

# The Aesthetic Integration of Computer-Composed Scores

*For Otto Laske*

## SUMMARY

Although the composition of music – with or without computers - depends to a great extent on subjectively experienced criteria, the algorithmic description of the production process adds an objective feature; because of it, "form" is no longer the personal manner in which the musical material is presented or the listener's perception is guided, but the rationally discernible, reproducible effect, detached from the composer, of an organized system on arbitrary material.

Composing programs may differ as to the variability of the input data or even to the extent to which the rules can be modified: in any case the composer must settle the conflict between the objectified grammar and his subjective awareness of form. Simple programs which leave the material in a relatively natural state force the composer to radical treatment of the result in a way that resembles "free" composition without a computer and thus renders the use of a computer superfluous. More exacting programs mould the material down to the last detail, fending off any subsequent intervention; the composer has to accept the form resulting from the treatment of the material if he wishes to avoid the conflict with his own conception of form.

"Form" here is not merely a vessel, but a process which starts with the composer's inspiration and proceeds by way of design, execution, correction and performance to the listener's ear and judgement. The conflict, then, is not due to any difference in the ideas of the writer of the program and the composer, but rather to the elimination of the composer during an important phase of the process. Even composers who like to experiment will want to bear responsibility for the aesthetic result, and will therefore try to come to terms with their own form-criteria. In doing so, they enter territory which is at least as close to interpretation as to composing. The conflict can be described as long as it is concerned with the algorithm on the one hand and the composer's strategies on the other. Since, however, as stated above, form is a process (or at any rate the result of processes which leave their traces), it is difficult to describe the conflict, which can only be resolved by making corrections, a process which, like the others, determines the form.

A practical example of the integration conflict is provided, say, by the task of scoring "points", arranged in fields, as parts, i.e. as lines. "Points" (in time) are the result of entry delays being distributed along the time-axis; each point can also be given a vertical density value (chord size). In this fashion a varying temporal density (speed) can be realized, possibly together with a vertical density curve. "Lines" (tone sequences) can result from an ensemble which does not allow any mass effects, such as a group of solo instruments. In such a case, scoring should satisfy the demand for every voice to have a "meaning" - to conform with the principles governing the harmony. (We are assuming the form-process to develop in the interaction of horizontal and vertical relationships of a harmonic, rhythmic and spectral nature.) Perhaps the conflict cannot be resolved because it is caused by peculiarities of the creative act which cannot be formalized, or only in special cases. The thing to do in such a case is to arrange the compositional algorithm in such a way as to keep the conflict as small as possible or to have the result exhibit some tolerance towards the composer's attempts at solution.

A possible aid is a sound-generating system which provides the composer with an acoustic rendering of the result or at least of the most important parameters, rather like a piano score), allowing him to make his corrections before transcribing the printout. However useful such a method may be in investigating the conflict described here, it cannot do away with the conflict itself. It would be better to be able to influence the compositional algorithm continuously in order to obtain more insight into these matters. The author is currently working on plans for such a system with the provisional title of "Project 3".

My contribution to this conference [ICMC Conference in Venice 1982] is not to pose a *problem* in the hope that someone else has already found a solution and is prepared to let me know about it;

neither does my contribution present a *solution* to a problem which other people might be tackling at the moment. It is only in the pursuit of my own activities that I have come across facts that from the algorithmic formulation of musical problems and which consequently claim the right to be heard at a conference devoted to computer music. Since the time at my disposal is too short for a detailed presentation, I shall limit myself to a brief outline.

## 1

I have been involved with the algorithmic description of composition processes for about thirty years. My interest started with the analysis of music composed in a strict style (like Bach's or Webern's), and compositions of my own in which the material was to be organized according to a plan. *Instrumental music* in this category consisted of several pieces for chamber ensemble and orchestra (1952/55), piano pieces (1957), a wind quintet (1958/59) and a string quartet (1959).

My interest in algorithmic description was reinforced by my involvement with *electronic music* which, owing to the new kinds of production technique using electro-acoustic measuring apparatus, required more intensive planning. This period is documented by my "Klangfiguren" I and II (1955/56), "Essay" (1957/58) and "Terminus 1" (1962).

Eventually my attention focussed on algorithmic description itself when instead of obeying composition rules, I started using a computer to carry them out. This led to my computer programs "Project 1" (first version 1964/66), "Project 2" (first version 1965/69) and my sound synthesis program "SSP" (1972/79).

I was able to make certain observations, which I should like to mention in this outline, from the following *computer-aided.compositions*: "Version 1" for 14 instruments (1965/66), "Version 3" for 9 instruments (1967), "Segments 1-7" for piano (1982), "Segments 99-105" for violin and piano (1982, first performance during this conference), "3 ASKO pieces" for chamber orchestra (1982, to be performed for the first time in November/December). I composed all these pieces with "Project 1".

At present I am working, albeit sporadically, on another program which I call a "mentor system". As "Project 3" it will carry on the work started in "Project 1" and "Project 2".

## 2

While I was occupied with the algorithmic description of compositional processes, I became increasingly aware of how much the planning and execution of a compositional idea depend on, or are influenced by, the individual *mode of production* (solo instrument, ensemble, improvisation, score, tape, synthesizer); by mode of production I mean the *technology* and *social circumstances* of sound production. I count as social circumstances the *function of music* (mythical-ritual, to the glory of God, court splendour, bourgeois status, symbol, social contacts, amusement, the reinforcement of the communal spirit, education, for setting a mood, background, documentation of individuality by musical means), but it also includes the social *division of labour* (solo performance, group performance, ensemble, large orchestra, music-making in the home, automata in the form of musical boxes and street organs, electronic sound production, loudspeaker performance). Production modes

also include technique in a stricter sense, in the form of the technique of playing instruments, improvised or "from the score", the extension of the body by complicated tools such as the piano or organ, the use of electric current (electric and electronic music) and electronic circuitry (digital data processing). Increasing change, both in technology and in the social division of labour for purposes of musical sound production, gives rise to the question of how a composer reacts to the different variants of the production mode. I have not done any sociological or psychological research on this subject, but as a composer I have felt a need to react functionally. "Functionally" means that players should not be treated like generators, nor generators like players; functional means that not only stylistic imitation is prohibited, but also the imitation of a particular production mode in another medium.

Let us, for the sake of illustration, take a look at the relationship between instrumental and electronic music.

Instrumental music:

division of labour during performance of ensemble music, requiring formalization (common tonal system, common metric time-basis), but also allowing individual freedom (melody against a harmonic background, expressive rubato, counterpoint in independent parts; note that constant spectra are necessary in order to distinguish the parts) and results in central planning (composition).

Electronic music:

no performance, hence no division of labour, hence no need for common tonal or metric systems; melody, harmony and counterpoint therefore lose their meaning, becoming historically and in a functional sense wrong. Division of labour is limited to the production process in the studio, which causes the composer's planning--to acquire engineer-like dimensions.

If we stress the similarity between instrumental and electronic music instead of the difference, we can attempt a comparison with computer music; by computer music I mean the production of music as a language-like process, not just making sounds.

Instrumental and electronic music:

division of labour between planning (composition) and execution (performance); division of labour in execution as well (players in the orchestra, working processes in the electronic studio); the composition of music by a living subject constantly exposed to psychological influences (memories, perceptions, associations), but who can vary at will between writing something down and correcting it; we observe a dynamic process.

Computer music:

here the division of labour is modified by additional formalization of the composition process; in execution the division of labour is extended to include transcription of the computer printout; music is composed by a machine without any psychological feedback, meaning that time is suspended for the duration of the composing process. We observe a static process; before performance, the result is subjected to transcription and interpretation.

The computer is introduced in the planning phase, the unity we observed in the planning phase of instrumental and electronic music thus being split. This presents a third comparison: between electronic and computer music; we can forget instrumental music for the moment because as far as the dynamic compositional act is concerned it is no different from electronic music; electronic music is thus presented as a step in the development of instrumental music towards computer music; synthesizer circuits which produce music automatically, i.e. algorithmically, belong by analogy to computer music. In

electronic music:

the dimensions freed from the production mode of instrumental music can be re-defined (free choice of tonal systems, rhythms, densities, spectra); the result of technical realization is put on tape directly – without any further intervention. In

computer music:

the strategy freed from the psychology of the composing human subject is taken over by an algorithm by means of which the elements and methods (selection, permutation, conditional branching in the working schedule) are redefined; the result of algorithmic compilation is converted into categories which are foreign to it: voice-leading, phrasing, playing technique... in one word – into a voice model.

### 3

For computer music, i.e. algorithmic compilation, I have designed a *time-parameter graph* with an T (or X) axis for time and a P (or Y) axis for the musical *parameter*. Both axes can be subdivided in whatever way the composer wants. Each parameter has its own P axis; but all the parameters have one common T axis. (This last condition can be omitted in electronic music and digital sound production.)

This time-parameter graph (see fig.) is meant to illustrate the transition from the composing subject to the compiling data-processing system. Imagine a given piece of music reduced to a duration of zero: all parameter data are then imprinted, so to speak, onto the P axes. Similarly, reduce the same piece of music to a parameterless representation: this would cause the parameters on the T axis to be imprinted where changes occur in them. If we go on to imagine that the imprint on the axes becomes stronger, the more data coincide at one point, we obtain the *multiple histogram* of that given piece of music with regard to the time and parameter values. The histogram cannot enable us to reconstruct the original piece of music, but it does contain characteristic features – those of rhythm and of the distribution of all parameter data with regard to the frequency of their occurrence. It resembles the preparations which a composer accustomed to working constructively makes before he starts writing his score. Converting a histogram back into one of the many variants of the score is done by connecting all the imprints on the time axis with all the imprints on the parameter axes; every time two data are connected the imprints become shallower, until they disappear. In terms of the histogram: the columns decrease by a uniform value with each connection, and all the columns must be used up entirely.

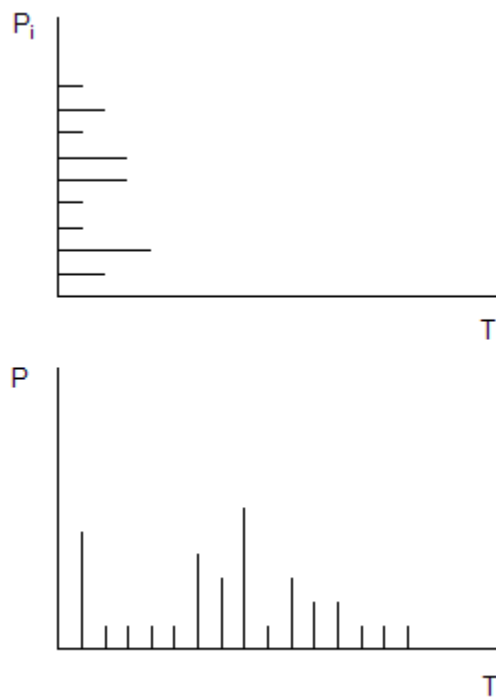


Fig.

This model lends itself to algorithmic representation if the composer supplies the histograms and the computer program takes care of the data-linking. Neither the histograms nor the linking algorithm contains any hints about the envisaged, "unfolded" score, which consists of instructions for dividing the labour of the production mode, i.e. for the parts. The histogram, unfolded to reveal the individual time and parameter values, has to be split up into voices; the trivial condition is that they are "contained" so to speak in the histogram (and the linking algorithm); the non-trivial condition is that the parts also fit into the historical situation (formed and at the same time urged on by tradition).

The fig. shows a histogram for parameter  $P_i$  and a histogram for the sequence of events in time  $T$  in which several parameters are involved. The height of a bar indicates how often a parameter value was used or how many parameters were given a new value at a particular time. The composing subject sets up the parameter lists

and also influences the data selection by activating selection algorithms. These algorithms include random decisions, so that when lists and algorithms are identical, but random sequences differ, different compositions can result. The problem for the composer is to choose lists and algorithms (including ones for time-values which affect the rhythm) in such a way that under restricted, but nonetheless unpredictable, random decisions a "meaningful" composition will result. The graphs are supposed to show that the musical idea of which the composer is aware – the continuous data flow – can be divided into several operational terms (parameters, selection criteria) which in their turn can only be experienced aesthetically in the time-medium, after being combined.

#### 4

This kind of experience came over me recently while I was transcribing scores produced by "Project 1". The algorithms combined in "Project 1" are based on ways of structuring musical time, defined in the technique of serial and electronic music. The algorithms produce *cycles of different frequency* (and also of differing irregularity of movement), so that constantly changing overlappings occur. This principle – a circular one – is not goal-oriented; the result is static and consequently – I think – suitable for being split up into voices because nothing urges towards particular developments, not even towards developments with an influence on the instrumentation, and because the balanced distribution of the material in fact permits different interpretations.

Before embarking on transcription it is advisable to compare several printouts. To aid such comparison, "Project 1" is linked with a sound system (VOSIM Composite) which plays the composer a kind of piano reduction (pitches, entry delays, dynamics; it can also produce various spectra and modify the durations, resulting in staccato tones or superpositions; in this fashion

instrumentation variants for the same score can be simulated). The general decision as to whether a printout is suitable for transcription is only made easier with regard to rhythm, tempo, harmony and dynamic gradation; the sound system does not impart any information about the possible construction of a voice model, since the score is still presented as a sequence of chords.

## 5

By *aesthetic integration* we may understand the process by which the data of the computer printout are transformed into the *aesthetic object* we hear as a piece of music when performed. It appears quite legal to substitute for performance a score making provisions as a reference system, for different performances of the same piece. This process is comparable to composing itself, because individual data which refer abstractly to each other but are not concretely fixed in time are given their final position; the process might be compared to the way from the idea to its execution. The length of this way depends on the extent to which the computer program has been able to represent the abstract relationships as concrete time relations and also on how important this distinction is to the composer. I think that it would be very hard to find an algorithmic solution to this conflict between the idea and its representation in time, because the relation of the composition process and thus of the aesthetic shape of the finished work to the mode of performance (or execution) is of prime importance. Performance on traditional instruments requires instructions distributed over the parts and granting the individual part its historical rights. Algorithmic composing by division of labour introduces a new element here, whilst preserving what was given. The algorithms squeeze in between the general idea of a piece, where the musical data only sustain abstract relationships, and the writing of the score which concretizes these relationships. In my opinion the composing algorithm formalizes a critical instance which syntactically groups the data which the composer has only roughly pre-sorted, presenting the material in such a way that the composer the first interpreter of the material - is given distinct information as to the mode of performance, i.e. as to playing technique in passing time.

[1982]