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PROBLEMS OF ELECTRONIC MUSIC NOTATION

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PROBLEMS OF ELECTRONIC MUSIC NOTATION

Summary

A method of notation based on a three-dimensional principle is being developed for the purpose of writing down electronic music. A few simple symbols are used by which it is possible to give a graphical representation of the electronic sound structures. Unlike the usual methods of notation, there is no score, but merely working instructions for the electro-acoustic realization of the composition.

Conventional musical symbols cannot be used for writing down electronic music. The multiplicity of electronic shaping elements goes far beyond the graphical powers of representation of our notation. It is necessary, therefore, to take into account the differentiations of electronic music not known in earlier music, by means of a notation which will correspond to the acoustic processes. This cannot be accomplished by any extension of the traditional notation, which suffices, at most, for the writing down of quarter or sixth tone music. On the contrary, logically speaking, the sound processes of electronic music can be set down graphically only in the form of an "acoustic" representation.

Whether this acoustic notation still contains the symbolic values of an actual notation, and whether in this sense it can be "read" by the musician, is a question which can only be answered after much longer practice and more experience has been gained. In general conception the function of notation is estimated very one-sidedly and is understood only in the light of the history of the last 200 years. Even in Bach's time the so-called interpretation marks, which later came to be regarded as the very essence of music, were seldom met, and the

"concert-performing style" involved a great many musical processes which were not written down. In the 15th and 16th centuries there were no time signatures, and whole epochs prior to that time were content with symbols which gave only approximate values for the pitches and rhythms. To conclude from this that these ages had no clear tonal consciousness is a modern prejudice, as indeed is the belief that the level of rational development of a notation permits conclusions to be drawn concerning the level of musical culture prevailing at a given time.

Where our conventional notation possesses highly rationalistic characteristics, the "acoustic" notation of electronic music will employ technical and scientific means of representation. It need not be emphasized that the music itself is not affected by this rational or technical character of its notation. The general principles of the technical-acoustic notation will now be discussed.

Acoustic phenomena can be represented by a three-dimensional diagram employing the coordinates of frequency, gain and time. Sound processes which have time limitations (e.g. musical notes) are depicted as solids[1]. According to the rules of analytical geometry for the representation of points, lines and planes in vertical-parallel projection it is possible to draw this image so that its acoustic realization is possible.

For this purpose the solid representing the sound is cut into sections in such a way that all the details required for the construction of the process are recognizable (Fig. 1). In almost all cases it is sufficient for this purpose to have sections which depict the frequency-time plane and the gain-time plane.

The number of sectional areas depends on the structure of the sounds and noises and must be great enough so that a reconstruction of the sound event is possible on the basis of the diagrammatic elements. It has been found useful for this purpose in each case to set up a frequency-time plane and the corresponding gain-time plane (Fig. 2). The sound processes occurring in these planes can be described with the aid of a few simple symbols.

For the technical execution such a description must contain all the necessary data. So that it can be read by all participants agreement must be reached concerning the nature of the diagrammatic representation.

According to Fig. 2 acoustic processes are characterized in the following way:

(a) Distribution of Partials

Pitch and duration are plotted in the frequency-time plane, the exact amount of the frequency and the gain to be written above the line representing the partial. So that the entire auditory range can be covered by a single scale the frequency range involved in each case is indicated by a factor put in front.

The dynamic character of the sound event is obtained from the gain diagram. As seen in the example, the fade-out conditions are represented by a falling, dashed line.

For reasons which arise directly from the method of production, the time axis is graduated directly into lengths of magnetic tape (referred to a tape speed of 66.2 cm./sec.).

(b) Modulation

If two sounds are to be modulated one by the other the partial distribution of the original sounds are set down in accordance with instruction A; this, of course, is done in two systems arranged one above the other. The kind of modulator to be employed (four-pole modulator, ring modulator) is indicated in writing between the two systems.

(c) Frequency Band Clipping

If a coloured noise band of given width is required, this can be represented by two frequency lines joined at the beginning and at the end and showing the band limits. The dynamic characteristic, as usual, is indicated on the gain plane.

(d) Frequency Band Compression and Expansion

The partial distribution of the sound to be compressed or expanded is entered in the usual way and the expansion or compression value is indicated on the time scale. For example, the number 3 indicates a threefold expansion of the original sounds while $\frac{1}{4}$ would mean compression down to one fourth part of the original sound.

By combining the above examples, and from the aims of the composition in a given case, a sufficient number of symbols may easily be assembled.

The depicted way of plotting electronically produced sounds and noises of course represents one working instruction which is intended to facilitate the production of these sound processes[2].

Composition with sinusoidal tones requires accurate plotting of the frequencies. However, if the composer uses complex, indeterminate sounds, the lines provided therefor do not denote the frequency but the relative pitch. In this connection the following should be carefully noted: a sound is acoustically defined when its spectrum is defined; it is musically defined when it can be reproduced at any time. From this it follows, with regard to technical production, that a score which uses only sinusoidal tones can be realized from the graphical instructions in the way a manufactured article is produced from a drawing, i.e., it can be executed by the technician. In the other case, that is for the complex sounds, the composer must do his own selecting and setting down for the score. If the composer also determines the envelope curves in advance, writing say a passage for percussion sounds, the result will be a comparatively simple-appearing score. This will be illustrated by a simple example.

A piece employs eight different percussion sounds of various pitch, ranging from a deep gong sound to a high metallic clang. These sounds are first selected and then produced with the proper envelope curves. For these eight sounds (A, B, C ... H) eight score lines are required on which the sounds may be plotted according to time (in cm.) and intensity (±0, -5, -10, -15 ..... db.), (Fig. 3a).

The band pattern of this example (Fig. 3b) provides the following data: Capital letters = sounds, numbers = centimetres, numbers in circles = centimetre lengths of pauses, small numbers = db., bracket = sign for two tapes to be played one above the other.

For greater clarification this example has been translated into current musical notation (Fig. 3c).

It need scarcely be said that such translations to a foreign script are not adapted to the nature of electronic music. The task of composing consists in the production of the acoustical score. For technical realization, in general the data of the band pattern will suffice.

References

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2. Meyer-Eppler, W. Über die Anwendung elektronischer Klangmittel im Rundfunk (On the use of electronic sound producers in radio). Tech. Hausmitt. NWDR, 4: 130-135, 1952.

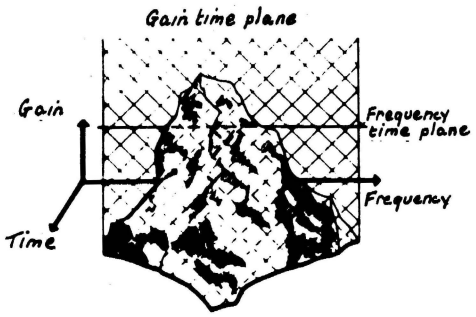

Fig. 1

Three-dimensional diagrams for representation of acoustic processes.

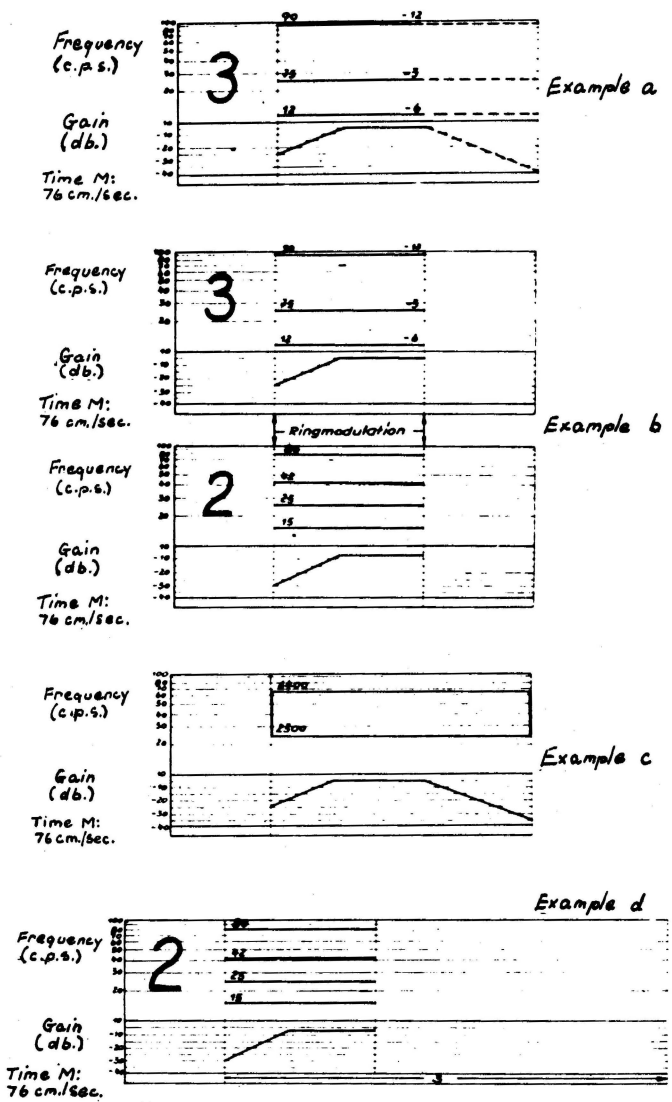

Fig. 2

Working instructions for electro-acoustic realization of sound processes.

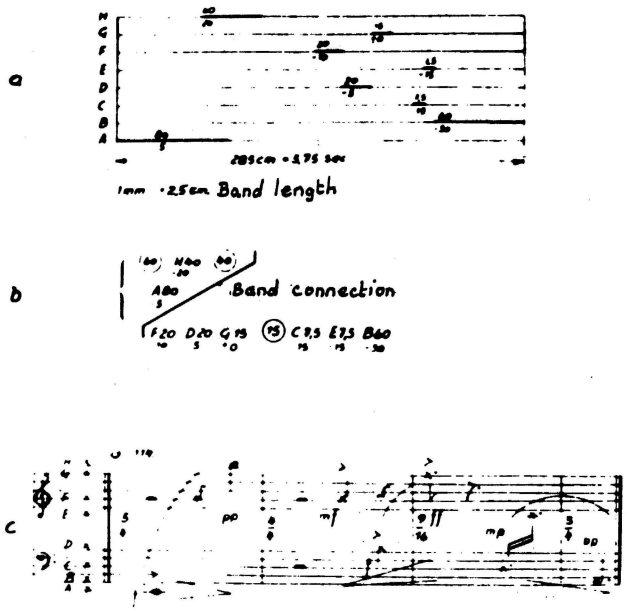

Fig. 3

Graphical fixing of electronic percussion sounds:

(a) Score

(b) Band pattern

(c) Translation into conventional notation.