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COMPUTER SYNTHESIS OF SOUND APPLIED TO COMPOSITION WITH SONIC PROCESSES

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Computer synthesis of sound affords the composer with the possibility of applying compositional control at the level of the sonic processes, to control "sound structure in music", as R. Erickson puts it. This can be appropriate in compositions for tape alone, but also in pieces combining tape with live instruments : the sonic microcomposition in the tape part can then reflect or extend the macrocomposition in term of instrumental notes. In this presentation, I shall give sound examples of various sonic processes which I implemented in my own compositions, using M.V. Mathews' MUSIC V program.

One should not think that the MUSIC V program is restricted to the specification of quasi-periodic tones. The "note" concept in MUSIC V should not be likened to the instrumental note : one MUSIC V note may correspond to many subjective events ; conversely a single aural event may result from the fusion of many Music notes. The MUSIC V "note" triggers on and off, at prescribed instants, a Music "instrument", i.e. a combination of functional blocks, and specifies those parameters that have been left variable from note to note. The composer selects in advance his combination of blocks : those can be oscillators - audio or sub-audio, which put out a prescribed function and which can be modulated at will in amplitude, frequency or phase ; random generators ; mixers ; multipliers ; units giving as output a prescribed function of the input ; filters ; reverberators... New blocks can be added if desired. The functions can be defined in several fashions : as piece wise linear functions ; through mathematical formulas ; with graphic tablets, if available. These possibilities, compounded with personal compositional subroutines, extend the role of the MUSIC V score : not only does the score specifies in complete detail the physical structure of the sound ; it also serves as sonic structural notation, suggesting and facilitating specific sonic transformations and processes.

Here follow some sonic processes I used, illustrated in the presentation by musical ~~examples~~ excerpts.

1) "Spectral" transition from one pitch to another through non-linear distorsion (or waveshaping) (Arfib, Le Brun). The specification of a simple index controls a variable spectrum, which can coïncide either with the fondamental alone, or with a prescribed spectrum. This spectrum can be restricted to harmonic # n : in this case, the transition occurs between the pitches of harmonics # 1 and # n . I have used such transitions in my pieces "Profils" and "Contours", where the two pivotal pitches correspond to harmonics 1 and 11.

2) Compositional functions extending, e.g., serial procedures within the sound texture. Functions describing rows of pitches can be used in Pass III one can also define rows of envelopes. Thus these functions can merge intitely with the sound structure - they can be speeded up to the point where they determine a textural grain, or they can be compounded with other sonic processes (e.g. glissandi). I used this in "Mutations" and "Dialogues".

3) "Parallel" voices gliding in pitch with a constant frequency difference. This helps the components to fuse because of "common fate" ; it also animates the sound, since it yields a varying beat pattern. The harmony vanishes into a dominant pitch. Then this pitch can be associated with other pitches bearing the same relations as in the initial harmony, which is thus nested. The tone quality much depends on both the frequency spacing and the frequency region. I used this in "Little Boy", "Mutations", "Inharmonique", "Songes".

4) "Harmonic" development, generating harmonic and melodic material from a given chord structure. Subroutines can generate harmonics of the fundamental of a given chord. The emergence of the various harmonics can be controlled by the program to occur either in orderly fashion (like harmonic arpeggioes) or in arbitrary order (the score must then be defined in a quasi-graphical way). Thus vertical (harmonic) and horizontal (melodic) material both derive from the harmony, like harmonic emanations. This gave its title to "Mutations", (an allusion to the mutation stops of the organ) ; I used it also in other pieces.

5) Intimate transformation of the texture of inharmonic sounds with controlled harmonic content. Through additive synthesis, inharmonic sounds (e.g., bell-like sounds) can be composed like chords. Changing the envelope

from one with a sharp attack and a ringing decay into a gradually swelling and subsiding one will transform bell - like timbres into fluid textures with the same underlying harmony. One can thus foster either auditory fusion or auditory dispersion, focalization into dominant pitches or refraction displaying the harmonic "inside" of the sounds. I used this in "Inharmonique", "Songes", "Profils", "Passages".

6) Non stationary random processes - Complex stochastic processes (built up with complex combination of unit generators) can be monitored with curves. Random modulation can be used either in a "cosmetic" fashion (to simulate the chorus effect) or in a more structural fashion, as illustrated by Tenney, Xenakis and others. In the example (drawn from "Inharmonique") random variations are combined with a "skeleton" specifying the evolution in time of various parameters.

7) Beats, phasing, frequency modulation to "animate" harmonic textures. Although this might look like a purely "cosmetic" effect, it may serve to underline separately the components of the harmonic texture. For instance, one can approximate a chord by an incomplete harmonic series. Playing this harmonic series at frequency 55 Hz together with the same at frequency 55.1 Hz will cause a beat at the period of 10/n seconds for harmonic ## n . The emergences of the individual harmonics is reinforced by the addition of several equally spaced frequencies (55, 55.1, 55.2, 55.3 ...) as in the Fabry - Perot interferometer. I have used this in "Inharmonique", "Newton", "Profils".

8) Pitch and rhythm illusions. Through additive synthesis of octaves, one can convey pitch and rhythm illusions. I thus generated a tone which goes down the scale while it gets higher and shriller ("Little Boy", "Mutations") or a tone which speeds up and at the same time slows down ("Moments newtoniens"). Such illusions are not mere curiosities ; they deal with the nature of the sonic attributes we compose with - for instance they illustrate the duality of pitch (low-high dimension and pitch class).

9) Timbral transitions - Here it is suggestive to gradually go toward a well-known timbre. As was shown by Mc Nabb and Chowning, the singing voice can easily be evoked with a proper spectrum and careful pitch modulations (cf. "Passages"). If one wants a tone to keep a realistic (e.g. vocal) quality throughout repetitions and transpositions, one should carefully vary the parameters from note to note ; such variations can be implemented in a synthesis by rule process.

10) Frequency control through complex curves. For instance, curves specified through Fourier synthesis can be useful for frequency control : in "Songes" and "Aventures de lignes", I combined such fluid and bouncy curves with a discrete grid, thus suggesting the emergences of an underlying scale below the vibrant pitch continuum.

All these processes are easy to implement with a building-block synthesis program like MUSIC V. Designers of digital sound synthesizers should take in account the need to provide easy ways to reconfigure the synthesizer for implementing various sound models, and also the importance of programming structures facilitating the compositional specification of sonic processes.

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