How I realised the "Geometrische Patterns" from Herman Van San's Opus Electronicum (1956/57)

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Herman Van San (19?? - 197?) is a composer whose works have become available only very recently, thanks to the work done by Prof. Herman Sabbe (RUG), who maintains the hereditage of his works. One of these long kept jewels is his Opus Electronicum (1956/57), a series of electronic pieces elaborated in technical scripts. Of these pieces, the "Geometrische Patterns" seemed to be the most completed one, ready for realisation.

The "score" of these "Geometrische Patterns", or "Drehbuch" as Herman Van San calls it, consists of four distinct parts. The first one describes the 24 "Spektrale Strukturen" used. The second chapter similarly describes 48 "Hz. Patterns" and 48 "dB Patterns". The third section "Operationen" is a kind of a playlist giving the order in which to use these "Spektra" and "Patterns", bundled into 10 "Sätze". This is in fact the core description of the piece itself with its 10 movements of varying durations. The last part "Symbolik" explains all abbreviations and symbols used throughout the "score". This section actually contains the keys to a better understanding of the preceding chapters.

Each of the "Spectrale Strukturen", as explained in chapter 4 of the "Drehbuch", consists of 4 different sound sources. Each of these 4 sounds has a different nature[1] and is used with different types of reverb[2], giving a total of 12 different sounds. These are assigned to a quadraphonic sound system[3]. Because of the very nature of these sound sources, CSound appeared to be the best choice for implementing, as they all are already built in[4].

But here also the first problem appeared: which pulsewidth does he need? A closer look at the first page of Section 4 "Symbolik" shows some additional remarks[5]. So, since all durations are expressed in tapelengths, with 200 cm as a reference[6], there are 100 pulses per 200 cm, which gives ± 38,5 Hz if played back at original recording speed.

Next problem is the quantity of metalplate and reverb to use. Here, since the "score" doesn't give any more information, Prof. Sabbe agreed to let musical taste judge, as Herman Van San would probably have proceeded himself while realising the piece..In average, I used a standard 2,5 sec reverb, and a comb filter with a clear metallic color, which I adapted manually for each individual Spectrum.

[1] Sine, White noise (width 25 Hz), Pulse, Pulse of white noise (width 25 Hz)
[2] pure, with metalplate reverb, with metalplate + traditional reverb
[3] l1, l2, l3, l4 in the Spektrum descriptions
[4] 'oscil' and 'noise' for the sound sources, 'comb' and 'reverb2' for the plate and the reverb; pulse was easily implemented with a simple wavetable
[5] 2cm = 1 Impulse, followed by a mathematical formula which converts this into a frequency (Hz).
[6] Recording speed is 76.2 cm/sec, as indicated in Chapter 4, so 200 cm lasts for ±2,6 secs

Once this was all decided, the realisation of the 24 Spektra was pretty straightforward. For each of the 12 sounds comprised in a Spectrum, the manuscript clearly indicates where it should start, how long it should last, which frequency and dynamic level it should have. Except for a few anomalies, which of course, I had to correct[7].

As far as the "Patterns" are concerned, a page added to Chapter 4 clearly indicates the dB-patterns (originally in a range -50 dB to +10 dB) have to be recalculated to a range of -40 dB till 0 dB[8]. But which type of modulation did he have in mind? Since Frequency Modulation (FM) didn't exist yet, it was most probably a kind of Ring Modulation[9], a technically and mathematically very simple procedure, very popular in early Electronic Music, especially in the 60's, which can produce very complex sounding results. In that case, the dB Pattern would probably indicate the Modulation depth, since otherwise he would get a dynamics range from almost 100 dB[10], which is virtually impossible, even on a CD! So, after contention with Serge Verstockt and Lieven Bertels, we finally decided to implement definitely as Ring Modulation with the given Hz Pattern, using the dB Pattern as the modulation depth.

Next step was to implement the very piece of music. At first glance this was very easy. The first Satz e.g. is built in 48 fragments, for each of wich the duration is given in tape-cms. Also the Spectrum to use is clearly indicated. However, how do I go from the original 200 cm tapelength of the Spectra to the indicated tapelengths. First reaction was to just alter the playback speed. But Van San doesn't give a speed in cm/sec, as he does starting from Satz 2.

So, perhaps, I should just add as many copies of 200 cm Spectra as needed and cut off the unwanted remainder in order to achieve e.g. 384 cm (= 2 * 200 cm, then cut off 16 cm). This is exactly what he describes in Chapter 4 as "Redundanz": first transpose with the proper playbackspeed (cm/sec), which yields a base length "Resultierende

[7] In Spectrum 1.1 and 1.3, the first sound component should last for 140 cm, whereof 120 cm to diminish from -6.5 dB to -27 dB, and 30 cm to go from -27 dB to -49.5 dB, giving a total of 120 cm + 30 cm = 150 cm (!). As it turns out that these 200 cm-based lengths are in fact a recalculation of 89 cm-based lengths, I changed these 120 and 30 cm to 115 cm and 25 cm, thus keeping approximatively the same proportions as in the old 89 cm-based (51 cm + 11 cm) durations. A similar problem is found in sound component 3 of Spectrum 2.1 and 2.3: 55 cm + 115 cm is only 170 cm (the length of soundcomponent 2), as is 123 cm + 47 cm. Since Van San corrected in the timetable this 170 cm to 174 cm himself, I decided to make 55 cm + 119 cm for the pitch, and 123 cm + 51 cm for the dynamics, in order to keep the tape-lengths 51 cm and 55 cm similar to the dynamics of sound component 4 and the pitch of sound components 1 and 5. In fact Van San always uses quite similar tapelengths throughout his Spectra. Which of course gives a very strong musical unity, as sound events get constantly similar durations in their components. Another missing element is the pitch data for sound component 2 in Spectrum 2.3. As it turns out, Spectrum 2.3 is the inversion of Spectrum 2.1. So, I took 8896 Hz as the summit of the first glissando in analogy with the pitch of sound component 6 of both Spectrum 2.3 and 2.1, and 4448 Hz in analogy with the pitch of sound component 3 of both Spectrum 2.3 and 2.1.
[8] A very usefull correction, since modulating up to +10 dB would inevitably have introduced saturation, whereas modulating as low as -50 dB would have been barely audible!
[9] A simple multiplication of two sounds. With analogous gear, realised with a transformator where both sources are connected to two independent primary windings, and the output to the secondary winding; with digital techniques a mere samplewise multiplication of both sources. Generates sum and difference frequencies between all spectral components of both sounds.
[10] 60 dB already in the Spektra itself + 40 dB of the dB Patterns

t”[11] , and then calculate Redundanz. But he only wants this to be done in Sätze 2-3-5-6-8.

In fact, for the first movement, he says: t von S umrechnen nach der Formel: “Resultierende m oder n = Operations-t/200 * m oder n von S”, which means he wants to recalculate all time parameters (“m” and “n”) to the desired length (“Operations-t”). This is real *time-stretching*[12]! A technique which, as far as we know, wasn’t available in his time. And for which, in his case, there would only be one solution: recalculate the Spektra and regenerate them, for each desired length!

Similar for the Hz and dB Patterns. However, Satz 7 is a special case. Here Van San indicates a playback speed of 95,2 cm/sec for Hz and dB Patterns, which results already in a duration of 160 cm. So, here those Patterns definitely become transposed too!

In Satz 9, Van San indicates a duration of 186 for Nr. 321, 330, 346 and 353. Since this is the only occurence of a duration which can’t be divided by 4 (necessary for the Patterns), and in his way of writing, a 9 could be easily mistaken for a 8, I substituted durations of 196 for those 4 Nr.’s.

Luckily, with CSound, the realisation of all this was not too time-consuming. I introduced a scaling factor with each time parameter[13], with the very same result as the desired time-stretching. I introduced a scaling factor for the frequency parameters, with the very same result as the different playback-speeds + “Oktave-Transposition”[14]. The overall scheme of the orchestra file[15] was rather simple: only 4 instruments. The first instrument implemented the 24 Spectra, with independently scalable pitch and time factors. The second and third instruments implemented the Hz and dB Patterns, both with independently scalable pitch and time factors too. The fourth instrument played everything together, applied the Patterns and added reverb (“ ” in the “score”), with the decay time scalable in function of the playback speeds (cm/sec). The score file contained the data from Chapter 3 of the “Drehbuch”.

After having compiled the piece for the first time, I had a rather strange experience. Everywhere where I made a mistake in one of the parameters, the piece just sounded wrong! Which of course made it far more easy to correct them. Another bizar discovery was that, while I first tried to implement the piece with the best possible sound quality, this sounded wrong too. Van San definitely really used the technical limitations of the equipment of his time, so I had to implement these too. I dampened all quick transitions in dynamic levels with 1 msec[16], plus I introduced a lowpass filter at 20kHz[17]

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[11] e.g. playback at half speed will give double length
[12] only making it longer, without transposing
[13] calculated automatically from the desired length
[14] here too: calculated automatically from the other parameters
[15] it’s a pity, but a severe harddisk crash caused me to loose the original CSound files, luckily after the whole piece had been generated successfully.
[16] causes a feeling of “spikes” with digital techniques; in Van san’s time, tape slowness would anyway have dampened them
[17] in digital technique necessary anyway to avoid problems with the Nyquist frequency (22050 Hz). And in Van San’s time, those high frequencies would anyway have been filtered out automatically by the limitations of the electronic equipment.

So finally, after having generated the complete quadraphonic piece and before mastering it on a digital multitrack tape[18], I only had to mix it and to determine the timing inbetween the movements. And of course, I made a stereo mixdown on standard CD too, which is now available at Matrix.

[18] a Tascam DA88