Martin Neukom Studie 18

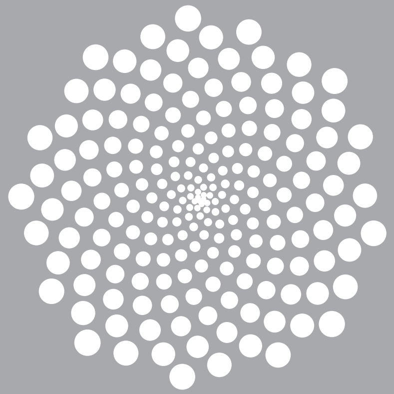
18.1
18.2
18.3
18.4
18.5
18.6
18.7
18.8
18.9
18.10
18.11
18.12
18.13

Total 42:07 mp3 surround data.

Studien 18.1 – 18.13 In Studien 18.x, series of sounds are arranged regularly in space and in the parametric sound space. The rules that generate pitches, spectra, time and location of the individual sounds are very simple but are chosen in such a way that structures emerge out of the regular stream. In all the studies, the organization of the pitches is the same: it follows the same principle as the arrangement of the seeds, leaves or thorns of certain plants. The arrangement of sound in space is realized with the Ambisonics surround system. In the different studies, duration, loudness, spectrum, location and movement of the individual sounds and various parameters of the arrangement of the pitches and of the density are varied.

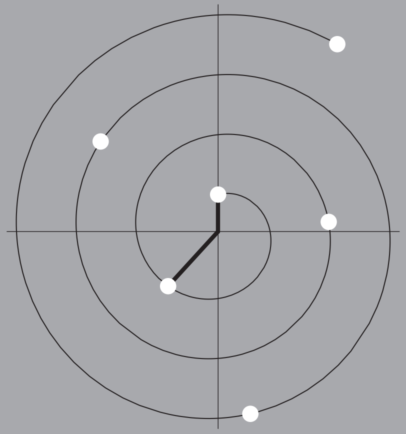
A Growth Process The following diagram shows the pattern of seeds in certain plants (e.g. the sunflower). In this arrangement, the available space is fully utilized. To the left and to the right, spirals are woven together in such a way that the viewer perceives them in both directions.

Fig. 1



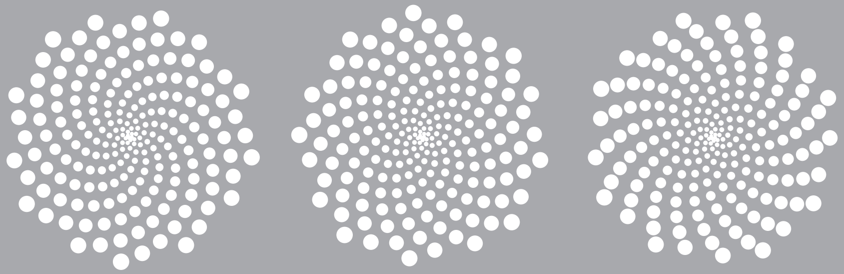
The following diagram shows the genesis of the pattern. The points are arranged along a spiral. The angle of rotation between two consecutive points divides the circle in the golden ratio g. This angle amounts to g*2π or g*360° = 222.492°.

Fig. 2



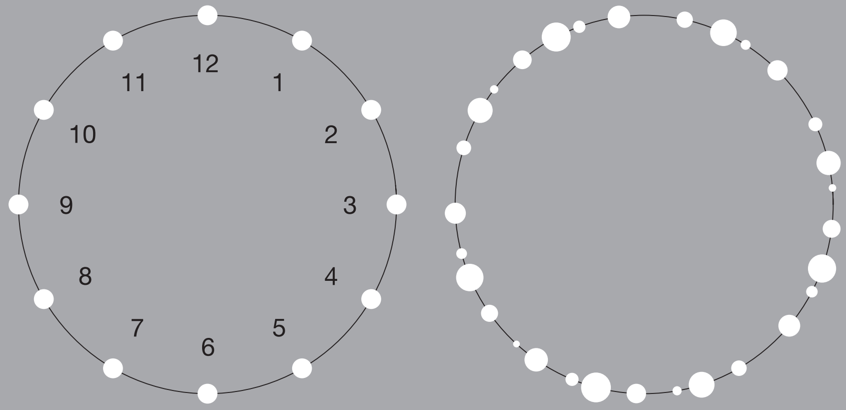
If the angle between successive points does not equal exactly the golden ratio, spirals turning one way will dominate. For the left and right figures in the following diagram, angles were used which differ by as little as .001 from the golden ratio.

Fig. 3



Translation to Musical Parameters The pattern can be translated to musical parameters if pitches that differ by octaves are regarded as the same (pitch classes). A progression of semitones reaches the octave after 12 notes, the circle is closed and the scale repeats itself (left figure). If the octave is divided by the golden ratio, an interval somewhat smaller than a minor sixth is generated. A progression with this interval always produces new pitches that are spread in “pitch-space” as in the above-described pattern (right figure).

Fig. 4

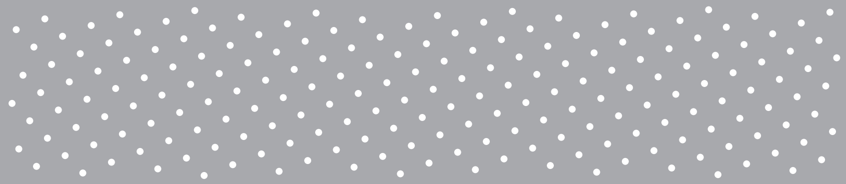


The pattern can be used to organize rhythm and loudness if the circle above is unwound onto a line and distances are interpreted as duration, and the size of the points as loudness of the notes.

Fig. 5

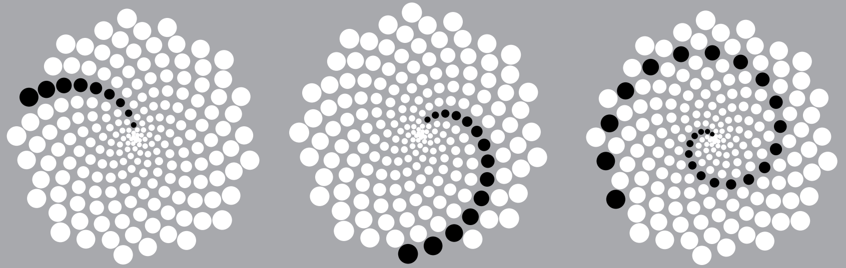
Time-pitch diagram If the notes follow at regular time intervals in a time-pitch diagram, a very regular pattern emerges.

Fig. 6



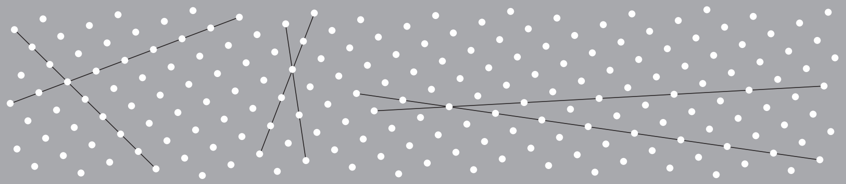
As in the seed pattern, spirals with different pitches can be seen, so, in this score, rising and falling lines of tone sequences can be heard.

Fig. 7



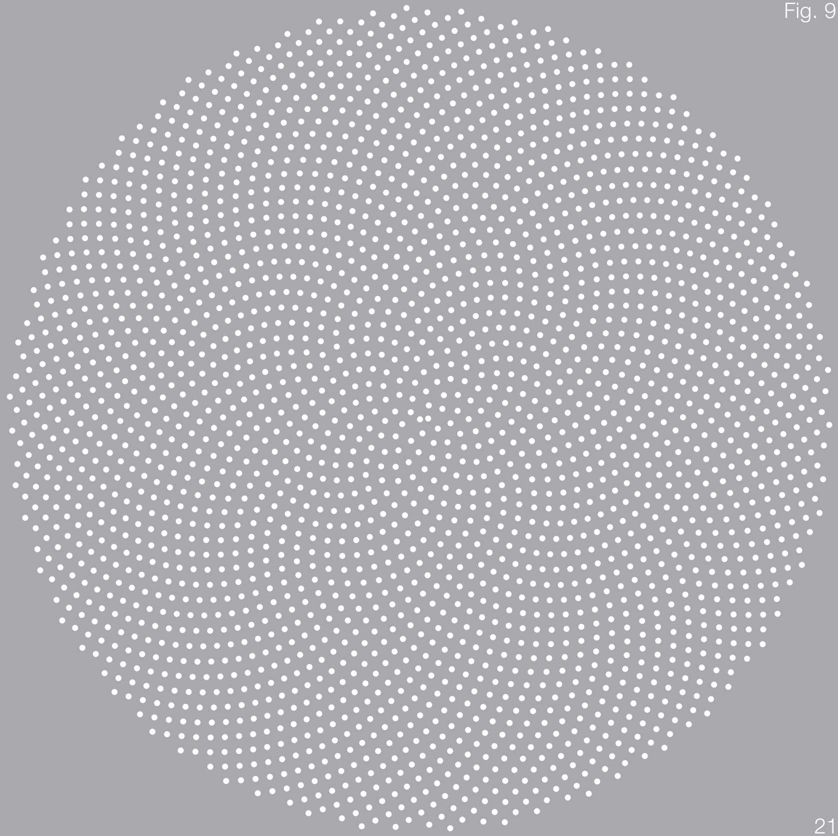
If the sequence is played as shown in the diagram here, upper and lower border notes obtrude. In the studies, this is avoided by different means: If the range of frequencies is very wide, these notes fall into a non-audible frequency range; notes can be doubled in octaves throughout the audible range (Studie 18.1); the borders can be bent (Studie 18.3).

Fig. 8



As shown here in Figure 9 (where different spirals can be seen at the same time), in the studies, different rising and falling tone sequences with different speeds can often be heard simultaneously. Which of these sequences are actually heard depends on the one hand on the focus of the listener and on the other on the design of the musical parameters.

Fig. 9



Space The positioning of the sounds in space is realized with the Ambisonics surround system. For each sound, a position, direction and speed of movement is determined. In addition to the direct sound, the first 8 reflections are calculated. In the direct sound and in the reflections, changes in loudness and pitch introduced by the movement of the sounds are simulated.

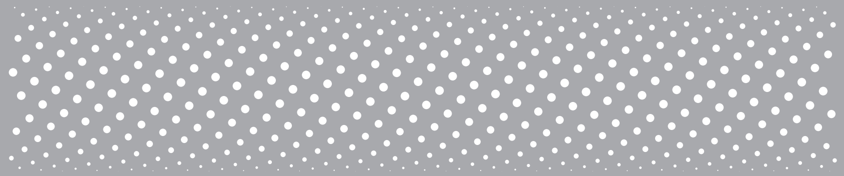
Studie 18.1 In Studie 18.1 only the speed of rotation of the sound source around the listener changes. All other parameters remain constant (the interval, loudness, distance and movement of the individual sounds etc.). The accelerating rotation provokes the changing perception of outlines.

As in the acoustic illusions created by R. Shepard and J. C. Risset, all pitches are doubled in all octaves throughout the audio range between 20 and 20000 Hz. Thus, it is not clear which of two succeeding sounds is higher, and the boundaries of the pitches are not perceivable.

Studie 18.2 In Studie 18.2, 18 notes always sound simultaneously. One hears at first dissonant bell-like sounds and after a while rising and falling sequences.

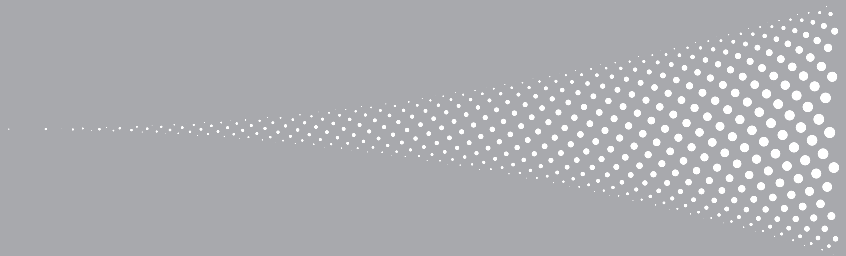
Studie 18.3 If, in the score, the size of border points and the distances between border points is scaled down (i.e. differences in amplitude and frequency), the lines are bent and disappear imperceptibly at the borders.

Fig. 10



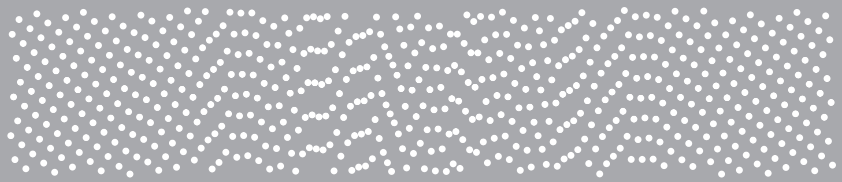
In Studie 18.3 the frequency band becomes broader and broader:

Fig. 11



Studie 18.4 Minor deviations from the golden ratio produce distinct variations in the perceived outlines.

Fig. 12

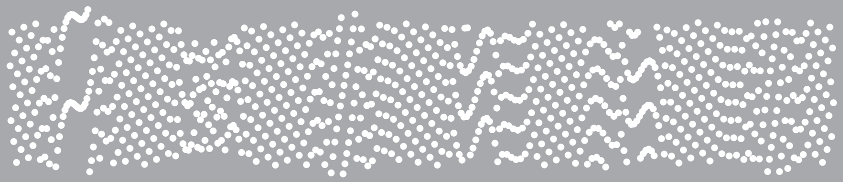


Studie 18.5 In Studie 18.5 the starting times of the notes are produced in the same manner as the frequencies: The first sound produced begins at an arbitrary time, the second at g times the duration of the piece later and so on. If the starting time exceeds the duration of the piece, this duration is subtracted from the starting time. The amplitude of each sound is proportional to its starting time. The following diagram shows starting times and amplitudes of the sounds.

Fig. 13

Studie 18.6 If frequency is not folded back exactly after reaching an octave (or a multiple of an octave), the pattern is disturbed.

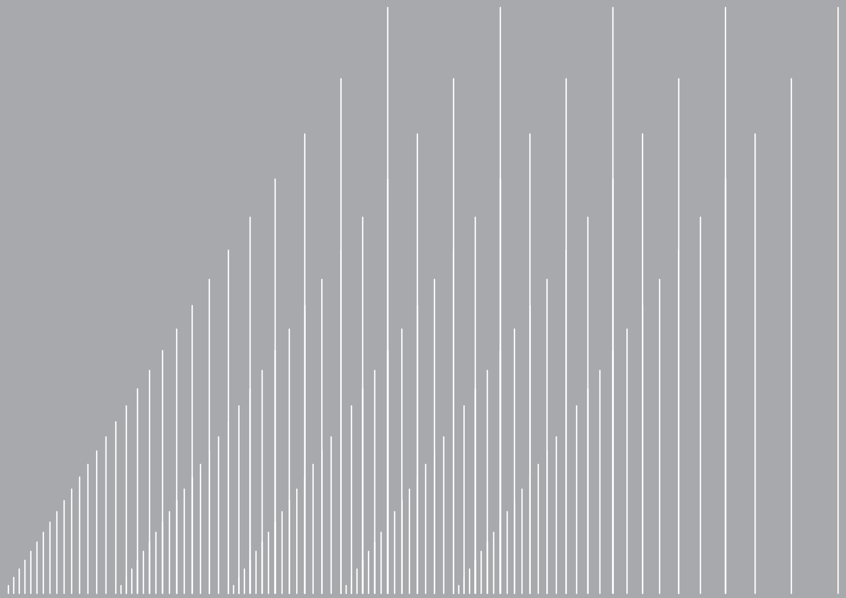
Fig. 14



Studie 18.7 In this study the individual notes are longer than in the other studies and are faded in and out smoothly. As soon as a certain number of notes sound at the same time, they cannot be perceived individually. The resulting cloud of sounds seems to rise or fall depending on the deviation from g.

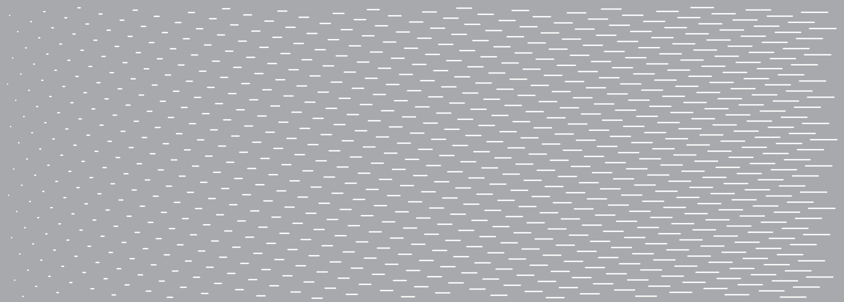
Studie 18.8 In Studie 18.8 every newly produced pitch is repeated several times, making sequences with increasing amplitude and increasing difference in starting time. The resulting deceleration is such that some notes of different sequences sound together and produce bell-like sounds. The deceleration of the sequences is perceived more and more as a never-ending slowing down of the tempo.

Fig. 15



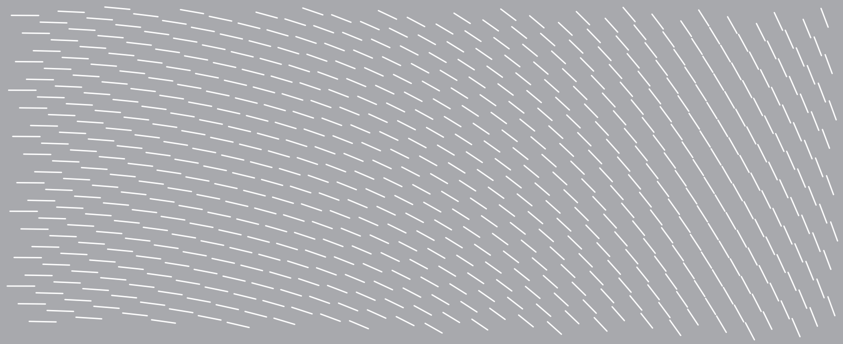
Studie 18.9 The sounds in the sequence become longer and longer. Firstly, individual sounds or, depending on the focus of the listener, outlines are heard. When the sounds become longer, lines obtrude which connect the end of one sound with the beginning of another. Therefore, more and more “voices” are heard which rise and fall with a slower and slower tempo.

Fig. 16



Studie 18.10 In Studie 18.10 the sounds move faster and faster. Their path is chosen such that because of the Doppler effect a linear glissando occurs. The speeds of the glissandos determine which outlines are heard.

Fig. 17



Studie 18.11 The perception of one sequence is influenced by another sequence. In Studie 18.11 the two sequences differ in the number of notes per second, loudness and movement.

Fig. 18

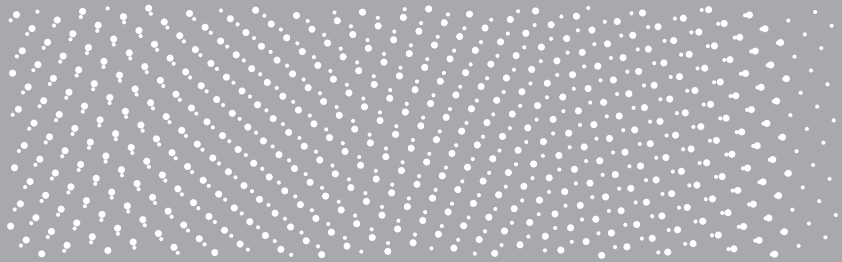
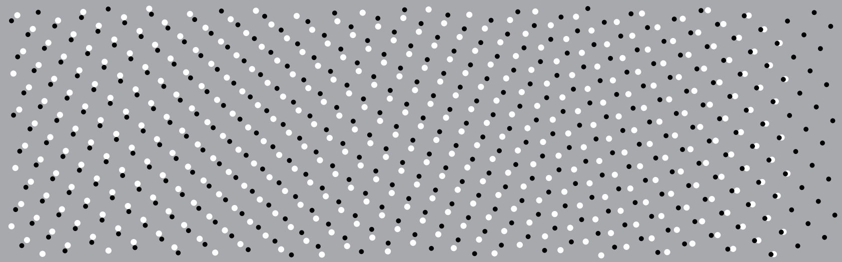


Fig. 19



Studie 18.12 In Studie 18.12 the frequency ranges of two sequences are diametrically opposed: One begins in a high region and falls slowly, and the other vice versa.

Fig. 20

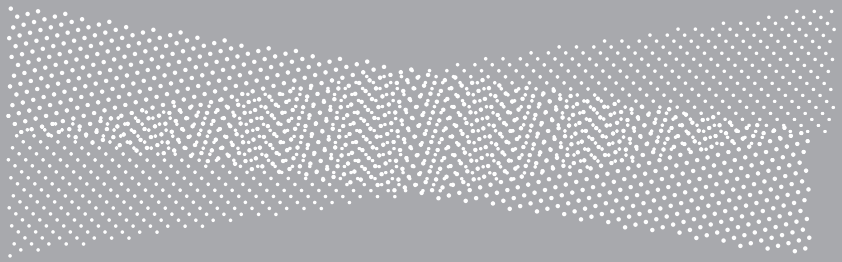
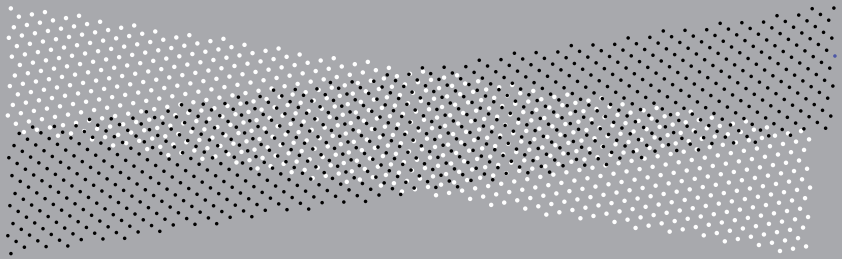


Fig. 21



Studie 18.13 In Studie 18.13 the sequence is played so slowly that one does not follow the melodic lines but the harmonies. These harmonies are always the same since the interval between successive pitches is always the same. But the pitches never repeat exactly because the golden ratio g is irrational.

All music composed by Martin Neukom. Mastered at the Institute for Computer Music and Sound Technology, Zurich. Graphic design by Medusa Cramer.

The realisation of this work with mp3 surround technology is powered by all4mp3.com/ the Fraunhofer Institute, Germany.

You can play the mp3 surround files in any mp3 player as stereo files. If you would like to listen to Studie 18 in surround, you need to have a 5.1 surround system connected to your computer. Then download the Fraunhofer Institute‘s mp3 surround player at all4mp3.com and install it on your computer. Drag the files to the player window. For a good surround impression while listening with headphones, activate Ensonido.

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