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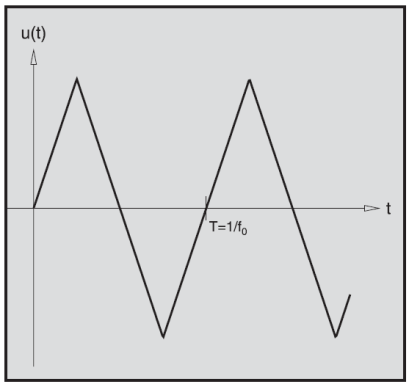
If it feels good, it must be in time!!

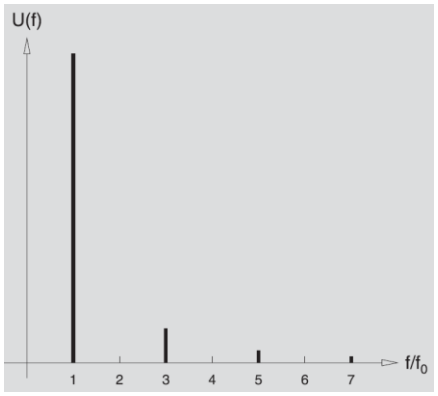
Electronic sound music

Physical basics of information transfer help us the field of electronic sound Music to understand better.

Spectrum analysis seems to be a kind of "secret knowledge" for many to be, which only a few specialists can master. You could get this impression if you Read available literature on the subject. Integrals, differentials and theoretical considerations as far as the eye can see.

However, the practitioner is primarily interested in two questions: "How does it work and what can I do with it?".





Pictures: 1) Amplitude over time. 2) Spectrum over time

	Oszilloskop	Spektrumanalysator
Darstellung:	Yt-Betrieb (Amplitude über Zeit)	Yf-Betrieb (Amplitude über Frequenz)
X-Achse/Massstab:	Linear (Zeit)	Linear (Frequenz)
Y-Achse/Massstab:	Linear (Amplitude)	Logarithmisch (Amplitude)
Frequenzbereich:	DC...1,5 GHz	Grösse 0 Hz-300 GHz (keine Gleichspannung)
Dynamik:	‹ 30 dB	› 80 dB
Phaseninformation:	vorhanden	nicht vorhanden
Preise:	Einige tausend Euro bis 100 000 Euro	Einige tausend Euro bis mehrere 100 000 Euro

signal theory
time range

Jean Joseph Fourier showed as early as 1808 that every periodic process can be broken down into its fundamental (1st harmonic) and its overtone (2nd, 3rd, etc. harmonics).
For electrical engineering this means:
Any periodic signal (square, triangle, sawtooth, other forms) can be represented by a sum of sinusoidal oscillations of different amplitudes and phases. The fundamental has the same frequency as the signal, the harmonics have integral multiples of the fundamental frequency.

For me this means that when I look into a cable, I see a superposition of harmonics coming towards me.

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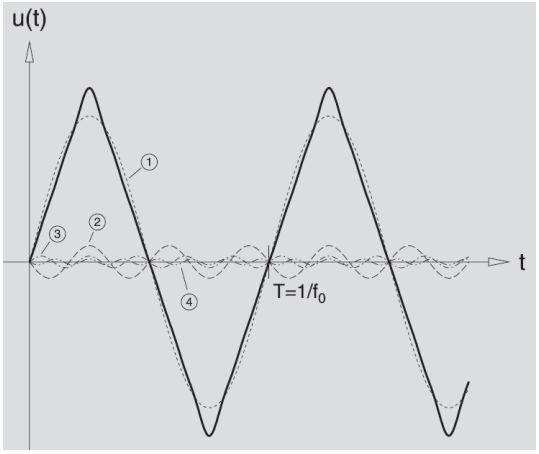
Kurve 1	Frequenz	fo= 10 kHz	Amplitude=1
Kurve 2	Frequenz	3fo= 30 kHz	Amplitude=0.111
Kurve 3	Frequenz	5fo= 50 kHz	Amplitude=0.04
Kurve 4	Frequenz	7fo= 70 kHz	Amplitude=0.02



Superposition simply means adding the curves.

Dezibel

10er Logarithmus (dB-Wert) und Leistungsverhältnis		praktisch:
0 Bel	≙ $10^0 = 1$	Signal wird 1:1 übertragen, d.h. keine Verstärkung oder Abschwächung
1 Bel	entspricht einem Leistungsverhältnis von $10^1 = 10$	Verstärkung des Signals mit dem Faktor 10
-1 Bel	entspricht $10^{-1} = 0,1$	Änderung des Signals mit dem Faktor 0,1 = Abschwächung
1 dB	entspricht $10^{0,1} = 1,259$	Verstärkung mit Faktor 1,259
3 dB	entspricht $10^{0,3} = 1,995 \approx 2$	Verstärkung mit Faktor 2
10 dB	entspricht $10^1 = 10$	Verstärkung mit Faktor 10

Mathematischer Zusammenhang: 1 Bel = $\lg 10^1 = \lg (10^{0,1})^{10} = 10 \lg 10^{0,1}$
Bel 10 dB

On oscilloscopes, the Y-axis is scaled linearly. Depending on the setting, a division (raster division) has the same value.
Example:
1 div. = 2 volts results in 5 div. = 10 volts.

The y-axis is scaled on a logarithmic scale in spectrum analyzers. A division here always has the same value in dB.
Example:
1 div. = 10 dB results in 5 div. = 50dB. The advantage of the logarithmic representation is that very large value ranges are still table above.

The designation dB (=decibel) means one tenth of the unit Bel. A bel is the 10-fold logarithm (lg) of the ratio of two powers. A bel has no unit, it is a dimensionless quantity (see table decibel).

https://www.facebook.com/watch/live/?ref=watch_permalink&v=515010452527552

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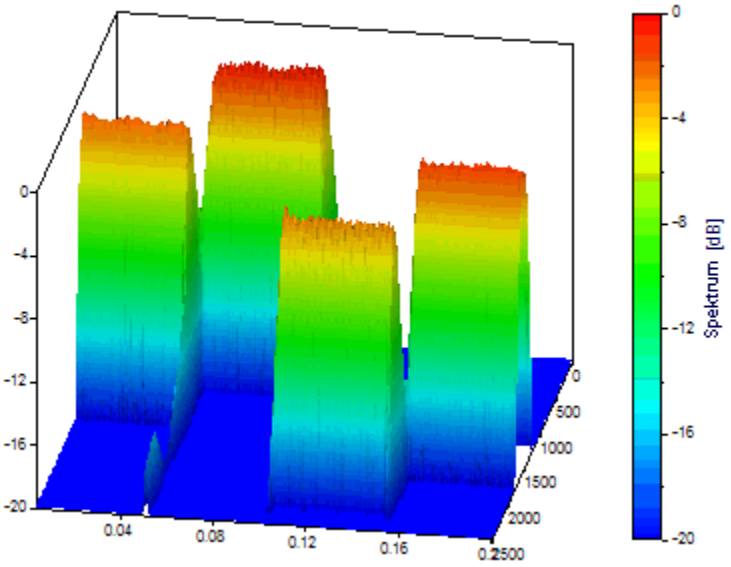
Acoustic processes can be represented with level-time and frequency.



There is an almost infinite variety of electronic music design elements that cannot really be represented with our notation.
A separate notation for acoustic processes in electronic sound music can, but does not necessarily have to, make sense.
An adopted musical notation is not sufficient for this.

Quarter tone and sixteenth tone music
An extension of our musical notation is sufficient for this music.
The Russian pioneer of microtonal music **Ivan Wyschnegradsky** was always on the lookout for new worlds of sound.

https://www.youtube.com/watch?v=tDJAmY-hmvA
https://www.youtube.com/watch?v=JiZ5EwSqAd8

https://www.wikiwand.com/de/Iwan_Wyschnegradsky

https://www.youtube.com/watch?v=X7dqrHdSo1w
An extension was enough for this music as well
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An extension was enough for this music as well

Ondes Martenot
https://www.youtube.com/watch?v=CrhYIg8wV74

https://www.youtube.com/watch?v=Zp4mBmsV6Xk

The mystical, divine being of the composer **Ivan Wyschnegradsky**, striving for a cosmic consciousness, and his vision of a sound continuum, a limitless, ultrachromatic music can be guessed at very well.

➔**Not to be forgotten**
Jonathan "Jonny" Richard Guy Greenwood is a British musician, film composer and member of the alternative rock band Radiohead.

https://www.soniccouture.com/en/products/24-vintage/g27-ondes/

https://www.youtube.com/watch?v=jNY_wLukVW0&list=PLxzSZG7g8c8x6GYz_FcNr-3zPQ7npP6WF

Im Unterschied dazu, können die Klangvorgänge elektronischer Musik nur mit einer akustischen Darstellung graphisch festgehalten werden.

Even today, the function of musical notation is evaluated very one-sidedly and only from the historical perspective of the last two centuries.
➔ **In Bach's time** there were still no performance markings and the concertante style has many musical processes that are not written down.

There used to be epochs that were content with signs that approximately recorded pitch and rhythm.
If we conclude from this that at that time music was played without a clear sense of tone, that is another prejudice of the modern age.

The degree of rational development of a musical notation does not allow any conclusions to be drawn about the status of a musical culture!!

➔**An acoustic notation of electronic music uses technical-scientific means of recording.**
However, the music is not affected by this rational, technical character of the recording!!
Acoustic phenomena can be represented in a three-dimensional space with frequency, level and time, as shown in the introduction.
➔Tones, sounds have a time limit and are therefore mapped as bodies.
With the help of descriptive geometry with the depiction of points, straight lines and planes in vertical parallel projection, these structures can be recorded in such a way that nothing stands in the way of acoustic realization.

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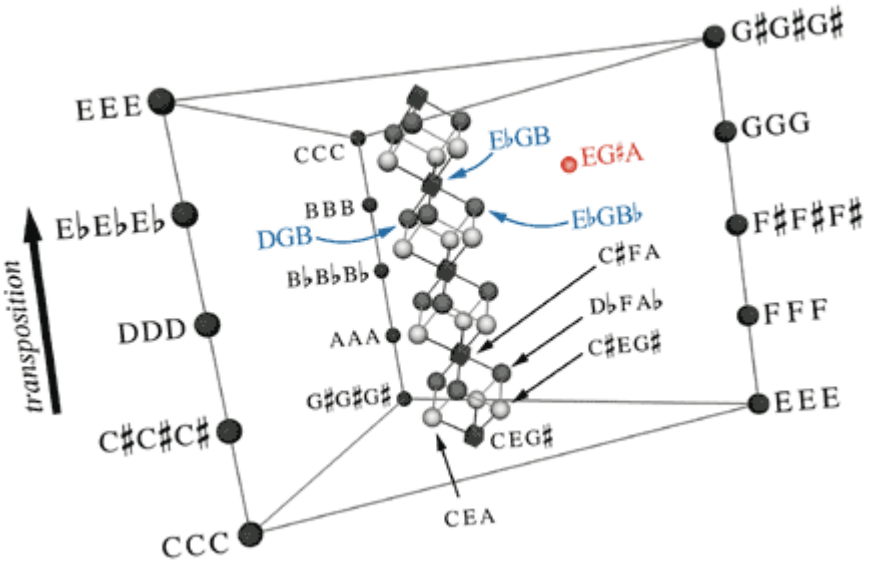
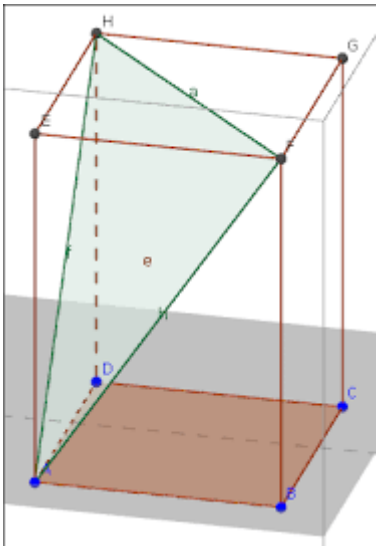
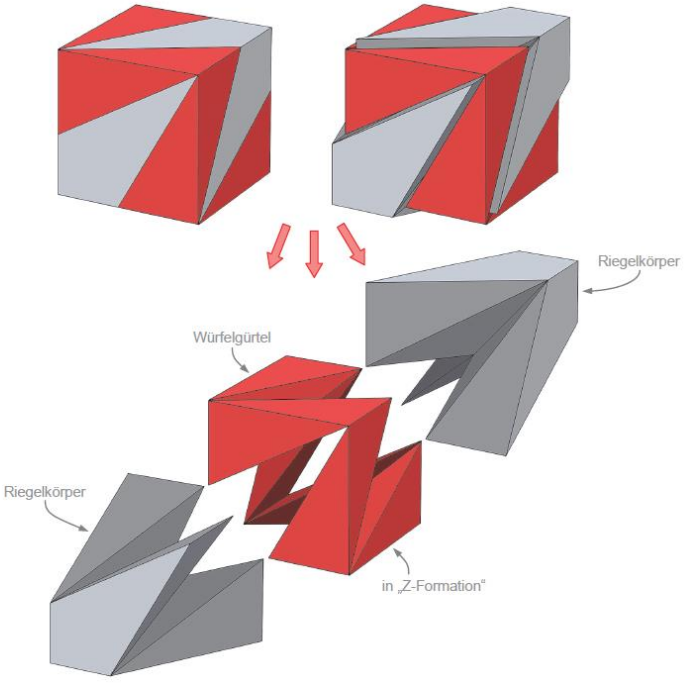


A Geometry of Music – Harmony

Each 3-dimensional sound body, formed with level, frequency and time, can be broken down by sections, like in a technical drawing, so that all the properties required for its construction can be seen!





s.a. Schatz – **Rhythmusforschung in der Technik** und Berger – **Aspekte der Körpergeometrie**

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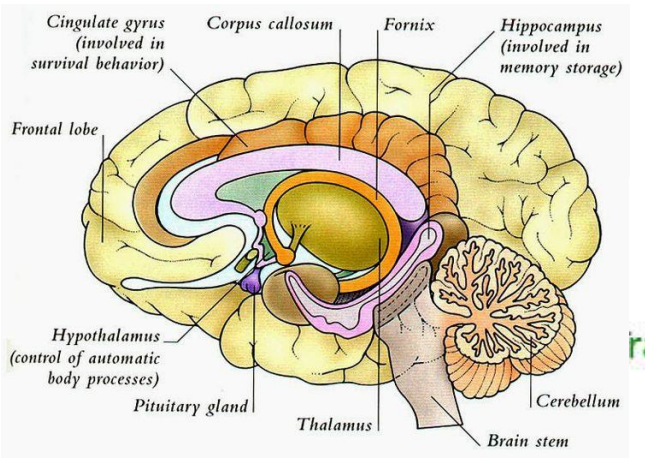
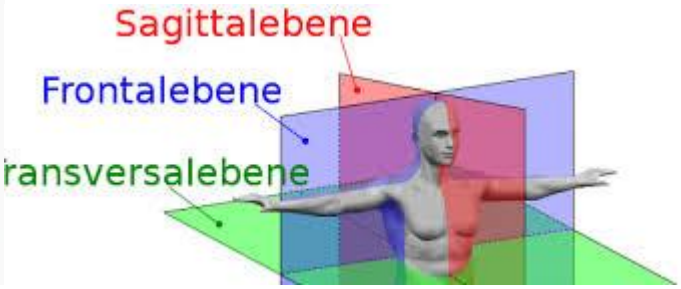
Auch das ist ein Schnitt, der jedem von uns bekannt ist.





In brain surgery with robots.

➔In almost all cases of electronic music, cuts that depict the frequency-time level and the level-time level are sufficient.

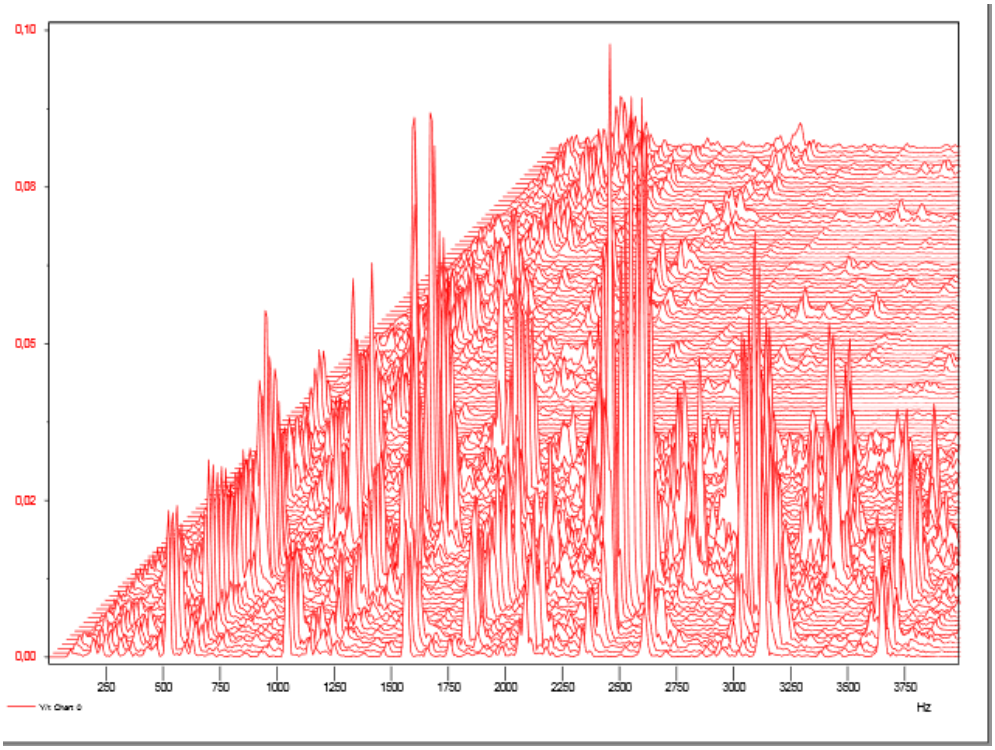


Fig: Time-frequency landscapes are used, among other things, for voice analysis or when examining certain transient processes. Shows how the spectrum of a signal changes over time. The frequency axis is horizontal, the time axis is diagonally backwards. The vertical axis gives the level
once again.
➔Today (2010) this can be realized cheaply with software.
The number of cut surfaces depends on the structure of the sounds and noises and must be large enough to enable the sound event to be reproduced on the basis of the graphic documents.

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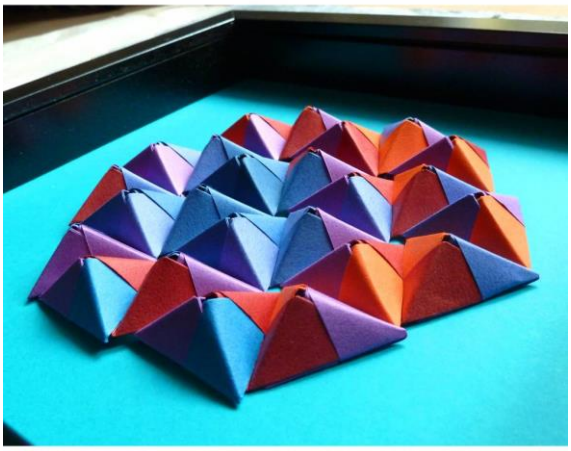
It has proven to be useful, the frequency-time level and the Associated to put the level-time level together.

Special case:

➔**The PM synthesis is a special case** of the mathematical modeling of physical processes especially for the needs of acoustics with special consideration of musical boundary conditions and mainly includes second-order oscillation equations.

➔**With the help of a programming language (e.g. Java)** you can program every landscape, and thus every sound of the universe. This knowledge is also useful when programming games. **e.g. Blender.**

https://www.mathworks.com/help/physmod/simscape/physical-modeling.html



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With the help of some simple symbols one can do all of these Levels describe occurring sound processes.

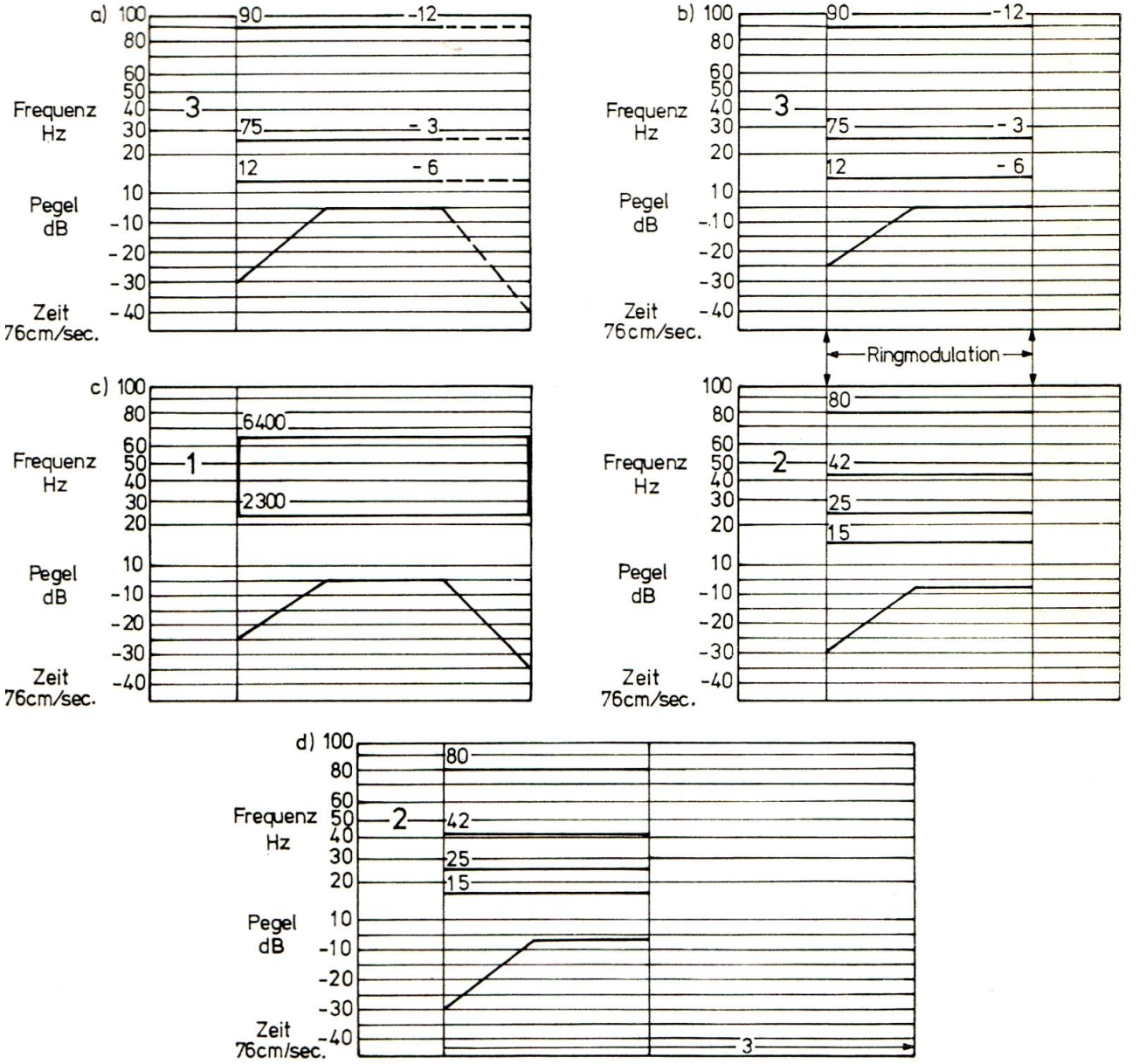

Fig: Representation of the acoustic sound processes generated for the realization of electronic sound music

Such a description must contain all the information required for the technical implementation (the trade). Just like in a technical drawing. So that it can be read by all those involved, agreements must be made about the type of graphic representation.

Explanations for the figure above:

Please turn.

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1. Partial tone distribution

Overtones (also partial, partial, aliquot, side or connotations) are those next to the
Components of a musically instrumental or vocally generated tone that resonate with the fundamental tone.

In the acoustic sense, however, such a tone is not a single tone (sinusoidal tone), but a sound or a mixture of tones, i.e. a sound event that is primarily composed of several sinusoidal partial tones of different amplitudes.
The lowest partial is called the fundamental and usually determines the perceived pitch. The higher partial tones, the overtones, create the timbre.
Pitch and duration are entered in the frequency-time plane, with the exact amount of frequency and level being written over the line representing the partial. In order to capture the entire hearing range with a single scale, the applicable frequency range is defined by a preset factor.
The dynamic course of the sound event can be seen from the level diagram.
As can be seen from the example, the reverberation conditions are characterized by a falling line.
For reasons arising from the manufacturing process, the time axis was divided into magnetic tape lengths (based on a tape speed of 76.2 cm/sec). What you no longer need today. \Ableton Live

1. The modulation

If two sounds are to modulate (change) one another, the partial tone distribution of the original sounds is recorded in the same way, but in two systems arranged one above the other. The type of modulator to be used (four-pole modulator, ring modulator, etc.) is written between the two systems.

2. Frequency band clipping

If a band of colored noise of a defined width is required, this specification can be represented by two frequency lines that limit the band and are connected at the beginning and end. As usual, the dynamic course is entered at the level level. (see also communications engineering)

3. Frequency Band Squeezing and Frequency Band Spreading

Here, the partial tone distribution of the sound to be pressed or spread is entered in the usual way and the size of the spread or compression is given on the time scale.
For example, the number 3 means that the original sound has been stretched threefold, the number ¼ means that the original sound has been compressed to a fourth part
➔A sufficient number of symbols can easily be put together by combining the examples listed and the composition tasks given.

The described type of recording electronically produced
Of course, sounds and noises only represent a work instruction that

Production of these sound processes should facilitate.

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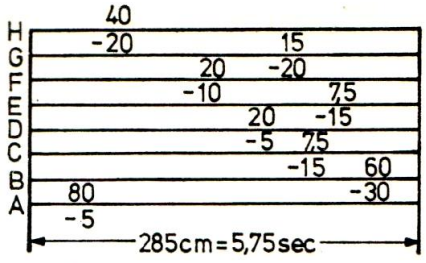
➔ **The composition with sine tones requires precise registration of the frequencies.**
➔If, on the other hand, the composer uses complex, indefinite sounds, the lines provided for this purpose do not designate the magnitude of the frequency, but the relative pitch of the sound.

The most important note:

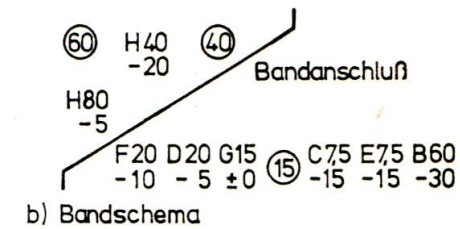
➔A sound is acoustically defined when its spectrum is defined;
A sound is musically defined if it can be reproduced at any time.

From this it follows for the technical production that a score that only uses sine tones can be realized according to the graphic information like a workpiece according to the drawing, i.e. it can be executed by the technician.
In the other case, with complex sounds, these must first be selected by the composer and designated for the score.
If the composer also determines the envelope curve beforehand, for example when he writes a piece for percussion sounds, the result is a relatively uncomplicated score, which is illustrated below using a simple example.

A piece uses 8 different percussion sounds of different pitches, ranging from a low gong to a high metallic percussion. These sounds are first selected and produced with appropriate envelopes.
For these 8 sounds (A,B,C,D,E,F,G,H), 8 score lines are also necessary, on which the sounds are classified according to duration (centimetres) and sound strength (+/- 0, -5 , -10, -15 ….)dB) can be entered. ➔**Fig: a)**



a) Partitur



b) Bandschema

The band scheme of this example - shown in Fig. b) contains the following data:

Capital letters = sounds
Numbers = centimeters
Circled numbers = centimeter length of breaks
Small numbers = dB
Brackets = sign for two tapes to be played one above the other

The band scheme in Fig: b) is sufficient for the technical realization.

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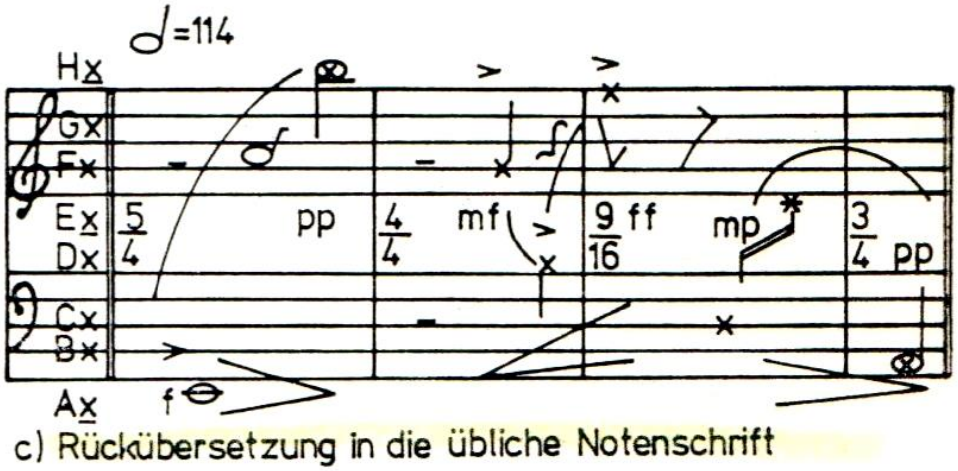
Now one could turn this example into one that is familiar to the musician translate notation.



c) Rückübersetzung in die übliche Notenschrift

It goes without saying that such a retranslation into a foreign script in no way corresponds to the nature of electronic music.

➔**The compositional task is to produce the acoustic score.**

Quellen:

1 Internet
2 Pfritzmann
3 Hameg