SHAPING A COMPOSITIONAL NETWORK WITH COMPUTER

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I would like to concentrate in this article on describing my musical thinking concerning composing with the computer and on introducing the running principles of the program I created for this purpose, with the help of examples.

The program has been entirely realized with Xavier Rodet's and Pierre Cointe's FORMES system which runs on IRCAM's VAX 11/780 computer and can be linked with the CHANT sound synthesis and processing program on the array processor FPS-100. All the sound examples have been synthesized with this version of CHANT, which has been realized by Yves Potard and Jan Vandenheede. This version includes the Formant Wave Functions synthesis technique (hereafter called FOF) by Xavier Rodet (see Computer Music Journal 1984 volume 8/ 3), as well as a bank of time-varying filters. These filters are controllable in the same way that formants are usually controlled in CHANT; that is, by specifying the central frequencies, bandwidths and amplitudes. This implies the possibility of using CHANT not only for synthesis but for filtering and sound processing. Any kind of external source can be used, but in this work I used these filters only with a noise source.

I owe special thanks to Xavier Rodet and Jean-Baptiste Barrière for the realization of my program, which demanded, besides musical planning, many new solutions from a programming point of view.

In this work, I started with problems concerning the organization of sound material. I wanted to find out how a composer could be able to work on musical elements without getting lost in the endless network of algorithms. Producing an interesting sound makes great demands on her, so the compositional work itself with a synthetic material often remains a secondary matter.

I shaped in my mind some primary models for musical situations. Starting from these models, I intended to control various musical parameters, without forgetting their particular features. I wanted to find out how far various parameters could be treated starting from the same outset point. I wanted to have possibilities to realize two situations of different types at the same time:

- a gradual interpolation between given points, and
- sharp transitions between different musical characteristics.

I have been interested since a long time in the idea of musical interpolation and processes. My starting-point in this developement is partly determined by these interests in relation to various specific musical parameters.

In general, my programs consist of patterns, which are described as lists of values for a chosen parameter, and then mapped together. I will call these lists and sets of lists matrices. Besides them, various functions of time for determining general evolutions and envelopes can be used. In the matrix, values are given to a desired number of particles and the interpolation relations are defined:

```
(setq pat-ryt-dep '(0.133 0.133 .....))
(setq pat-ryt-arr '(0.8   0.1   .....))
```

Within one sound, a simple interpolation can be made between two values (0.133→0.8), or between the circular matrix where each value, when repeated, has changed, and thus continually changes the total character of the pattern:

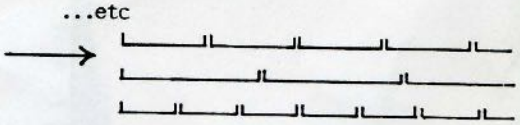
```
0.133 0.133 0.233 0.3 0.1 ....
  ↓     ↓     ↓    ↓   ↓
0.8   0.8   0.8   1.8 5.  ....
```

This kind of a circular list may be, for instance, the chord of the pattern where each tone during the process makes a glissando to the tone of a new chord.

My object is to produce a multilevel network of continually changing but controlled items. By these means, I can control also on different scales the same parameters, as if inside and outside a sound.

Generally taken, a continually changing but purposeful process can be produced by combining the different sized matrices of various parameters:

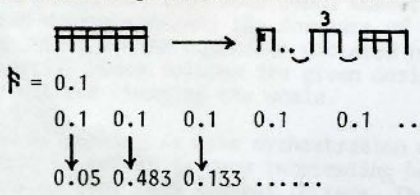
```
rhythm      0.133 0.133 0.233
            0.8   0.8   1.8
dynamics    ff    pp    pp    f   ff
            ff    mf    pp    f   pp
pitch       27.5  29.
            196.  194.
      ...etc
```



It is easy to control larger units, without losing grasp of the situations at the micro level. This makes possible the control of musical forms and a concentration on the realization of a larger scale formal thinking.

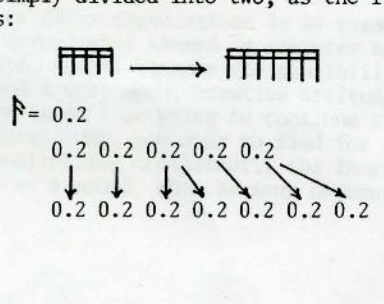
I would like now to present the rhythm part of this program, that, once adapted, stands as a basis for treating other parameters, as well. I wanted to have conditions where it is possible to repeat the same rhythmic pattern with smoothly changing tempos, and, at various speeds, to make interpolations between groups of different length and possibly of differing amounts of particles. I wanted to realize such musical dreams of mine that are easy and even characteristic for the computer, but impossible to realize as such in instrumental music. Another interesting aspect associated with this is to make research on a computer's and instrumentalist's interpretation of, for instance, the same rhythmic process, since these two instruments, because of their different natures, give emphasis to different aspects of a given model. I studied such ideas for the first time in my work " Verblendungen" (1982-84) for orchestra and computer tape, and I foresee many further possibilities in this direction.

In the realization, I had to modify in the first place the setting of the durations of the rhythm patterns and the rhythm matrix where the relations between various particles are defined. For example:



This example is a rhythm process where a rapid ostinato changes its profile little by little. The speed of the interpolation within the given total duration can be regulated by a given function of time, and various phases of transformation can as well be accentuated by giving them different durations.

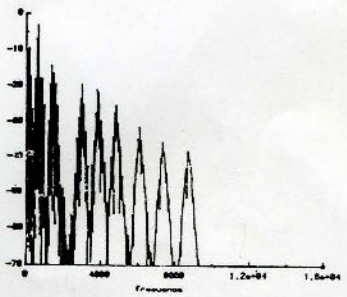
The following rhythmic interpolation differs considerably from the preceding, very organic, metamorphosis-like process. This interpolation takes place between two such groups that have different amounts of particles. The process like this is more capricious than the former one, and it is more difficult to shape. In the following, simple example an even ostinato of five notes changes into an ostinato of seven notes in such a way that two notes are simply divided into two, as the figure below shows:



Starting from this primary rhythmic model, the program has been extended to cover other musical parameters. Now all the parameters to which these kind of processes fit can be included within the limits of this program.

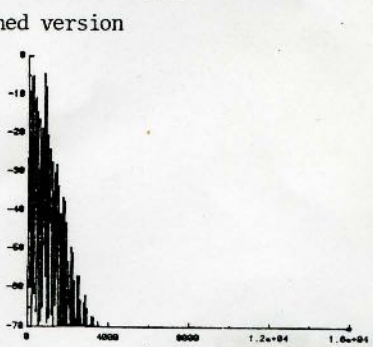
I wanted to adapt it next to the control of dynamics. Dynamic as an independent group, being of different length than for instance rhythm could form continual changing accents on rhytm.

For timbre, certain parameters can be chosen for the matrix group and others can be controlled with normal time functions and ramps, depending on needs and details. One of my objectives concerning timbre is to produce a precise timbre change on each tone. This kind of pointillistic texture can then be combined with interpolations of greater line occurring within other timbre factors or other parameters. I realized one application of this idea with what I call a stretching-matrix, in which I modify spectral envelopes by stretching and compressing formant frequencies (see the pictures below). Here each particle of a pattern has a formant structure that is different from the preceding one.



A spectral envelope in its original form

Stretched version



Compressed version

In the FOF synthesis technique, when the formmant banwidths are diminished and approaching zero, they become partials. This is a way to make additive-synthesis with the CHANT program, and provides an interesting way to make inharmonic sounds by taking any kind of spectral envelope and diminishing the formant bandwidths.

In my work I use different types of hierarchies for the evolution of bandwidths; I can have a general evolution during a phrase or a group of events, and another one inside a note.

One of the specific features of the CHANT program is the ease with which one operates on transformations from the physical model of voice or some other known instrument into abstract sound objects without recognizable identity. For me this axis is one parameter in the timbre domain. I have combined, for instance, breathing and voice-like materials with very bright, bell-like colours. The attenuation time or resonance time is a variable and here set to be long.

The matrix gives infinitely many possibilities for timbre. In the examples here I have chosen to work with only one spectral envelope, for which I use different stretching patterns for FOFs and filters.

This way of approaching a sound, "opening" it by making parameters independent so that a physical structure is exposed, is far from the traditional musical material. For instance, I created sounds where various timbre elements advance independently when two different times are used within the same sound. An example of this is a sound where the stretching-matrix controls the formants of the filter, adapting itself to the durations dictated by the rhythm matrix. Noise follows its given designated envelope without changing the scale.

This kind of working is like orchestration on a microscopic scale. It is very interesting because it sets thinking free from several fetters. The idea of realizing certain forms as well in a macro as in a micro structure is already completely possible for timbre as well as harmony. The matter in question is finding out solutions that are musically significant. These kind of multidimensional sounds cause trouble in vertical and horizontal organization. Movement within the sounds and the pitch relations that can already be heard really demands giving up traditional organization models. It seems unnatural to force such a material to conventional schemes, as musique concrète considers traditional music theory and for example choral settings strange. On the other hand, I don't believe either that there is a reason to give up all the traditional dimensions because of the new ones. One has rather to look openly and with musical sensitivity for new solutions that can gradually increase, born by new media.

For me, the pitch organization is at present one of the most complicated themes in computer music composition, simply because the possibilities are endless and a very open, creative attitude is needed to explore them. I am going to continue attempts in various directions, probably to find for instance ways of controlling consistently the inner and outer structure of a sound, when harmony becomes seamlessly assimilated in timbre. The strength of harmonic thinking lies in its ability to control forms and create tensions. That is why I have come to the idea of operating with various tunings and finding out ways of moving from one tuning to another. One way is like the rhythm interpolation described above, where the tones gradually move to the nearest tone of a new tuning. I'd like to find by various tunings new empirical substitutes for modulations and keys, by means of which music could be coloured in a certain hue. In any case, my aim is to totally unify harmonic thinking to timbre organization in my own work.