CAC - MIDI MUSIC
The Computer without algorithm

NELSON CAVALCANTI DE ALMEIDA
UNIVERSIDADE FEDERAL DE PERNAMBUCO
DEPARTAMENTO DE MUSICA
Recife - Pernambuco - Brasil
Post code: 50 607-901
Phone number: (05581) 2718300
Fax number:
(05581) 2718300 - 2718308 - 2718142
E-Mail: 16almeida@npd1.ufpe.br
Department of Music
Keele University - Staffordshire
ST5 5BG - England
E-Mail: Mud00@cc.keele.ac.uk

Abstract

There exist a great diversity of uses of the computer to make music. Nevertheless, this diversity falls into two broad categories. One of them is concerned with processing an input a sequence of instructions, expecting an output, by means of a programming language. This type of music making is known as algorithmic. Another way is to use the computer in networked devices able to understand each other by means of a common language. This common language is MIDI which stand for Musical Instrument Digital Interface. MIDI opened a new and soft way to make computer assisted music

This Essay describes three aspects of computer music making: selecting sound, composing and performing, using a MIDI platform. A brief incursion into algorithmic environments is carried out in order to clarify some convergent and divergent points between non-algoritimic and algorithmic composition.

Introduction

Montague (in: Pope, 1994) has stated that in the 1960s many of the people interested in computer music were technicians or engineers and the music produced sounded like music made by technicians and engineers. I believe it was, among other reason, because dealing with that technology was a hard task. However, nowadays, the technology applied to music has improved. Electronic devices, computer hardware and software are now commercially available, price has decreased becoming attractive to many musicians. Nevertheless, this facility in handling brings with it a danger for new music. It is still concerned with technical quality, since the digital music world has attracted anyone more beyond technicians and engineers. This is made worse if one considers that many of the new users are not experts in either music or technology.

CAC - Computer Assisted Composition

According to Dodge & Jerse (Dodge & Jerse, 1985) the main fields of the computer music are three: Sound synthesis, Composition and Performance. There exist three classes of software as well: algorithms for sound generation, programs to assist composer and program which allow performance of the compositions. The above quoted types can work both in algorithmic or non-algorithmic environments The composer is free to choose between using the processes either in part or the whole of his composition.

From this point of view the composition may be done by the computer, which Cope has called machine composition (Cope, 1991); with the computer, generally known as computer assisted composition; and for the computer, that is music to be performed by the computer.

These three related aspects of computer music have a relationship with both algorithmic and non-algorithmic techniques. When we use, for example, random processes or deterministic operations we are working in an algorithmic environment. If we use MIDI or Digital Sound Processing we are in non-algorithmic environment. Once again the composer is free to use one or both systems isolated or gathered together, either as part or as a whole of a composition.

Computer Assisted Composition in an algorithmic environment, albeit its diversity, falls into two broad categories: aleatory and deterministic music.

In aleatory music the computer generates events based on statistics using random processes. In deterministic music the computer receives a set of predetermined compositional elements, such as rhythm, melodic or harmony patterns, pitch etc. It then performs determined calculation and yields a result.

From a strict point of view the computer can perform nothing without following instructions, so in theory, there is no computer without an algorithm. In fact what exist is a set of translators between what the user wants to perform and the final response of the machine. These translators range from the nearest machine language level up to 'clic-on-icon' programs. The user gives a sequence of instructions using an appropriated computer language or just clicks on an icon.

The difficulty of the task of giving a sequence of instructions to the computer depends on the level of that language. Nowadays applications tend to be less demanding from the point of programming and more user friendly.

For example, one can simulate a procedure to get a musical event using an imaginary computer language:

```
[Note1]
Play  p = 440     d= 120   v= 64
Play  p= 0        d= 60
Play  p = 880     d= 240   v= 127
End
>Note1
Where:
p= pitch
d= duration
v= velocity
```

A very simple algorithm to obtain, as an output, A4 with a duration of 2 seconds and a dynamic level of *piano*. It is followed by a rest of one second and by an A5 with a duration of 4 seconds and a dynamic level of *fortissimo*. It seems very easy to do, but the task becomes more difficult when we try to get something slightly more complex, even when it is as simple as "Brother John".

In order to enhance the previous example, on can change the data in that sequence by typing:

```
[Note2]
Sort      p = (170-1001)   d  = (15-240)      v = (30-127)
repeat 10
End
>Note2
```

As a result the new sound will consist of different pitches, durations and dynamics.

These are very simple examples of algorithm composition.

I have been involved in the past in the development of an application for children (of any age) to compose using the computer. The program is called "Sound Letters". In programming it, a sequence of algorithms was associated with the first seven letters or the alphabet. Children just need to type a sequence of the first seven letters of the alphabet, in any order, instead of typing an instruction like play p= 440, d= 120, v= 64, and so on. In response they get their music. Of course other features, such as different octaves, tempo, etc. are available.

The program was developed using Pascal, in an algorithmic way, but the outcoming music is a clear example of non-algorithmic computer assisted composition.

MIDI Music

The first thing to bear in mind when working with MIDI and, in general with computer, is that the latter is not a wizard, it has no power to turn one into a great composer. This fact can be seen as the dilemma of this century. The quality of the music which has been done with so much technology. Nevertheless computers in general, and MIDI in particular, have no doubt brought new directions and easy to music making. MIDI must actually be considered as a powerful tool to enable musicians to experiment and realise sound generation, composing and performance.

Computer MIDI systems can perform a full orchestral score, or any combination of instruments. Synchronisation with images, in video and cinema, is now a easy task. Likewise acceleration or slowing of the tempo in order to adjust music to image, is now simple to achieve. Since MIDI music is recorded track by track and each track is recorded event by event it enables complete control over the music, ranging from the shortest of notes to the whole composition, including any individual parameter. Obviously this music still lacks human touch; however we must realise that it is not the same thing that listening to a live orchestra performing. In fact no recorded performance should be compared with a live performance.

MIDI music can be perfectly applied in a professional and commercial context. But it is not the only way: MIDI is a powerful tool for academic purposes to help teaching in matters such as perception, counterpoint, classic and contemporary harmony, aesthetics, analysis, music education and, of course, composition.

A MIDI workstation is not cheap, in fact it is very expensive considering the economical reality of many enthusiastic musicians. However, the price of the electronic devices often decreases barely one or two years, after they have been launched. Nevertheless one must decide what one really wants to do before buying MIDI system.

For players, a simple but good MIDI system would be a rack of expander and effect units under a keyboard, MIDI Guitar or wind controller. For education purposes a computer running appropriate software connected to a MIDI keyboard may be good enough. For composers, the above platform may be enlarged. The computer must run a Notation type program, Sequencer software, and digital sound processing software. A multi-timbral controller keyboard, at least one expander and a printer are also necessary.

Sound: Generation and Manipulation

Computers are actually able to generate and manipulate a large variety of sounds to be performed in musical context. Generation and manipulation of sound events can be done by a digital sound processing program or using a sound synthesis generator program.

Digital sound processing programs record and edit sounds, from any source, sampled via microphone or line inputs. Most pieces of software of this kind show the waveform of the recorded sound which can be altered by dubbing, mixing, cutting, pasting, adding effects, changing pitch, time, and so on.

Sound synthesis is the generation of a signal with acoustic quality.

Sound can also be generated and manipulated by voice editor program or using a MIDI expander, which may be a synthesizer or sampler unit.

A sampler is a MIDI device able to recorded sound as MIDI event. A sample is closest to a natural sound but a large amount of data is required when sampling. The sampler is required to have a large memory and editing is a challenging task if one is to obtain convincing results.

Sounds generated by MIDI samplers are saved in MID format, so that they are suitable for use with MIDI sequencing or notation programs as well in live performance using a MIDI controller.

Synthesizer units provide resources to generate and to manipulate sounds by adjusting parameters using increasing and decreasing push bottons supplied. The adjustments are shown in LCD displays. The generated sounds are stored into the internal memory of the synthesizer, into an external cartridge or into a computer memory via specific software and MIDI connexion. As in the case of samplers the new sounds are saved in MID format suitable for use in the same circumstances. To synthesize sounds may sometimes be an unwanted task, especially without editing units now available for some instruments. In any case, synthesizer usually to provide a large quantity of factory preset sounds, both in the internal memory or as external data storage, to aid the user's task.

Voice editors are computer programs which allow the musician to program sounds quicker and easier than with synthesizer modules. They mimic controllers over all synthesized sound parameters.

Besides the advantage of having more memory available in the computer, all the control knobs and switches are present on a large screen to be handled both by the computer keyboard or via the mouse. Another useful feature is the capacity of changes to envelope shapes using the mouse.

Voice editor pieces of software are able to sent any new generated sound directly to the synthesizer to be heard on request.

As stated above, voice editors save the file in MIDI format.

Composition

I will divide this writing into three broad parts: digital music composition (DMC), acoustic music composition (AMC) and digital-acoustic music composition.

Digital music composition (DMC) consists of the use MIDI instruments instead acoustic ones. Instrument, in this context, means exactly a timbre you choose from a MIDI device (in an algorithmic context, the term instrument means an algorithm that realizes a musical event). MIDI instruments are about 32 notes polyphonic and up to 16 parts multi-timbral. In others words they are, in fact, many instruments built into one unit. sixteen different instruments sound as a big orchestra. Each one of this 16 instruments is able to play up to 32 notes at once. It is like having 32 first violins or 32 trumpets playing (32 voices in a *divisi)*, each voice has independent control of parameters such as duration, pitch and dynamics. The voice or voices of an instrument are assigned a track in the software which often provides more than two hundred tracks. The 16 MIDI independent channels receive one or more of these tracks and play them back using a timbre which the composer choses. All 16 MIDI channels work via one port available in the software. Since the up-to-dated programs has at least two ports it means that we can get at least 32 independent channels or 32 different instruments playing together. One can get two or more different timbres for the voices within a track by connecting an expander via a THRU connector. Another simple way to do this is to copy one track to another and set a different channel for the latter.

Having finished the set-up of the instruments and effect processing devices, the next step is to chose the appropriate software.

The composer can choose between a sequencer, or notation software, or both, depending on what he intends to do. Let us assume that the best choice is a sequencer. This device works as if it was a multi-track tape recorder. Working with a sequencer, the composer sets up the MIDI orchestra by selecting the number of track he needs, choosing channel, timbres, etc. Secondly he input music by playing on the master MIDI instrument or using any step time process. Even using a real time method he can record in slow tempo in order to avoid mistakes. Changes in tempo do not alter the real pitch. Even in polyphonic passages, piano-like, he can play line by line having total parameter control by setting one track per music line. In the end, or at any time, he can access any editing mode.

The sequencer provides two basic kinds of editing facilities: edit event and take note. Both give the composer the ability to change data, at event level, such as pitch, duration and velocity. Event editing is provided in form of text or text/graphics screens that exhibit the data of a track respectively in text only (alpha-numeric) or in text graphic (horizontal bars) display. The value of each event can be increased or decreased both by the computer keyboard or by mouse.

'Take note' is another type of editing. It is in the form of traditional music notation. In it, events can be changed by using the computer keyboard or by mouse-dragging from a pallet provided. 'Take note' works as notation programs do. However there exist quite a few differences with the latter, since take note is just a tool within the whole software while notation is itself the complete program. Similarly one can find sequencing capabilities in notation packages. The differences between notation and sequencing is becoming blurred as most software comes now in one integrated package. Anyway, most sequencers can save files in MIDI format which can be loaded into the majority of notation packages and converted into traditional music sheet, if desired.

At this point the composition is quite ready to be performed. A sequencer itself can do this by acting as a multi track tape player. Again all the facilities described above, and other I have not mentioned, make this task easy for the composer. The main screen of a sequencer has bottons, just as the front panel of a tape deck, which allows change of time, fast forwarding, rewind, pause, accurate identification of song point, etc.

In order to write acoustic music composition (AMC) the composer may choose a notation program rather than a sequencer or he will use the former after using a sequencer, since the score will need to be printed out. Unlike Digital Sound Composition the choice of the instruments, timbre and effects occurs outside of the computer or electronic environment. However composing, editing, printing out and even producing a demo tape can be completely assisted by a computer and MIDI devices.

The workstation necessary for AMC may be simpler than that in DMC: a computer controller, a multi-timbral MIDI keyboard, a printer and an audio system is just what one needs. Of course, improvement this platform is welcome. The computer must be equipped with MIDI interface and software as well. Since AMC is

conceived to be performed outside of the computer network I will just describe what is necessary while the composition is being built.

The keyboard does not need specifications as touch sensitive or after touch since the notation program may ignore its results. The simplest way of changing velocity is writing down dynamic marks along the score. The notation program will recognise them. We can change the parameter from a dynamic marks pallet by changing the default value provided. The MIDI keyboard represents nowadays more than the acoustic piano has represented along the 300 years for the composer, as it does not work alone but directly in connection with a multi track tape recorder and an animated score sheet. Both, recorded sound as well the score can be stored in disk data to be revised, modified or just to be continued after a break. The multi-timbral unit should be provided with a good library of acoustic sampled sounds. For example, while writing for real flute, a sample of this instrument may give a good idea of how it will sound in reality, mainly in relation with the timbre of the orchestra. However the composer must to keep in mind that it is just a virtual orchestra. The phrasing and articulation in real acoustic instruments are completely different, even In the case of the best sampled sounds.

In addition the composer's workstation provides facilities to record the finished composition on a tape, using MIDI sounds, to be used for purposes such as teaching, symposiums, commercial demos or just for pleasure.

Turning back to the notation programs, there are two kinds. One is just a note processor, similar to the word processor. It does not provides sound facilities but is rather useful in order to get a good publishing presentation.

The common kind of notation program handles multi-staves display, has all the ordinary music symbols, defines key and time signature, plays scores via MIDI, has automatic beaming and spacing, has a simple word processor, can transpose, copy, print, save into MIDI format and so on. Although all these advantages, notation still present many problems. One of them is its tendency to want to do everything automatically. Another common problem concerns the word processing, which is incompatible with the graphic symbols when the document is reformatted, repaginated or changes the size of the music fonts, for example. There is a notable lack of contemporary symbols; however some software increases this features by allowing the composer to draw his own notation. Flexibility can be achieved by allowing the user to chose between automatization for some features. Another good idea, I believe, is the capability to copy to a clip-board allowing the user the possibility of using an integrated desktop publishing package. I am hoping for a notation program which supports at least the two last features quoted. But it should not be only a single note/symbols processor. It should allows drawing symbols created or edited in a pallet provided or imported from a real graphics editor to be associated with a sound file. These features may be improved by allowing imported symbols from graphic editors, such Tiff format, as well as by the use of any true type font. The new program may provide a interface in order to create, edit and import sound files both in MIDI and DSP (digital sound processing) format from a Voice Editing program. This sound file would be associated with the symbol created/edited and the Notation would recognise it while in play back mode.

In order to produce digital-acoustic music (DAMC) composers may proceed by using some features present in both, acoustic and digital composition. I have spoken about the two processes separately. I have quoted the sequencer kind of software as the best option for making digital music. I have pointed out the notation kind software as the best choice for making acoustic music.

There are three steps in digital and acoustic music composition. The first consists of setting up the instruments, the timbres and the parameters. The second consist of choosing an appropriated program. The third consists of providing the performance. In digital-acoustic composition the process is not different. In fact, all we need is to gather together the two former processes, or least part of them. As the name indicates digital-acoustic music means music with both digital and acoustic sounds. The initial process of setting up sounds and parameters was explained above. The choice of software was also covered. In this composition the best option is a sequencer-notation integrated program, or using both simultaneously. The digital-acoustic composition takes the acoustic instruments in studio for a tape recording or takes the digital sound modules to the stage, for live performance.

Performance

Performance is the last phase of the composer's goal. Dealing with computer music, or electronic music as a whole, means to work with electronic devices in addition to people; often, more devices than people. Besides finished tape recordings for video, cinema or home users, computer music targets live performance on stage. This performance can use just recorded sounds or a mixing of recorded and live sounds.

Mari Kimura, who is a violin player working with both acoustic and MIDI violin, has stated (Kimura, 1995) that, as in old media, computer/electronic music performance has common problems concerning the sound. 'Performing electronic music involves working with sound sources other that the performer's own instrument. In live music for instruments and tape, and with live electronic such as integrative computer systems, instrumental performers have very little control over the synthesized or recorded sounds'. She argues that the environment affects these sounds considerably and differently than it affects traditional ones. The performers need to make adjustments in computer music rather than in acoustical performance. 'One must understand the difference, and compensate accordingly', she says.

Other particular characteristics of performing computing music have been discussed by composers and performers. No inclusion of computer music in the annual program of orchestras and chamber ensembles has been pointed as a generic problem applied to contemporary music performance. Lack of performers' interest, unsuitable concert halls and lack of audiences are quoted as main problems.

However the number of musicians and listeners involved in computer music has increased. New people are fascinated mainly by the novelty and, of course, by the publicity.

Conclusion

I was led to write this paper by a wish of organize a set of ideas concerning computer assisted composition and its relationship with algorithmic or non-algorithmic techniques

I must confess you that it was not a easy task for me. I am still worried about what it is that people related to computer music would like to listen, or to read.

To the experts my apologies if I said no more than the obvious. However it seems to me that, sometimes, experts hold information which could be useful to other people, just by considering it extremely evident.

My intention was to write for people wishing to join us whether it is a composer, performer or just a listener trying understand a small bit of the world of computer music, which despite its almost half a century of existence, still remains a new branch of musical science. It is frequently up-to-date and has improved the means of music making, therefore I consider that the first word was spoken, but the last one has not been uttered yet.

References

Anderton, Craig. (1986). *MIDI for Musicians*. London, Amsco Publications
Ballista, A et al. (1992). A MIDI/DSP Sound Processing Environment for a Computer Music Workstation *Computer Music Journal* 16:3, pp 57-72
Brummer, Ludger. (1994). Using a Digital Synthesis Language in Composition *Computer Music Journal* 18:4, pp 35-46.
Byrd, Donald. (1994). Music Notation Software and Intelligence *Computer Music Journal* 18:1, pp 17-20.
Chimera, Marie. (1995). Performance Practice in Computer Music *Computer Music Journal* 19:1, pp 64-75
Cope, David. (1991) *Computer and Musical Style*. Oxford. Oxford University Press
Dodge, Charles & Jerse T.A. (1985). *Computer Music: Synthesis, Composition, and Performance*. London: Collier Macmillan Publishers
Moore, F.R. (1988). The Dysfunction of MIDI *Computer Music Journal* 12:1, pp 19-28.
Pope, Stephen Travis. (1994). Music and Computer: NEMO Composers' Panel Discussion *Computer Music Journal* 18:3, pp 33-44.
Penfold, RA. (1989) *Computer and Music*. Sussex: PC Publishing
Penfold, RA. (1995). *Practical MIDI Handbook*: Glasgow. PC Publishing
Penfold, RA. (19.91. *Advanced MIDI*: Users Guide. Exeter: PC Publishing
Wright, Matthew. (1994). A Comparison of MIDI and ZIPI *Computer Music Journal* 18:4, pp 86-91.

Acknowledgements
I would like to thank Universidade Federal de Pernambuco, Brasil and Conselho Nacional de Pesquisa-CNPq for support my research at Keeel University, England.