Visualising Sound – Sonifying the Visual

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Abstract

The sound of music can be linked with the visual in diverse ways, for instance

1) technically, attempting
   a) human performance by means of a *prescriptive* performance score,
   b) graphic depiction in a *descriptive* function
      (typical in electroacoustics, e.g. Ligeti's *Artikulation* or Stockhausen's *Electronic Study II*), sometimes prescriptively as part of a sort of (re-)construction kit

   or

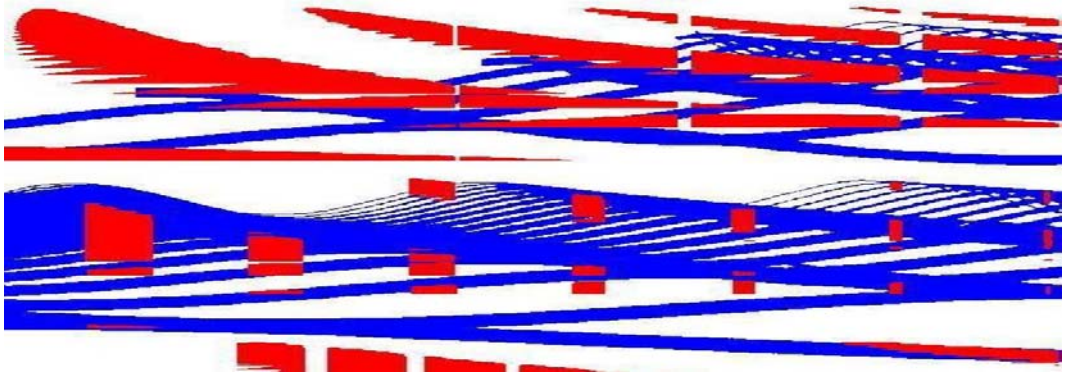
2) aesthetically, through
   a) sound *visualisation*, whereby sound-derived images satisfy,
   b) image *sonification*, whereby image-derived music satisfies,
      heightened in both cases by a comparison of source and result.
      In multimedia such as film it could be the counterpoint of sound and image that pleases, especially when clearly bonded to another as when visualisation or sonification is involved.

In the above, the vectors prescription-description and visualisation-sonification work both ways, i.e. a prescriptive score is potentially descriptive, and one could (re-)imagine a visualised sound aurally, a sonified image visually.

In this paper I illustrate (syn-)aesthetic aspects through my own work of several decades; I have long been fascinated by sound-image links involving Position, Motion and Color, all three musical aspects also basically spatial and ultimately visual: texts on music include terms like "high/low", "fast/slow" (spatial terms – cf. "andante", which means "walking") as well as "bright/dark" and "sound-color". Since over thirty years ago I have repeatedly been drawn to enacting these parallels. The first five examples are of sound visualisation, the last five of image sonification.

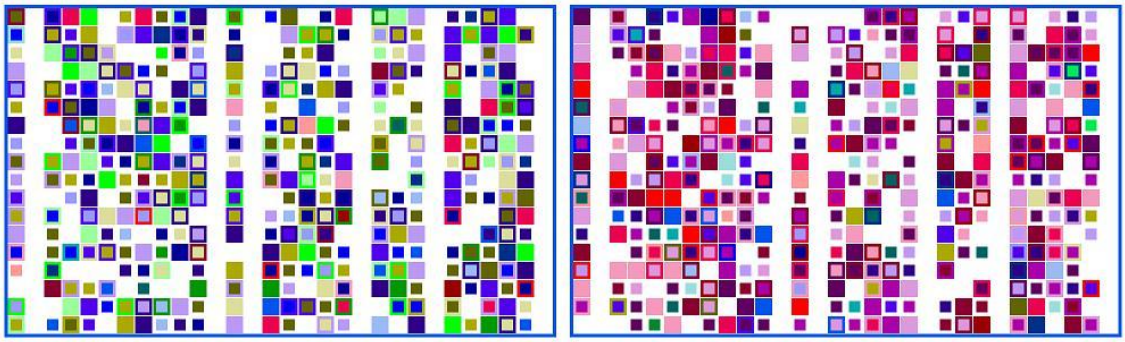
I. Sound visualisation

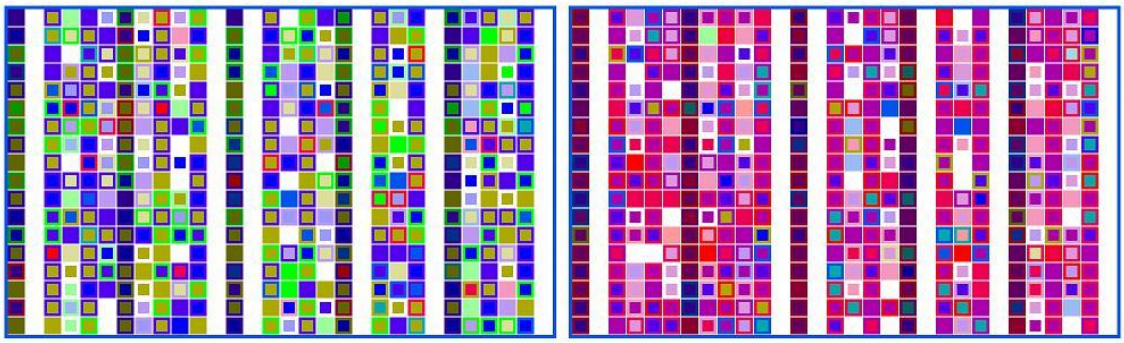
1. *Sinophony II* (1972) for 8-channel sound reproduction



Sinophony II, a purely electronic octophonic composition consisting wholly of sine-tones (hence the title) was realised in the EMS studios Stockholm in December 1972. Just after the audio realisation, I envisioned a graphic study score and plotted the same on Cologne University's central computer during early 1973. The result was released as an A2-poster by my publisher Feedback Studio Cologne in the summer of 1973. Above is a recent reconstruction of the first two minutes of tracks 5 and 6 (18-1500 Hz approx.) in red and blue, respectively. Each sine tone is depicted there as a horizontal strip, its bottom edge showing the frequency as measured vertically, its width giving the amplitude.

2. *Relationships* (1974) – *Version 4* (1976) for two pianos

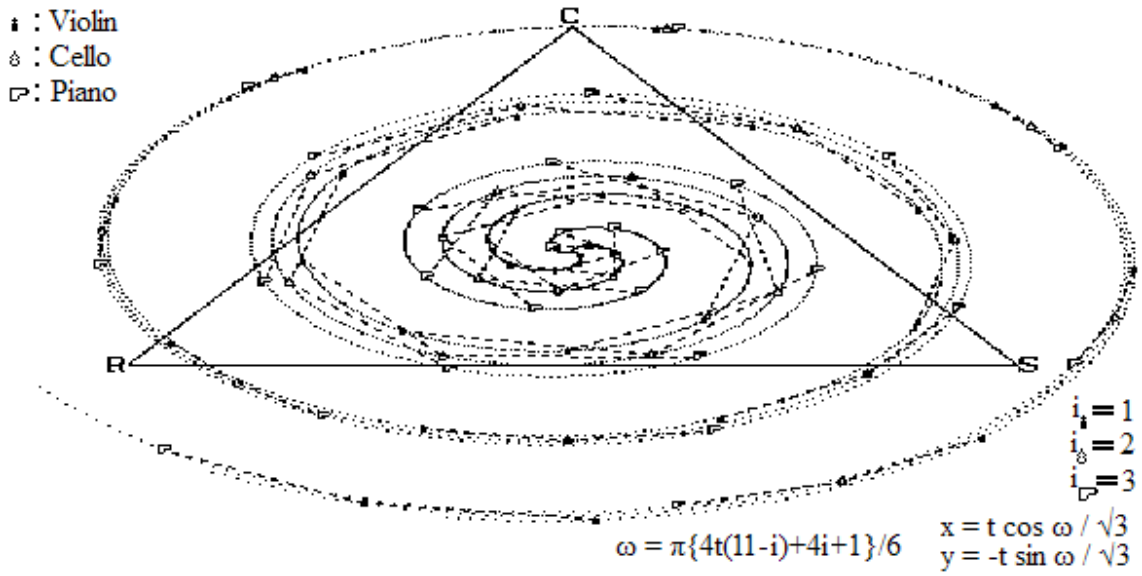




Here the twelve classical chromatic pitch-classes were probabilistically distributed so as to create pitch- and pulse-fields of variable tonality and metricism. Concurrently I planned a visualisation: the twelve pitch-classes would be shown by the well-known 12-color circle with B in red, G in yellow and E-flat in blue. The admixture of white, black or neither would show three dynamic levels. The thirty-pulse metric cycle would be shown as a row of 30 double squares, a small one for piano #2 inside a larger one for piano #1, each cycle by a new row of squares. 30 pigments (for three dynamic levels of 10 notes – D and E are missing in the piece) were made by mixing different amounts of red, yellow, blue, white and black and applying the mixes to self-adhesive white paper labels, but the next step – manually sticking about 70,000 hand-colored labels to sheets of paper – stumped me. I gave up, and after about 25 years color-programmed in Linux the four sections shown above: the two at the top are ametrical, those at the bottom metrical (seen by the vertical columns), the two at left atonical, those at right tonical (seen by the dis-/similarity of color).

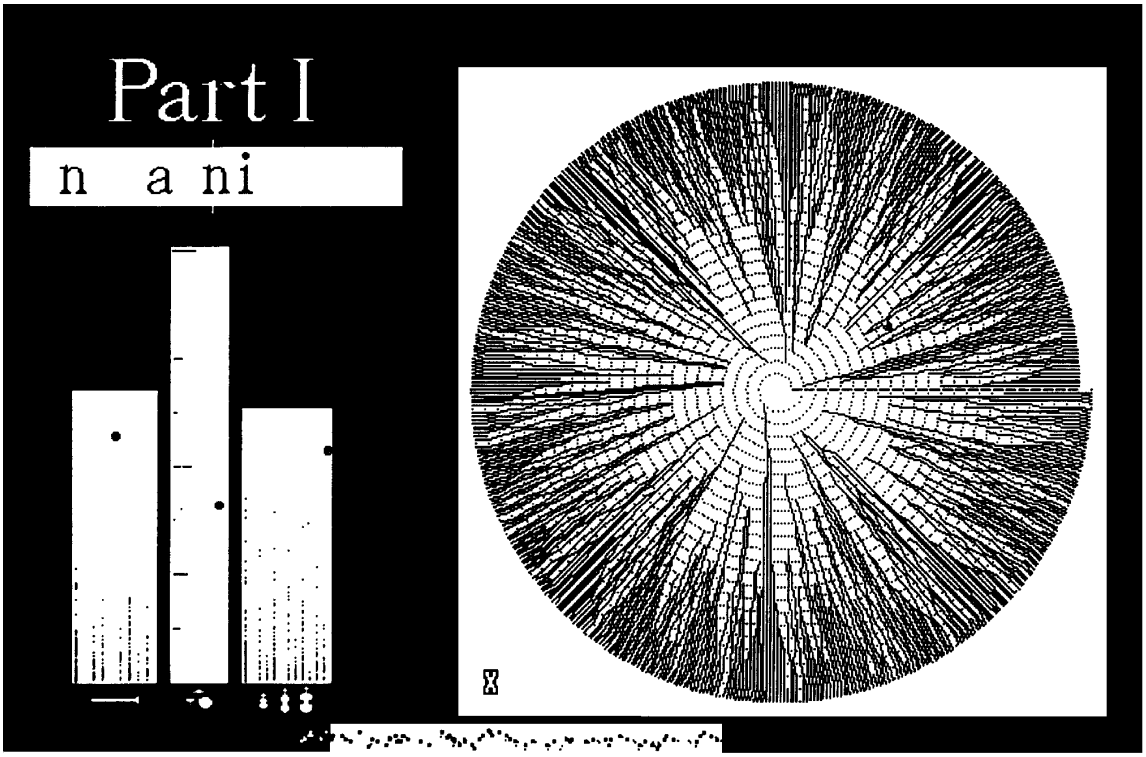
3. *1981* (1981) for Piano Trio

The music of each of the three instruments of this piece – 1. Violin, 2. Violoncello and 3. Piano – resulted from the statistic manipulation of the corresponding instrumental parts of the first movements of the following three works: *La Chasse* by Clementi (in C, 1788), Schumann's *2nd Piano Trio* (in F, 1847) and Ravel's *Piano Trio* (in A minor, 1914). The movements all begin together and finish about forty seconds apart in the order Clementi, Schumann and Ravel. The diagram following depicts the compositional makeup of the piece with the instruments shown as periodic icons along spiral arms: at the beginning, all three – at the midpoint of the graph – have equal amounts (33%) of each composer's music, because the proximity of an icon to an apex of the Clementi-Schumann-Ravel triangle corresponds to the proportional amount of the music of that composer.



4. *Im Januar am Nil* (1984) for chamber ensemble

Im Januar am Nil (="In January at the Nile") was written in 1981 for two soprano saxophones, percussion, a piano, four violins, two cellos and a double-bass. In 1993 I made a MIDI-realisation using instead of sampled instruments only classical electronic sounds – sine, sawtooth, square and pulse waves as well as filtered white noise. In 1999 I also made a video film to match this synthetic realisation, of which one frame is shown below.



Through the piece runs a melody repeated 24 times, growing each time both in length and density, new tones appearing in the expanding gaps. An initial single note develops into a melody played at first almost inaudibly by the bass clarinet, amplified by overtones heard as natural harmonics in the strings: the resultant phonetic timbre is based on an analysis of German phrases comprising only harmonic spectra (e.g. the title itself), viz. liquids, nasals and semi-vowels. The rhythmic plan is seen as a spiral, each arm matching one run-through of the melody. The "ball" in the 10th arm at about two o'clock is at the pulse current to this frame. The dots at mid-bottom reflect the pitch of the 10th generation with the moving left edge of the black-on-white part at the current pulse. The text below the words "Part I" displays phonetic elements currently audible. Finally the three boxes at left show interjections by the winds, percussion and strings: whenever one of the moving balls touches one of the dots in the strips therein, a loud sound is emitted by the corresponding instrumental group.

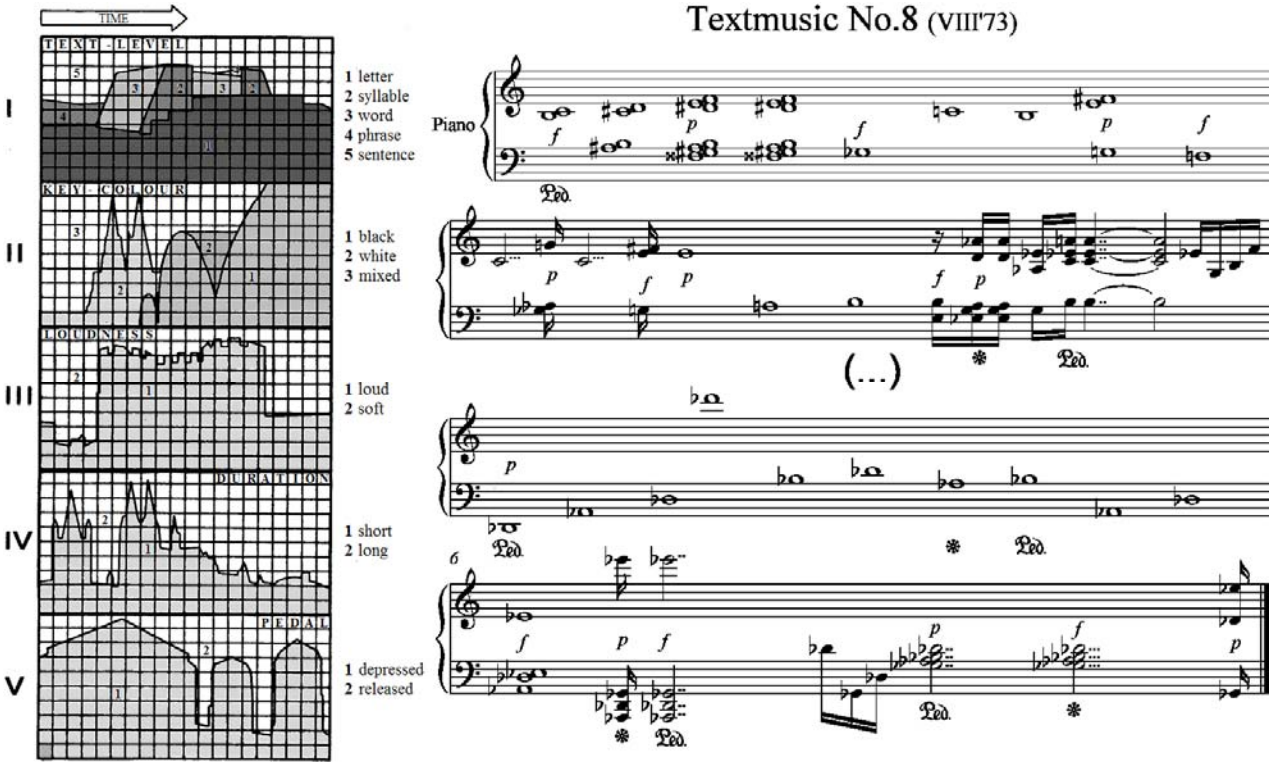
5. *...until...*(1972) – CD-Cover design (2003)

Conceived in 1972, this piece consists of a cyclic melody, its pitches initially consonant to a constantly sounding drone, then gradually giving way to more dissonant ones; near the end, a slight gliding pitch-adjustment of the drone reveals the new pitch set as a pitch- and phase-shifted transposition of the original. The to date nine versions of *...until...* are for instruments ranging from solo violin or guitar to a jazz group or an ensemble of North Indian musicians.

When designing in 2003 the cover of a projected CD of Versions 5, 7 and 8, I decided to apply the compositional principle to pixels instead of notes: a photo by Behr de Ruiter of Amsterdam buildings facing the electroacoustic music institute STEIM was separated into its red, green and blue pixels. Each of these monochromatic images was then faded from left to right into an x- and y-shifted version of itself – one can see how the gables on the left gradually "dissolve" into the sky at right, where new gables form more solidly a bit below to the left. The three new pictures in their respective red, green and blue were then merged to form the CD cover picture seen above.

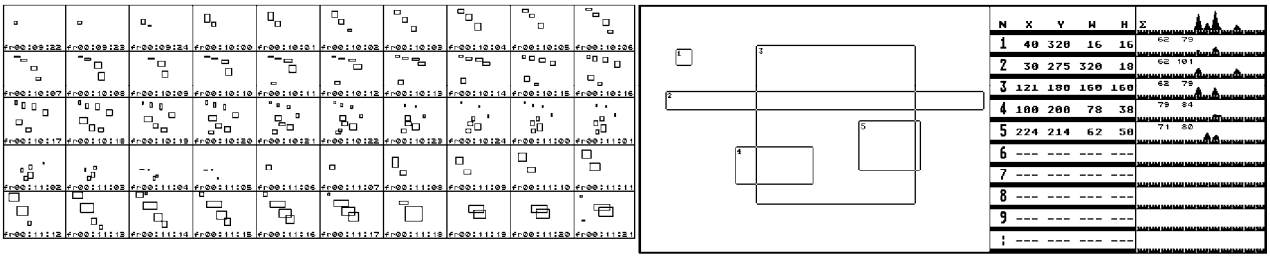
II. Image Sonification

1. *Textmusic for piano* (1971) – plan for and beginning and end of *Version 8* (1973)



This 8th of 15 versions of *Textmusic* (a set of piano pieces based on texts) stems from a poem in Cologne dialect (a Moselle-Franconian language akin to Dutch) variously praising the virtues of that city. Postcards of I. the Opera House, II. the Cathedral and the Hohenzollern Bridge, III. the West Gate of the mediaeval city, IV. a Rhine panorama with the Cathedral and the Church of St. Martin Major, and V. the Church of St. Gereon were applied as parametric curves (see the diagram's left side). The result bears audible links to these curves; e.g. curve II prescribes an initial key-color distribution of 90% mixed (i.e. chromatic) and 10% white (diatonic) and a final one of 100% black (pentatonic) keys – due here to the proximity of the bridge at the picture's right end – as borne out by the scored examples on the right: the upper shows the beginning, the lower the end of the piece.

2. *Estudio Siete* (1995)

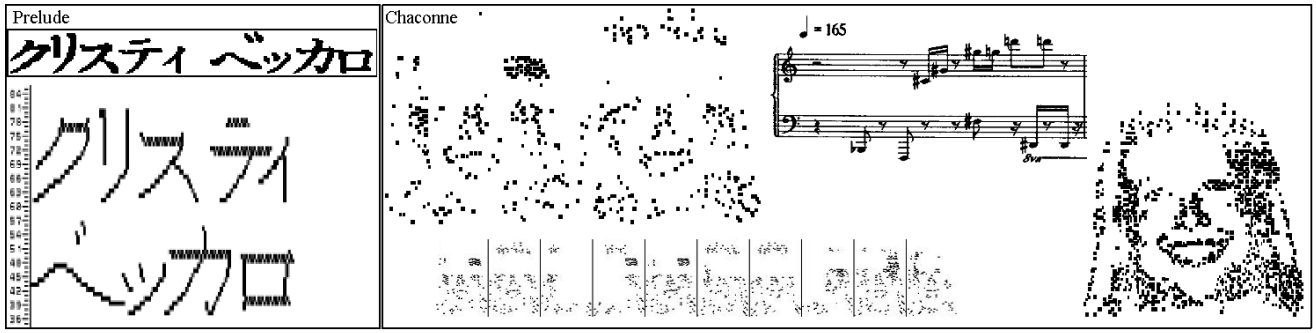


In 1995 I was commissioned to contribute to the "100 Years of Film" festival of the Bonn Kunsthalle with music to be synchronised to the 1930 film *Study No.6* by Oscar Fischinger. The original music by Jacinto Guerrero, to which Fischinger had synchronised his images, was to be confronted by a more contemporary work.

One of the layers of the composition is a metamorphosis of Fischinger's dancing objects; here I effected a phonetic linkage between the shape of the objects and the sound color of a resulting tone-cloud – horizontally stretched shapes yielded (as does the human mouth) an [i] ('ee') sound, squat shapes an [u] ('oo'), with sonic interpolations for in-between shapes.

Estudio Siete (Spanish for "Study" or "Studio" No.7) was composed in Cuenca near Madrid and realised in the studio that I used to head in the Royal Conservatory The Hague (Studio 7). It is best heard film-synchronised on a player piano.

3. *Kuri Suti Bekar* (1998)



Written for the pianist Kristi Becker, *Kuri Suti Bekar* consists of a Prelude and a Chaconne.

The twelve-second Prelude is a sonic translation of the pianist's name written in Japanese Katakana script (see the left of the diagram) – the right hand plays [ku-ri-su-ti] and the left [bek-ka-ro] simultaneously, the vertical axis being that of pitch and the horizontal that of time.

A similar graphic pitch/time representation of the Chaconne at mid-bottom shows successive "scans" of the ten pages (16 seconds each) of the score, the first two pages seen again at center left, the first bar scored at center right. A superimposition of the ten images approximates a scanned photograph of the pianist's face (far right).

4. *Les Ciseaux de Tom Johnson* (1998)

Instructions for manufacturing *Les Ciseaux de Tom Johnson*

1. Write the letters T, O, M, J, O, HN, S, O, N from left to right, their alphabetical order reflected in their position from bottom to top.

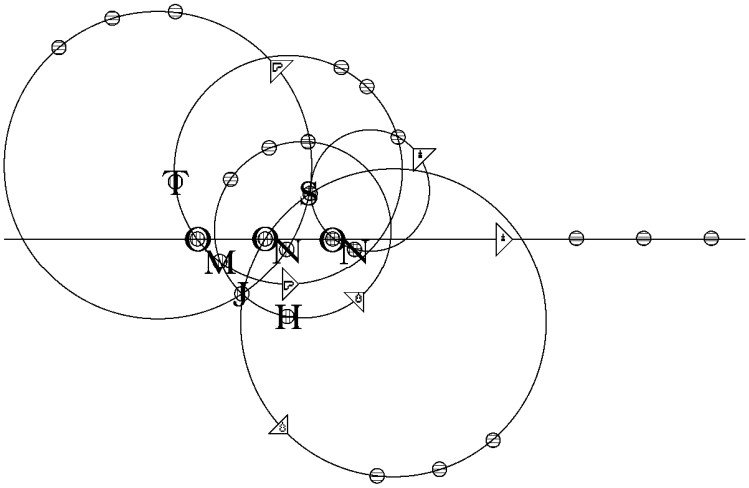
2. Sketch six circles through the letter combinations 'TOM', 'MJH', 'JOS', 'JNS', 'SON' and 'OOO', the last group in a straight line, i.e. an infinitely distant-centred circle.

3. Allow the six letter combinations to move anticlockwise along their respective circles by $1/90^{th}$ of the circumference of the smallest ('SON'-) circle: doing this 90 times in all causes all groups to traverse variously sized angular distances, 'SON' going full circle.

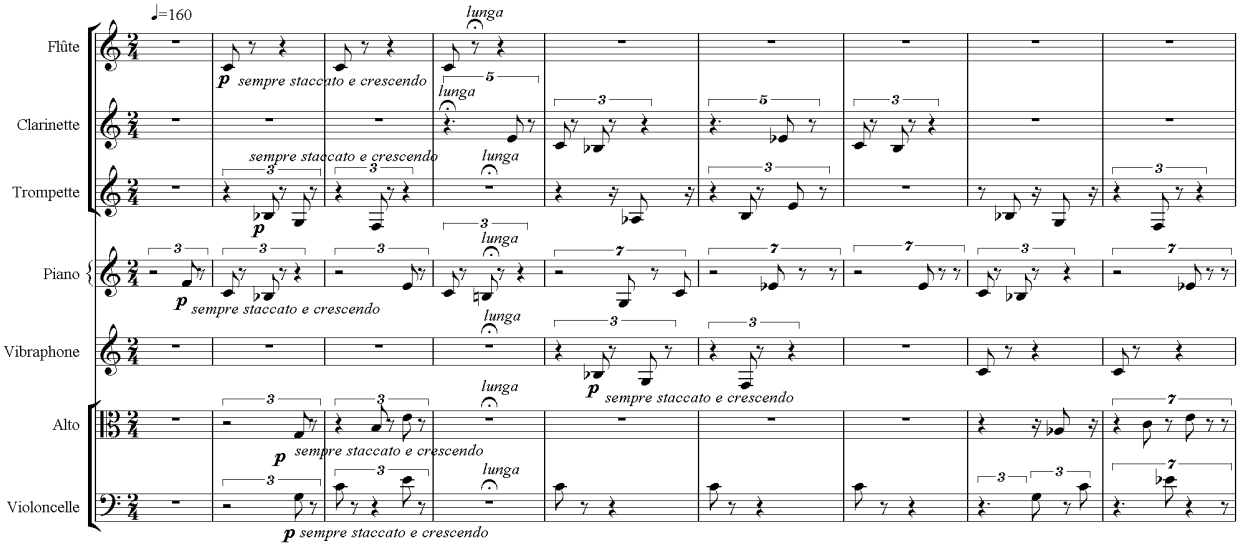
4. Scan the 91 obtained configurations each by an imaginary vertical line moving smoothly from left to right: the height of all letters encountered by the line gives pitch (alphabetically chromatic), the moment of the encounter gives time: the pitch-time interpretation yields a musical "mini-score".

5. Place the 91 mini-scores along a time axis, such that the time gap between any 'OOO' group and the next is equal to the gap between the 'O's in themselves, i.e. so that all 273 (=91x3) 'O's are temporally equidistant. Insert a small pause at the end of the first mini-score.

Voilà, *Les Ciseaux de Tom Johnson* is complete! (see the score for an example of the first nine bars)

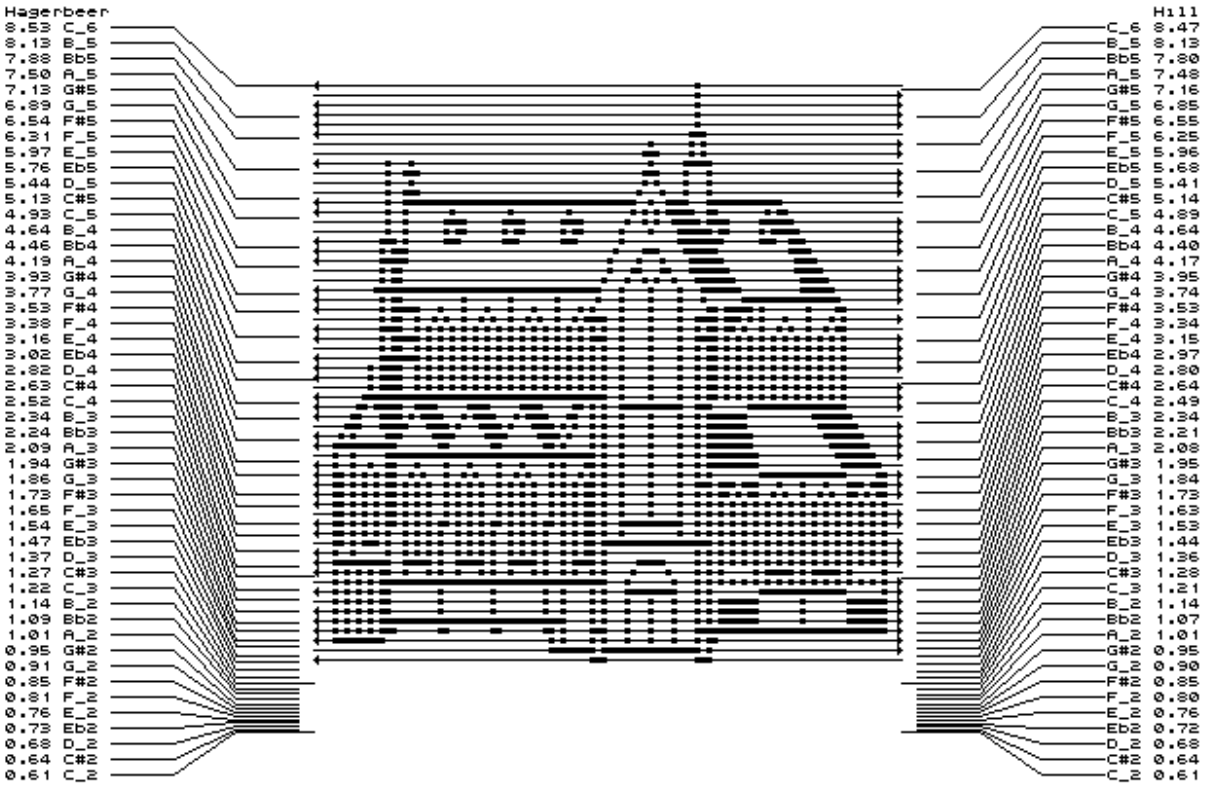


Les Ciseaux de Tom Johnson



5. *Le loup en pierre* (2002) for two organs

This piece (="The Stone Wolf") was composed for the two organs in St. Peter's Church in Leiden, the mean-tone-tuned Van Hagerbeer organ with A=419 Hz and the equal-tempered Thomas Hill organ with A=440 Hz. The first section of the piece involves a sonification of a sketch of the church building, calibrated to the so-called Bark scale of subjective pitch (see the upper picture on the following page): the pixels in the sketch are allocated to those keys on either or both organs, the Bark pitches of which are the closest. The building, graphically rescaled to the MIDI-scale (see the lower drawing), now provides the first 97 chords, initially filtered by a horn shape centred on pitch no.68 = A-flat, the only note common in pitch to both organs. Starting with this pitch, the range gradually widens to large microtonal clusters engendered by the central Gothic window.


Hagerbeer
8.53 C_6
8.13 B_5
7.88 Bb5
7.50 A_5
7.13 G#5
6.89 G_5
6.54 F#5
6.31 F_5
5.97 E_5
5.76 Eb5
5.44 D_5
5.13 C#5
4.93 C_5
4.64 B_4
4.46 Bb4
4.19 A_4
3.93 G#4
3.77 G_4
3.53 F#4
3.38 F_4
3.16 E_4
3.02 Eb4
2.82 D_4
2.63 C#4
2.52 C_4
2.34 B_3
2.24 Bb3
2.09 A_3
1.94 G#3
1.86 G_3
1.73 F#3
1.65 F_3
1.54 E_3
1.47 Eb3
1.37 D_3
1.27 C#3
1.22 C_3
1.14 B_2
1.09 Bb2
1.01 A_2
0.95 G#2
0.91 G_2
0.85 F#2
0.81 F_2
0.76 E_2
0.73 Eb2
0.68 D_2
0.64 C#2
0.61 C_2
Hill
C_6 8.47
B_5 8.13
Bb5 7.80
A_5 7.48
G#5 7.16
G_5 6.85
F#5 6.55
F_5 6.25
E_5 5.96
Eb5 5.68
D_5 5.41
C#5 5.14
C_5 4.89
B_4 4.64
Bb4 4.40
A_4 4.17
G#4 3.95
G_4 3.74
F#4 3.53
F_4 3.34
E_4 3.15
Eb4 2.97
D_4 2.80
C#4 2.64
C_4 2.49
B_3 2.34
Bb3 2.21
A_3 2.08
G#3 1.95
G_3 1.84
F#3 1.73
F_3 1.63
E_3 1.53
Eb3 1.44
D_3 1.36
C#3 1.28
C_3 1.21
B_2 1.14
Bb2 1.07
A_2 1.01
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D_2 0.68
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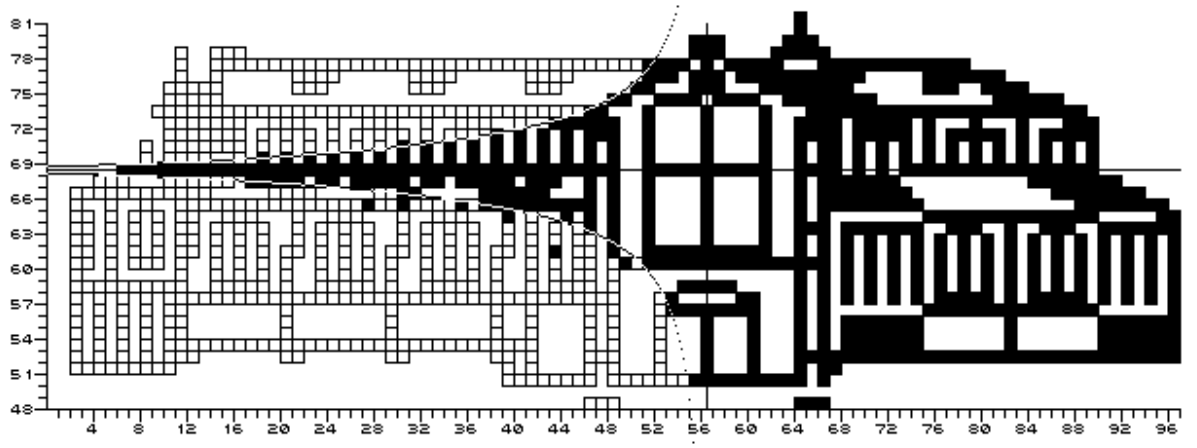
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