# Musica Visualis:
# On the Sonification of the Visual and the Visualisation of Sound

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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 (typical in electroacoustics) in a *descriptive* function, 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 the above, the vectors prescription-description and visualisation-sonification work both ways, i.e. a prescriptive score is potentially descriptive, and one could 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 Colour, musical aspects also basically spatial, ultimately visual: texts on music include terms like "high/low", "fast/slow" (spatial terms – see also "*andante*", which means "walking") as well as "bright/dark" and "sound-colour". Since over thirty years ago I have repeatedly been drawn to enacting these parallels. The first three examples are of sound visualisation, the last three of image sonification.

## Keywords:

Visualisation, sonification, probabilistics, graphs

## I. Sound visualisation

1. *Sinophony II*

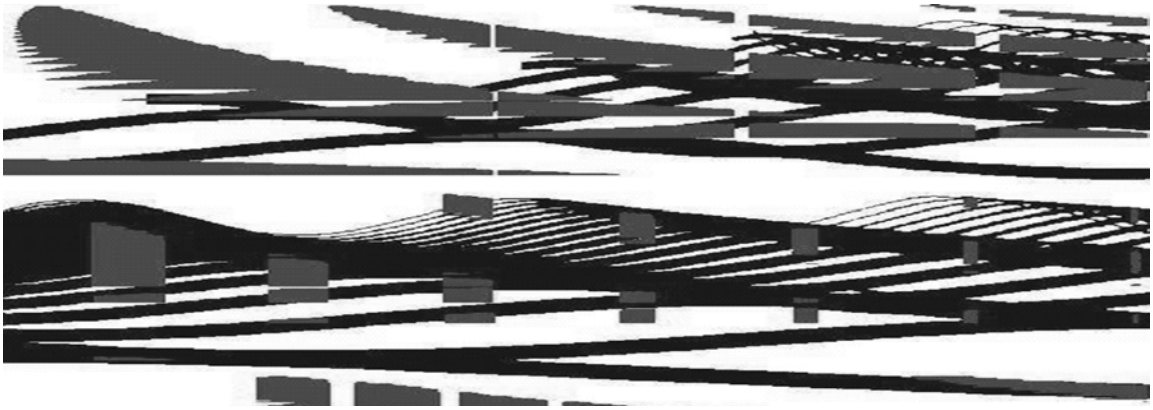

**Figure 1** – A graphic depiction of a part of my octophonic piece *Sinophony II* (1972): x=frequency, y=time.

*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 at 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. Figure 1 on the previous page shows a recent reconstruction of the first two minutes of tracks 5 and 6 (18-1500 Hz approx.) in two shades of grey. 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

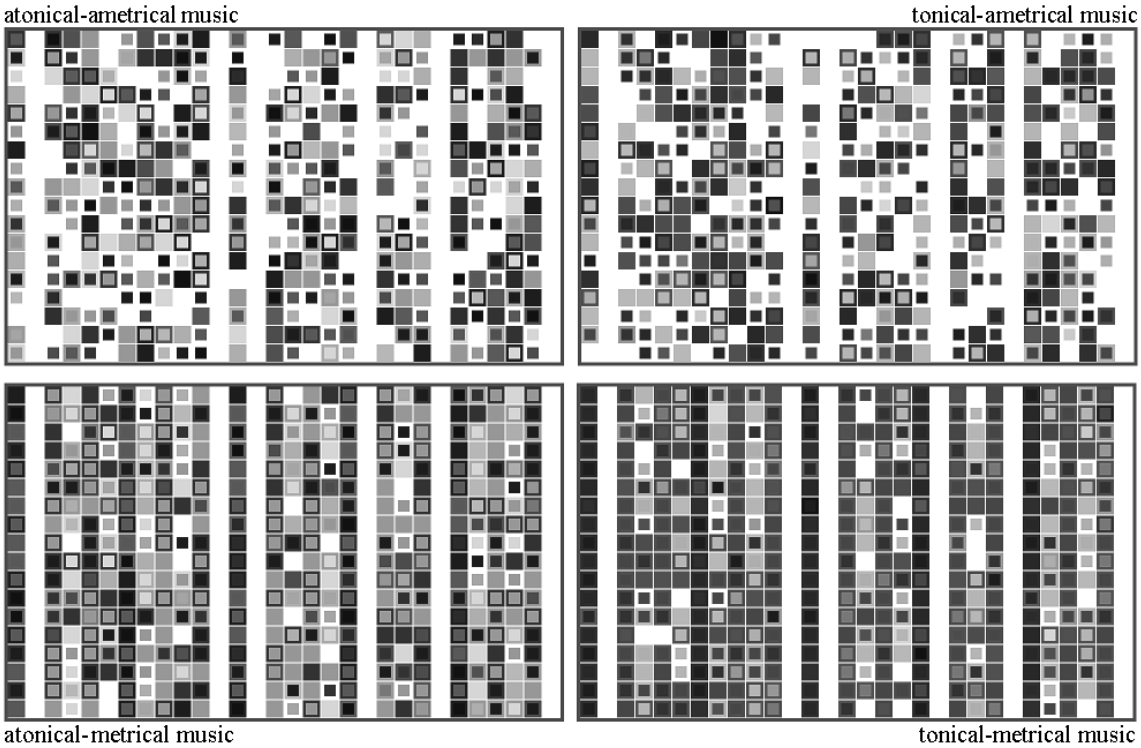


**Figure 2** – Four visualised sections of *Relationships* Version 4 (1974)

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-colour 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 (the 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-coloured labels to sheets of paper – stumped me. I gave up, and after about 25 years colour-programmed in Linux the four sections shown above in Figure 2 in grey-shades: 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 similarity of shade).

3. *1981* (1981) for Piano Trio

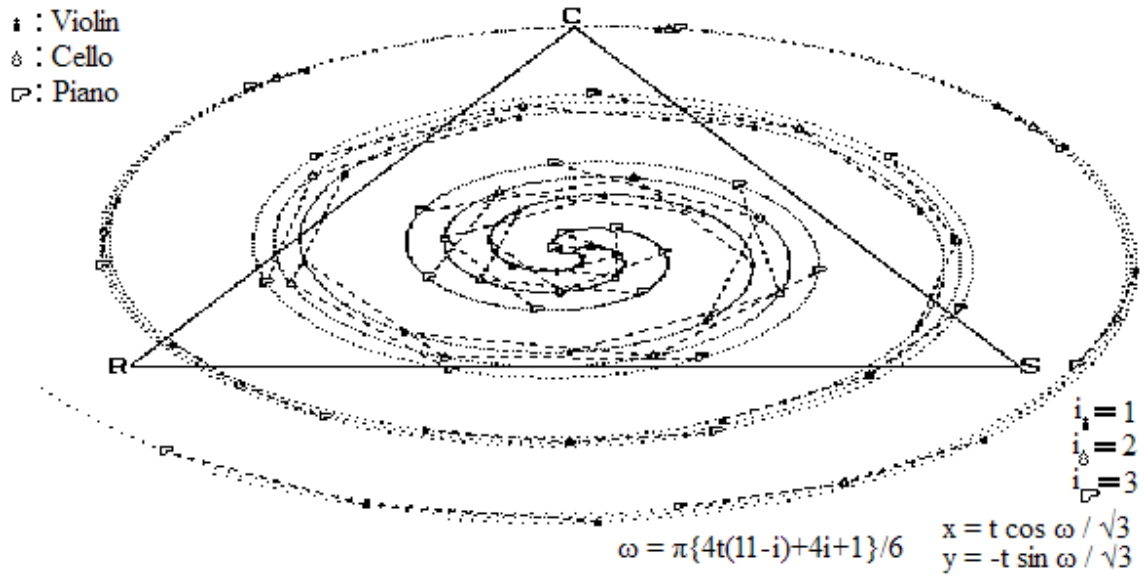


**Figure 3** – Spiral statistical distribution of the music of Clementi, Schumann and Ravel in *1981* (1981); the variables ω (direction from centre), t (time), i (instrument), x and y (Cartesian coordinates) generate the graph.

The music for each of the three instruments of this piece – violin, violoncello and piano – resulted from the statistical manipulation of the corresponding instrumental parts of the following three works: *La Chasse* by Clementi (1788, in C), Schumann's *2nd Piano Trio* (1847, in F) and Ravel's *Piano Trio* (1914, in A minor). These works' first movements were placed with all three beginning together and finishing at intervals of about 40 seconds in the order Clementi, Schumann and Ravel. Figure 3 here above illustrates the composition of the piece with the instruments shown periodically as icons along spiral arms: at the start, all three – at the centre of the graph – have equal amounts (33%) of each composer's music, because an icon's proximity to a particular apex of the Clementi-Schumann-Ravel triangle corresponds to the proportional amount of the music of that composer.

**II. Image Sonification**

1. *Textmusic* for piano (1971)

Textmusic is a series of piano pieces based on the letters of an individually chosen text. Parametric graphs (shown at left in Figure 4 on the next page) control the realisation. Version 8 of 1973 was based on a text in Cologne dialect variously praising the virtues of that city. It seemed appropriate to relate the graphs to the object of the text's adulation: postcard pictures 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 10th century Church of St. Gereon were used here. The musical result audibly links to these graphs; e.g. graph II prescribes an initial key-colour distribution of 90% mixed (chromatic) and 10% white (diatonic) and a final one of 100% black (pentatonic) keys (due here to the proximity of the Hohenzollern Bridge at the picture's right end), as borne out by the score examples on the right – the upper shows the mainly chromatic beginning, the lower the pentatonic end of the piece.

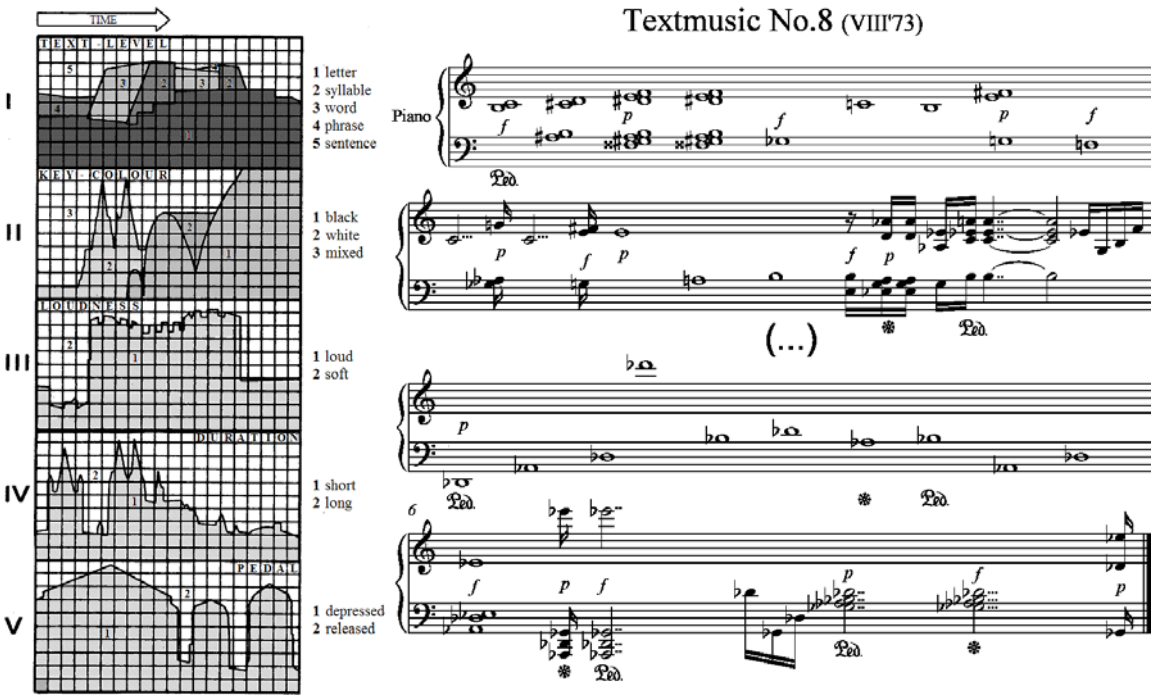


**Figure 4** – parametric curves (left) leading to score (beginning … end) of *Textmusic* Version 8 (1973) at right

2. *Kuri Suti Bekar* (1998)

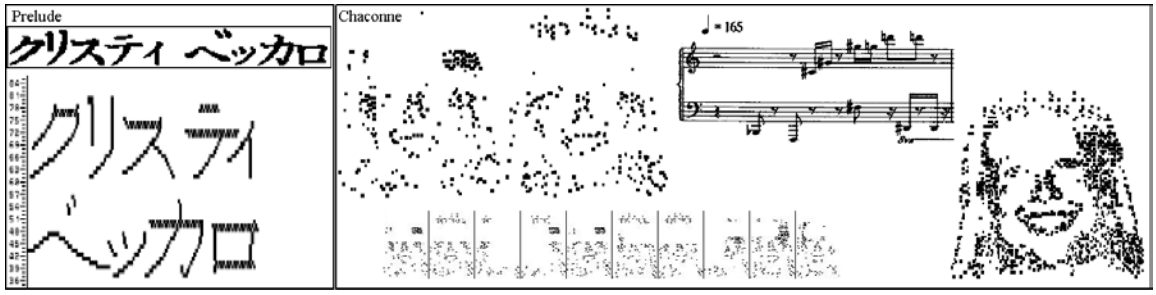


**Figure 5** – *Kuri Suti Bekar* (1998): (left:) Japanese Katakana source and graphic score of *Prelude*, (upper centre-left:) *Chaconne* - graphic score of pages 1-2, (lower centre:) ditto all 10 pages, (upper centre-right:) notated score of first bar of first page, (lower right:) superimposed graphic score of all 10 pages.

Written for the pianist Kristi Becker for her 50th birthday, *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 Figure 5 at left) – the right hand plays [ku-ri-su-ti] and the left hand [bek-ka-ro] (the closest one gets here phonetically) simultaneously, the vertical graphic axis being that of pitch and the horizontal that of time.

A similar graphic pitch/time representation of the Chaconne shows 10 successive "pictures" corresponding to the ten pages (at 16 seconds each) of the score. A superimposition of these ten images approximates a scanned photograph of the pianist's face (see again Figure 5).

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

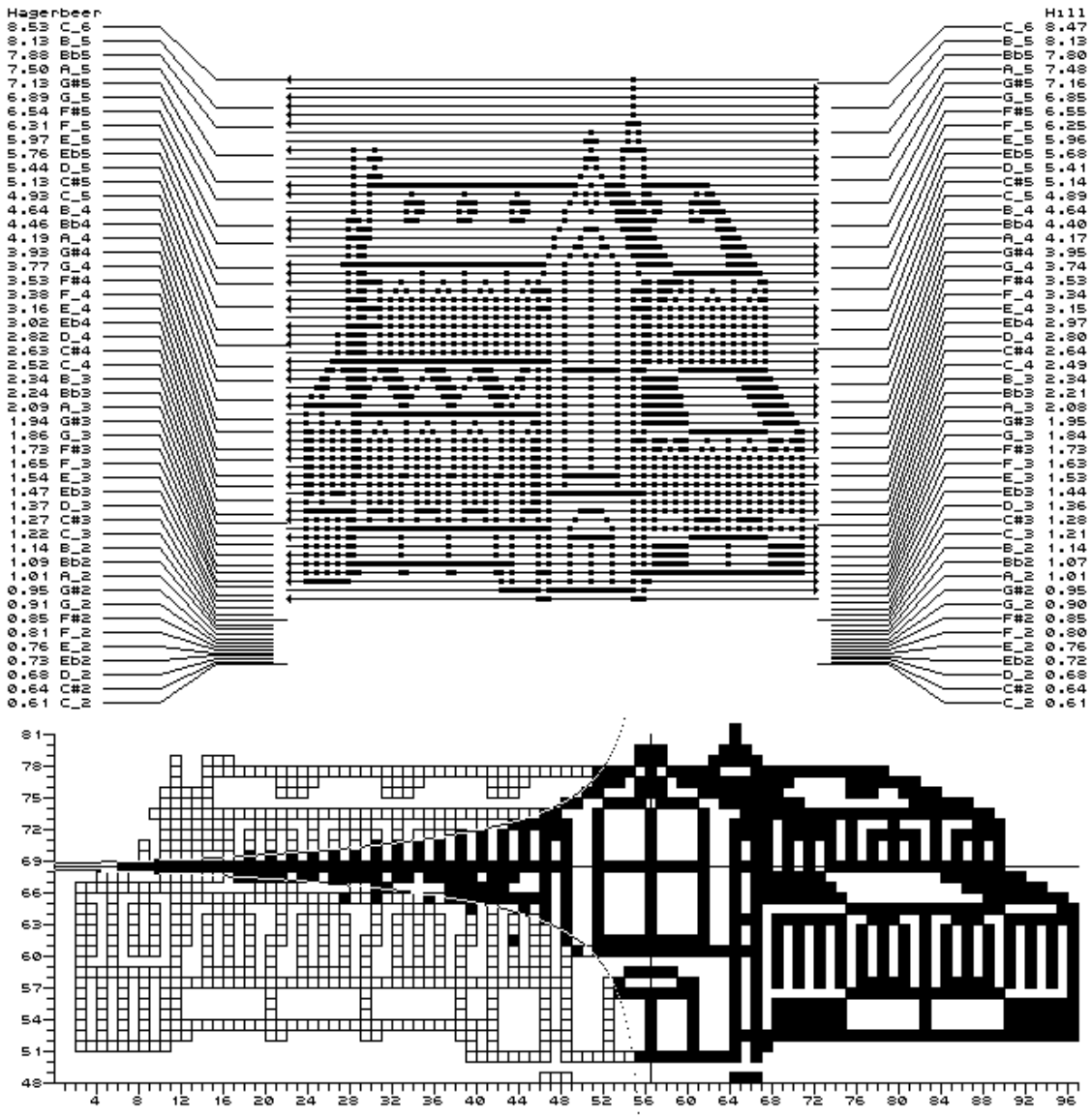


**Figure 6** – *Le loup en pierre* (2002) – (above:) the allocation of the keys of the two organs to the Bark scale, (below:) a graphic score of the first 97 chords with time in seconds (x-axis) and pitch in MIDI notes (y-axis) – the black squares indicate performed notes, the white filtered out.

"The Stone Wolf" was written for the two organs in St. Peter's Church in Leiden, Holland, 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 Bark scale of subjective pitch (Figure 6, top): the pixels are allocated to those keys on either or both organs, the Bark pitches of which come the closest. The building, graphically rescaled to MIDI pitches (Figure 6, bottom), yields the first 97 chords, filtered at left by a horn shape centred on the pitch A-flat (no.68), 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.