack, string-like sound.

Section III The melody from the bass voice of the previous section is moved to the treble. Between each note of the original melody, the voice splits and divides continuously into three notes, which recombine on the next note.

Section IV A melody is played three times; first in the treble, then in the bass with slight alterations in rhythm, finally in the treble with a frequency attack on each note.

Section V A bass line is played first with conventional notes and then with notes in which the frequency has been blurred with a large, rapid vibrato.

Section VI A sentimental, high-pitch section which demonstrates nuances of vibrato and attack.

Section VII A canon in which the two identical voices are separated by one rhythmic beat.

Section VIII A finale in which the tempo gradually increases to a point beyond comprehension. Some of the notes have no single frequency; they sweep over a range of as much as five octaves, and arc perhaps reminiscent of a passing bullet.

[[Side Two:]]

1. THE SECOND LAW (M. V. Mathews)

This composition makes extensive use of random noise. The noise is used with a variety of bandwidths (the frequency limits of a given sound pattern) to achieve effects ranging from notes of definite pitch to pitchless noise. Contrasted against the noise is a tone with vibrato.

2. MAY CAROL (M. V. Mathews)

This composition was produced to show the rhythmic possibilities of playing three notes against four. The work has three sections: the first is a study in rhythmic patterns, the second is a canon which is repeated with varying time intervals between the two voices, and the third is a development of the first section.

3. THEME AND VARIATIONS (S. D. Speeth)

This piece is a 12-tone composition which makes use of a tone row that is the same when played upside down and backwards. The three note motive E-F-D is the basic structural unit of the piece. The voice timbres employed were taken from a piece by J. R. Pierce, but with one modification: the rate and range of vibrato is made dependent on note intensity. The four sections are:

Section I Theme statement (Row is played upside down and backwards.)

Section II Transition

Section III First variation (Row is played backwards)

Section IV Coda; this is a computer-processed recording of a seismogram, sped up by a factor of 300.

4. STUDY NO. 1 (D. Lewin)

This 12-tone piece also exploits a durational series; augmentations, inversions, and retrogrades of a basic series of six notes are used throughout. The Study contains essentially only two types of notes, which may be called "clink" and "hoot." All tones are presented with the same amplitude, but their durations and registers are varied, affecting the timbre and intensity. The piece is an attempt to determine how musically effective a systematic control of the use of registers might be.

5. STUDY NO. 2 (D. Lewin)

This composition is also in the 12-tone idiom. The number of voices has been increased to four. Simple instruments allowing control of attack and waveforms only were used.

6. PITCH VARIATIONS (N. Guttman)

This piece illustrates how the content of a composition may be derived from a particular psycho-acoustical phenomenon. An experiment, carried out by the composer, showed that certain waveforms consisting of trains of sharp pulses produce unusual pitch impressions which may not correspond simply to the frequency of the waveform. At some frequencies, an impression of more than one pitch is produced. In this composition, these waveforms are reproduced at frequencies designed to make the pitch uncertainties more prominent.

7. NOISE STUDY (J. Tenny)

Each of the "instruments" used in this piece includes a noise generator. These "instruments" were designed in such a way that the amplitudes, center frequencies, and bandwidths of the output signals were all continuously variable within each "note" as well as from one "note" to another. The large-scale structure of the piece is defined by the changes in average amplitude, center frequency, bandwidth, and duration from "note" to "note" and from section to section. In addition, each section is characterized by a different range of variation in each of the four qualities mentioned above. The particular qualities manifested by the sounds at any given moment, however, were determined by chance methods (via random-number tables and tossed coins). Thus, although the general shape of the piece as a whole was predetermined by the composer, the way this general shape was realized in detail was not, but rather, left to chance.

8. JOY TO THE WORLD (M. V. Mathews)

This well-known carol is performed to illustrate different timbres. The first two playings differ only in the attack on each note; the first features a slow attack and the second a fast one. The third playing uses a vibrato which has a maximum intensity in the middle of each note.

GLOSSARY

FREQUENCY...The repetition rate which determines the pitch of a sound.

DECAY...The very end or "dying" of a tone.

AMPLITUDE...The magnitude which determines the loudness of a sound.

WAVEFORM...The pictorial representation of the shape of a sound wave.

TIMBRE...The quality of a tone which distinguishes voices or instruments; tone color.

INSTRUMENT...Pertaining to computer music, this term refers to a group of computer instructions which generate

the notes of a given type of sound.

THE COMPOSERS

DR. J. R. PIERCE is Executive Director, Research, Communications Principles Division, Bell Telephone Laboratories. This Division has contributed a great deal to the fields of radio, television, electronics, acoustics and vision, mathematics, and group behavior. Dr. Pierce's department carried out the work on Bell Telephone's Project Echo, and Dr. Pierce is credited with significant contributions to the success of the Telstar Program.

DR. M. V. MATHEWS is a member of the staff of Bell Telephone Laboratories, where he is doing important work in the area of visual and acoustical research. His main activities involve the study of speech coding and recognition methods by means of digital computer simulation. The programming of the music on this recording is the result of Dr. Mathews' work.

DAVID LEWIN is a prominent composer presently teaching at the University of California at Berkeley. Mr. Lewin also studied mathematics at Princeton. He was a Junior Fellow in Music at Harvard.

JAMES TENNY is a recognized composer who studied with Dr. L. A. Hiller, Jr. at the University of Illinois. He has since September 1961, worked at the Bell Telephone Laboratories writing computer music.

DR. S. D. SPEETH is a psychologist with a musical background which includes serious study on the violin.

DR. N. GUTTMAN is a psychologist at Bell Telephone Laboratories, specializing in speech and phonetics. His special interest is the perception of the pitches of unusual sounds.

Notes for this recording compiled and written by Dr. M. V. Mathews and Ken Deutschman.