ELECTRONIC MUSIC SYSTEMS: THEIR HISTORY AND FUTURE

The rôle of electronics in the composition of contemporary music is frequently debated in terms of its general relevance without regard to context. Any desire to utilize electronic sounds and treatments requires a rationalization of musical ideas into a form suitable for implementation within the constraints of a particular technological system, and a pre-requisite for the success of any such operation must be an examination of the precise relevance of electronics in the form available to the projected compositional conception.

Composers who for one reason or another fail to gain a clear understanding of both the possibilities and the shortcomings of electronic sound synthesis will find the results of their efforts limited in achievement and often unsatisfactory, and this frequently engenders a general disillusionment as to the creative uses of the medium. A considerable proportion of the blame for such breakdowns in communication may be attributed to the technological systems and their designers who in many cases seem rather more concerned with developing complex sound processing techniques without paying sufficient attention to the increasing problems encountered in creating an effective dialogue between composer and machine.

The proliferation of relatively cheap mini-synthesizers has considerably extended the availability of electronic facilities for the many composers who would otherwise find it practically or economically difficult to gain access to one of the established studios. The units function as simple sound generation and treatment systems which are particularly useful as live performance instruments utilizing both internal and external sound sources. Under these operating conditions the design limitations prove advantageous in imposing a necessary restriction on the complexity of operation. The desire, however, to engage in more complex procedures, such as the construction of complete electronic tapes as the whole or part of a composition, demands more flexible facilities which will allow a sophisticated interpretation of musical structures. The restricted "language" of these units forces the composer to comply with the specific operational philosophy laid down by the designer of the unit in a fixed form, and it is this remote superimposition of one person's design limitations on the creative workings of diverse musicians which will in many instances prove detrimental to the development of meaningful electronic composition. These smaller synthesizers can function as the basis of a modest electronic music studio providing they are supported with essential ancillary equipment, which must include flexible sound mixing facilities and a bank of high quality stereo tape recorders preferably working at up to 15 inches per second.

The use of tape splicing, multitrack and even variable speed techniques greatly enhances the practical applications of these systems as they permit complex sound structures to be built up from basic source material.

The larger studios naturally provide far more comprehensive systems of sound processing. The increase in size, however, is not necessarily a guarantee of freedom from unwanted technological constraints, and a brief consideration of the history of electronic studios since the end of the second world war will illustrate some of the major stumbling blocks.

Up until the late 1950's most of the studios were entirely analogue in nature, designed and developed around the specific requirements of a single or a very closely-knit group of composers. The systems created were thus primarily intended to serve the needs of only one area of electronic composition and the result, naturally enough, was a series of highly individual studios, each instrument belonging to a notable epoch. The products of the "Musique Concrête" school in Paris contrast sharply with the all-electronic emphasis of the Cologne studio during this period, and these are but two selected examples. Compositional philosophies, however, change, and the inevitable alterations in requirements have shown up only too clearly the basic vulnerability of these non-digital, fixed device studios geared to a specialist conception. This factor has proved, in retrospect, to have been one of the greatest drawbacks in the advancement of electronic music systems.

The development of direct computer synthesis in America during the late 50's and early 60's offered totally different methods of sound specification by replacing the constraints of analogue circuitry with digital simulation procedures controlled by a computer programme. Within such a concept it became possible to develop communications between the composer and his material through the logic of language instructions, and several complete compositional programmes have been produced, such as Music IV, Music V and Music 360. Operational constraints, however, have emerged which limit the implementation of these systems. The primary drawback is the need for access to a considerable source of computer power to run these very large programmes. Linked to this: the simulation of digitally represented sound within a computer and its necessary final conversion into an analogue form on tape or directly through a loudspeaker requires the use of the processing system in a manner somewhat alien to its normal function. In addition, large computing installations maintain efficiency by sharing their power between several programmes at once, each of which must conform to some common requirements, and this dictates that any use of the machine for musical purposes will be controlled and influenced

by the operating system which is designed primarily to serve commercial and scientific requirements. The resulting loss of interactive control is considerable. At many centres the user is expected to run his programmes in an overnight batch stream, submitting his instructions on an evening, and, if he is lucky, receiving a few seconds of output the next day. Some composers find that mathematical specification is suited to their work and will endure the delay between idea and product in return for the considerable freedom of specification, and several important compositions have been produced in this manner. To others, however, the degree of computational knowledge required, especially when combined with the extensive delays in actual processing, renders the system unsuitable to their needs. Further, studios offering such facilities are few and far between, and in this country no institution has yet offered any of these large synthesis programmes except on a short term experimental basis.

The development of direct synthesis was counterbalanced by the introduction of interactive voltage control techniques for analogue studios, which considerably improved their potential by permitting the application of the functional characteristics of one device as control parameters for the performance of another. It soon became apparent to some designers that since such studios relied heavily on the complex specification of control sequences, their flexibility could be usefully enhanced by harnessing a small digital computer to order the functioning of the system via suitable interfaces.

Thus the hybrid system was born, offering facilities for real or nearly-real-time operation via programming routines, or the input of manual operations on the actual devices which could be remembered and manipulated. From a practical point of view the demands on computer power have been considered sufficiently economical by some major studios to allow the construction of completely self-contained systems with their own computers, where the maximum consideration may be given to the creative needs of the composers without interference from alien demands. Stockholm, Putney (London), and Utrecht electronic music studios all support hybrid systems and several other institutions on the Continent and in America have already followed, or are about to follow, suit.

The influence of hybrid techniques has spread to the smaller voltage control systems including the mini-synthesizers, where simple digital sequencers may be employed to record and repeat the control information for a simple series of events. It is unfortunate, however, that a few commercial enterprises and studios are so eager to suggest, for the sake of prestige, that such modest facilities render their systems "computerised", for these little memories do not indicate the true potential of a fully hybrid system which, above all, offers programmable logic as the key to solving the problems of man/machine communication in the form of a system control or "macro" language.

The hybrid systems have proved immensely successful and have already gone a long way towards creating useful and flexible approaches to musical composition. One important drawback still remains. Notwithstanding the flexibility of computer control, with its potential to translate musical instructions into the most useful practical terms for operating the system, there is still an ultimate dependence on the limiting characteristics of analogue devices. Durham University Electronic Music Studio, in addition to setting up a normal voltage control studio, is in the process of investigating the possibility of developing a new type of synthesis system in collaboration with members of the Computing and Applied Physics departments. The general upsurge of interest in the wider applications of digital technology during recent years has flooded the market with an ever-increasing range of basic components, offering the electronic studio designer new opportunities hitherto unavailable except at very great cost. To return for a moment to the direct synthesis systems approach: one of the main reasons for the requirement here of large resources is the peculiar demands made on the computing system. A standard digital computer is expected to serve the general processing needs of a whole range of applications, efficient in nearly all, but special, normally, to none. Computer sound synthesis taxes certain parts of the system to its operational limits and makes inefficient use of others, and the real need is for a digital sound generation system uniquely designed and built to satisfy as wide and as flexible a range of studio requirements as possible.

Preliminary research we have carried out shows that digital sound generation and treatment devices are not only practical propositions but also cheap and powerful in their potential application, since we enter the philosophy of devices which have programmable specifications. In a hybrid studio the computer will control the functions of the various devices but it cannot alter the basic characteristics. In a prototype digital oscillator which we are developing the device characteristic itself, i.e. the actual waveshape, is digitally specified and hence may be altered at will. If we remember that sound complexes may be defined in terms of their constituent waveshapes, the device becomes an infinitely variable sound source - a considerable extension of the techniques used in the so-called "computer" organs which use a bank of stored waveshapes to specify the various timbres. The project sets out to construct a studio "black box" sound generation system entirely digital in operation, at a fraction of the cost of its direct synthesis counterpart, which will permit absolute sound specifications in any form capable of digital translation. Such a system will require, and indeed is ideally suited to, master control from a small digital computer, creating a parallel to the hybrid system. Thus this control computer will function as the interface between the composer and the sound processor and will be dedicated almost entirely to communication operations. Such a versatile system would be suitable for a variety of input techniques which could easily be changed without destroying the central system of sound generation, and we intend to include the following:-

1. The analogue specification and representation of all convenient devices (i.e. knobs, spinwheels, keyboard, registers etc.) integrated with an advanced and flexible computer graphics system. This would allow the composer to feed information into the system and also manipulate the product by the most appropriate method, playing interactively and in real time.

2. Programmable control of the sound processor both interactively and non-interactively via a specially constructed "macro" language. Some composers may wish to specify complete sound procedures in terms of a complex sequence of algorithmic instructions forming a complete section of a program. Such total conceptions are best suited to non-interactive operation using prepared paper tape. Others may prefer to select simpler structures and modify their development in the light of resultant sounds by direct interaction through a typewriter keyboard or any appropriate analogue input device mentioned in 1., with the running program.

It is intended that the former method should act as the primary input system creating an artistic relationship between the composer and a visual and physical representation of his sound material. Any analogue procedure used by the composer would not only be memorised but also translated and stored in the system language, permitting output in numerical form for modification by method 2. Such a method of operation would permit the user a complete freedom of choice between the physical, visual and mathematical specification of compositional ideas.

We hope that the creation of such a studio of unfixed configuration will permit study of the basic communication problems still existing, and serve to create methods of operation which above all are constructed in terms and facilities which are readily accessible to the many composers who find the present demands for a considerable understanding of technology unacceptable to their work.

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