Proceedings of the Institute of Acoustics

A COMPOSER'S VIEW OF MUSIC TECHNOLOGY

E. Graebner

University of Southampton, Music Department, Southampton, U.K.

Modern music technology caters well enough for live on-stage situations and for clients with money rather than time or patience to experiment with new sounds. As Martin Russ [1] can still observe in the Summer of 1989, "Almost all users of synths only ever use the preset voices supplied by the manufacturer...". Exceptionally, about five years ago, Yamaha introduced their CX5 computer-synthesiser which was evidently aimed at composers on a limited budget who were prepared to spend time in their studios developing ideas. The CX5 was a general purpose micro-computer - for instance, I prepared this paper on it using the WDPRO wordprocessing package - but slotted into the computer was the synthesis chip of the DX9 (smaller brother of the famous DX7). Nothing quite as versatile for its cheapness has appeared since, though the idea of software for synthesising, sequencing and editing has caught on for domestic computers in general. After one significant upgrade which essentially extended the CX5's midi capability, allowed disk storage and had another shot at programming the pre-set voices - though one was quietly allowed to believe in a hardware improvement - the serious market apparently saturated itself and the curious were no longer beguiled by the novelty factor. Meanwhile, the critics could point to several deficiencies. One was the relatively bad quantisation noise, a partly justified complaint. It can be avoided, but only by sacrificing certain things like very slow attacks and being very careful with amplitude modulation. As a composer I just accept that any instrument has its scope and limitations whether it's a harpsichord or a synthesiser, and these considerations obviously enter into the creative process. And although the listener may expect a synthesiser, unlike conventional instruments, to perform anything, as if the lost drama of human effort should be compensated by an inexhaustible richness of palette, the composer merely avoids the impossible and the listener is none the wiser. Another alleged problem was the unintuitiveness of FM when it comes to realising the sounds you have imagined. But this criticism makes the assumption that no-one is willing to spend time becoming competent with the theory. Yet another complaint, that the input to the sequencer unrealistically required a knowledge of Western music notation, begs the question of what other recognised notation would be equally comprehensive and familiar. An underlying assumption here seems to be that no-one will ever want to sequence anything more adventurous than the average popular hit.

In this short paper I intend to give some examples, including music illustrations, of how this relatively low-fi but highly versatile piece of equipment can still be put to good use - with some resourcefulness and obstinacy. Although many of its processes were available at the time, or later on, in more convenient, expensive and better forms, one of the CX5's assets was that synthesis, simulated signal processing and digital mixing were all specifiable in one stage (through the sequencer), once initialisation of instruments had taken place with the voicing software. If my own copious annotations (and corrections) of the manuals alone are any indication, the manufacturers considerably underestimated the variety of use to which this machine lends itself. For example, the "copy" command, intended as a standard editing facility

A COMPOSER'S VIEW

on the sequencer, can be used to simulate reverberation by duplicating a part so many times with delays and amplitude reductions on the way.

The two main areas likely to affect musicians are the voicing and composer software, the latter a sophisticated sequencer. (The synthesiser can also be used for live performance but I won't discuss this aspect since it applies to most synthesisers anyway.)

By means of the voicing software any number of instruments can be invented by the user and permanently stored on disk or tape in libraries containing up to 48 instruments each. Each instrument can use up to four oscillators in a choice of eight modulator/carrier configurations. Each oscillator has its own ADSDR amplitude envelope, 16 harmonic and 48 non-integer frequency factors, controls for output level and ranges of sensitivity for key velocity (or dynamic marks in the sequencer commands). In effect, each instrument involves up to 68 settings whose function determines the number of options (between two and 255), so that the range of possible sounds is enormous. There is also one LFO to share among all currently playing instruments which further extends this range, though it is tricky to use since you have to decide on a controlling instrument and then make sure that the LFO configurations of other instruments are either compatible or switched off, otherwise extremely weird results can ensue.

Turning now to the sequencer, we find available most of the usual editing facilities - copy, delete, replace, insert - which allow a piece to be changed as often as necessary and all intermediate results to be heard. You have access to 94 instruments at a time since a stored library of 48 user instruments (see above) can be loaded together with the 46 presets. Since certain sequencer commands can further alter the instruments, the user's options are considerable. Pitch, instrument, duration, dynamics and tempo are completely specifiable and there are utilities for repeating sections in various ways. Most commands can be entered at any point in any of the eight available parts and come into effect immediately. Among other things instruments can be changed in a part as often as desired. If eight polyphonic parts are not enough it is always possible to create another sequencer file and use a sequencer command to synchronize it with the first.

We see, then, that the voicing and sequencing software together provide a very flexible apparatus. Assuming now that the composer knows how to get what (s)he wants, we have a new problem when it comes down to composing a piece and deciding how to make use of all this choice. Take for instance the concept of "instrument". In a conventional instrumental piece some conventional classification of timbre - which distinguishes levels like: classical orchestra, woodwind, oboe, middle octave of oboe, fortissimo middle octave of oboe, etc. - is adequately understood by competent listeners most of the time, at least through habit, familiarity and musical context if not for acoustical reasons. For although the top A of an oboe may sound much more like the same A on a violin than its own bottom B flat this does not apparently cause the identity crisis three analogously different unfamiliar electronic sounds would create. Part of the problem is that there is as yet no standardised electronic music literature; our age is generally not conspicuous for the broad stylistic conformity of, say, the 18th c. in its musical language or forms. Also the acoustic categories that are most meaningful to physicists or electronic engineers who design synthesisers are not necessarily the critical ones from a music-psychological standpoint. A simple example - frequency spectrum is one component in identifying a sound sequence, and early electronic composers (and designers of synthesisers) assumed that instruments were recognisable through "typical" spectra. In practice, it now

A COMPOSER'S VIEW

appears that attack characteristics are equally if not more important. This incidentally helps us to distinguish the otherwise vastly different oboe notes in the example just given from the violin note. So the electronic composer may want to decide how to make convincing degrees of distinction between the sounds employed. One might decide to have a group of "plucked" sounds - i.e. with immediate rapid decay, in contrast with sustained ones; slow attack (vocal/string-like) versus fast attack (wind/percussion), un-pitched versus pitched, complex-pitch (e.g. gongs, bells) versus simple pitch (most orchestral instruments). [Play Music Example 1] I use conventional instrument vocabulary for these descriptions as it is the only one we share, without wishing to suggest that these sounds must be modelled on specific acoustic instruments. (Clearly, recognisable imitations of acoustic instruments solve the identity problems outlined above, but only in the sense that free-wheeling downhill solves the problem of a broken bicycle chain.)

It is also possible to combine characteristics of familiar instrumental types for whatever musical purpose. On one occasion I needed to go from an indefinite pitch to a definite one and back again at a late stage in the piece where it seemed dramatic and intelligible to confuse cadential (indefinite) with expository (definite) gestures. [Play Music Example 2] The most efficient way of creating this sound was, as it happened, to invent an "instrument" for that sole purpose, rather than have, say, two existing ones play simultaneously in some way. This decision illustrates a point about the concept of instrument as input data compared with the way it is understood aesthetically by composer and/or listener. Unlike the engineer or the listener, the composer is involved in a constant two-way translation. It is sometimes necessary to create different instruments in terms of logical design to achieve convincing variations in loudness or duration in what is to be perceived as the same instrument. As we know, the experience of loudness has as much to do with speed of attack and proportional amplitudes between higher and lower harmonics as with gross output amplitude. To some extent the FM design of the CX5 allows velocity sensitivity to control frequency spectra within a given instrument, by acting more or less vigorously on the amplitude envelope attached to a modulator. As regards duration, the execution speed of the note as a whole can also be configured to relate to pitch for some instrument (higher notes are over sooner - as on a piano) but if change is to be a function of anything other than pitch, the envelopes must be redefined, which means specifying a different instrument. When I needed a gong-like sound I found several instruments were needed to play the different durations I required, since the envelope unfolds very slowly and distinctively and the first two seconds of a four-second gong is not going to sound like a two-second gong. However, this does not rule out using the "half-gong" for something else! This is the obverse of what I have been describing. Just as several input instruments might be required to make available all necessary nuances of a given perceived instrument, so is it possible that one input instrument used in different ways will be perceptible as several different ones. It can be quite useful when improvising with one instrument setting to be able to play entirely different sounds by merely changing the note-on durations - say, staccato left hand, legato right hand. [Play Music Example 3] In general, you also find that one single logical instrument design can serve for lots of different perceived instruments by letting the <u>sequencer</u> make small changes in some parameter or other. Consider - a familiar example - how radically a change of an LFO value can affect the output. We see then that the concept of instrument as a piece of data-entry can be quite different from what the listener discerns as marking instrumental distinctions.

Another area in which synthesis allows a departure from traditional methods of composition is reverberation. The standard custom of preparing studio material dry then adding reverberation with an effects unit to make it glossy is rather more like searching for an ideal concert hall than of interest at the micro-level of composition. But the variable release time on an oscillator's envelopes (a perfectly standard feature of present day synthesisers, including the CX5) allows for great variety in what can come across to the listener as reverberation, though technically it is just part of the instrument configuration. We have grown so used to thinking of reverberation as largely determined beyond the piece of wood or metal that generates the sounds, that the idea of using it to project aspects of a musical structure - particularly middle- and larger-scale aspects - from within the instrument is rather underexplored. Again it is a matter of psychological judgement whether a particular application and context will give the effect of the same instrument in varying acoustic conditions or be understood as two different instruments. It is easy enough to identify "oboe in a cathedral", "violin out-of-doors", etc, by inference if not through direct experience, since we have heard what happens to familiar sounds in cathedrals, etc. and we have heard oboes before, if not in those surroundings. But changing the synthetic acoustic of an unfamiliar synthetic sound may not at all strike a listener as "instrument x in new acoustic condition y" unless it is supported and projected by other musical factors, not excluding such traditional devices as theme, register, density and silence. Again we come up against one of the chief difficulties of electronic music when it is not merely out to imitate live music - namely presenting qualitative distinctions among unfamiliar objects as though some network or hierarchy could be assumed by the observant listener. The problem is patently urgent now that synthesisers and samplers no longer have difficulty imitating live instruments or producing "nice" and "interesting" original sounds quite convincingly and with little effort; so that how to make it is no longer the burning issue but what to do with it.

Let us now return to the sequencer. Some of you may have realised that the distinction between instrument as input data and perceived phenomenon, which I outlined in connection with voicing, will lead to a similar disparity between information that is typically fed to the sequencer and a conventional music score. When I prepared a cue-score of the electronic part of a recent tape and clarinet piece [2] for the benefit of the performer it only barely resembled the sequencing data. As with the voicing software you must largely abandon the idea of synthesised instruments corresponding to perceived instruments on a one to one basis. Another likely source of a garbled-looking sequencer score is the fact that eight parts do not allow very effective eight-voice polyphony, assuming that is enough anyway. In practice notes must be allocated to parts so as to allow natural reverberation and prevent cut-off as the next note sounds in the same part. So input can be less like writing individual polyphonic lines and more a process of finding gaps in some part or other where a sound can be placed without disturbing what is already going on. This involves considerable planning and the result looks fairly meaningless to the human eye.

In discussing both the voicing and sequencer I have illustrated how it is often necessary to sacrifice conventional or intuitive appearances to arrive at both adventurous and comprehensible results. You may also have gathered from certain remarks I have made, and from my involvement with an "out-of-date" synthesiser, that for the realm of musical thought there is really no outdated technology except in the sense that human imagination can find no new use for it. In this sense the only outdated products are those whose boasted novelty is that they have anticipated all possible applications - meaning perhaps those of lazy, illiterate or uninventive people. On the other hand, with genuine innovation in technology or design, the solution of one technical problem always leads to previously unenvisaged or unexecutable possibilities for the composer ... leading to new aesthetic and creative problems! Thus creative and technological progress is like a cat chasing its own tail - though one hopes the expense of energy is more profitable.

REFERENCES

[1] M.RUSS, 'Composite FM the Creative Alternative', Yamaha X Press p.8 (Summer 1989)
[2] E. GRAEBNER 'Dollbreaker'. Composition for live clarinet and stereo synthesised tape First performance: Glasgow, February 1988, by Suzanne Hall

ISBN 0 946731 90 X