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Potential and Possibilities

A Short History of Musical Techniques

This work is a short historical discourse upon the history of music, musical instruments and notation. Technical and formal possibilities of generating music, aesthetic ideas, listening habits, typical musicals forms within periods and social contexts are also considered.

Systems of instruments

First we want to have a look at the term *musical instrument*. First of all one imagines musical instruments as objects, built with the intention to generate music. Automatically we associate classical music instruments with the image of for instance a violin or piano. Usually we neglect the fact that everyday objects as well as noises or sounds and especially the voice can be used as musical instruments too. New music and in particular Musique Concrète use these sources and process them musically into complex compositions.

There are different approaches to classify instruments. And like all classification systems these systems also have their pros and cons, their exceptions and overlaps.[1] There is the classification with regard to the orchestra score, musicology and the ways of tone generation. The range and the physical properties of an instrument are further classification principles. Various methods examine genre, the common use and purpose of an instrument. Most methods are specific to a geographic area or cultural group.[2/3]

Using the orchestra score system we classify instruments into woodwind instruments, brass instruments, kettledrums, keyboard and plucked instruments, percussion instruments, soloist, chorus and string instruments.[3]

In 1914 Erich Moritz von Hornbostel and Curt Sachs created the Hornbostel-Sachs musical instrument classification system, the most widely used category for classifying musical instruments. It is based on a system devised in the late

19th century by Victor-Charles Mahillon, that divided European musical instruments into four main categories. According to the nature of the sound-producing material he differed between air column, string, membrane and the body of the instrument. Coming from this basis, Hornbostel and Sachs expanded Mahillon's system to enable a classification of all instruments despite their cultural background. In 1948 the electrophone category was added to the system.

With the novelty of electricity and the associated emergence of electronic sound technology, musicians and composers adapted acoustic instruments. So a new classification of instruments into physical groups came into being: mechanical instruments, automatic instruments, electromechanical instruments and electronic instruments.[2]

Mechanical instruments are instruments controlled by mechanical means. Examples are mechanical organs, but also so-called acoustic instruments such as mechanical violins, flutes and kettledrums rank among this category.

Automatic instruments are self-playing instruments that function mechanically. A typical automatic instrument is the medieval carillon, the barrel organ, the pianola or the orchestrion. During the Renaissance, Augsburg craftsmen created music machines and self-playing spinets that functioned with the help of pinned barrels.

Electromechanical instruments such as the Hammond organ or the electric guitar are instruments whose unamplified sound is produced by physical objects moving, rather than electronic instruments whose sound is produced by purely electrical means.[1/4]

Electronic instruments are the theremin, synthesizers and computers. They generate electric signals (waveforms), and convert them by means of analogue and digital techniques.[1/4]

Periods of music

Not only musical instruments are classed. Categorizing music into epochs is an attempt to consider historical backgrounds in regard to development impulses and predominant musical intention. Music is also influenced by cultural aspects, including political, philosophical, social and economic experiences, it is then necessary to distinct different periods within music history.

The different eras of music are classed chronologically: prehistoric music, ancient music, early music, Medieval music, Renaissance music, Baroque music, Classical period, Romantic music and 20th century music.[5]

If we have a closer look at the periods of Western classical music, we'll recognize that all periods are linked up and only partially disenthrall the expectation of the listener. The musical development of the twentieth century is an exception.[6]

The earlier period of Medieval music (500-1400) is characterized by liturgical music. A good example of this genre is the Gregorian chant, a form of monophonic, unaccompanied sacred song. It was traditionally sung by male choirs, in the course of Roman Catholic masses. Gregorian melodies are traditionally written using *neumes*, an early form of musical notation with a four-line staff. A single neume represents a single pitch or a series of pitches all sung on the same syllable. About 1000 CE Guido d'Arezzo, one of the most important musical theorists of the Middle Ages, revolutionized Western music with the development of the gamut, in which pitches in the singing range were organized into overlapping hexachords.[7/8]

In ancient Greece it has been essential for educated citizen to study the liberal arts of grammar, rhetoric, and logic (also known as the *trivium*). During the Middle Ages these subjects were extended, and music became (besides arithmetics, geometry and astronomy, with which it formed the the so-called *quadrivium*) one of the seven liberal arts of the medieval university curriculum.[7]

It is difficult to demarcate the end of the Medieval end and the beginning of the Renaissance period (1400-1600), that according to music historians probably started about 1400 CE in Italy. Based on a revival of ancient Greek and Roman ideas, and in scientific studies, it brought a change regarding intellectual inquiries such as philosophy, politics, religion and science, but it also profoundly affected literature, the arts and music. People suddenly attached importance to realism and human emotions. Music emancipated itself from medieval constraints, it became self-sufficient and a vehicle to express personal feelings. Polyphony in particular is one of the remarkable achievements of this period, as is the emergence of the vocal genre. Different types of chansons became very popular, such as the rondeau, the virelai or ballad with instrumental accompaniment and the polyphonic unaccompanied madrigal, with its emotive texts. In contrast to popular ballads, the art songs were usually written for one voice with accompa-

niment, and their formal design was distinguished between strophic, modified strophic and through-composed.

The Baroque period (1600-1750) is characterized among other things by changes in musical notation and new instrumental playing techniques. The use of figured bass and counterpoint were important innovations and represent the increasing importance of harmony that led to the development of well-temperament, a type of tempered tuning. Compositions were generally simple, with repeated binary forms, simple three-part or rondeau forms by using all major and minor keys. Instructions for loudness hardly existed. Typical music genres of the Baroque period are the opera, cantata, oratorio, monody, concerto, and sonata. Very popular were the Baroque suite (consisting of dances after a prelude or overture), the passacaglia and of course the different types of fugue.

In the Classical period (1730-1820) there is an overall trend towards simplicity. In science, architecture, literature and the arts, the new taste for structural clarity becomes fashionable. The same tendency can be detected within the musical development. Harmonic functions were simpler than in the Baroque era. The music is based on chords built with the interval of thirds. It uses keys with less accidental and dynamics and tempo are predetermined. However, the compositional structure, the phrases and motives, become much more important. Many compositions of the early Classical period were homophonic melodies with chordal accompaniment. Melody became the vehicle of expression, along with clear-cut phrases and clearly marked cadences.

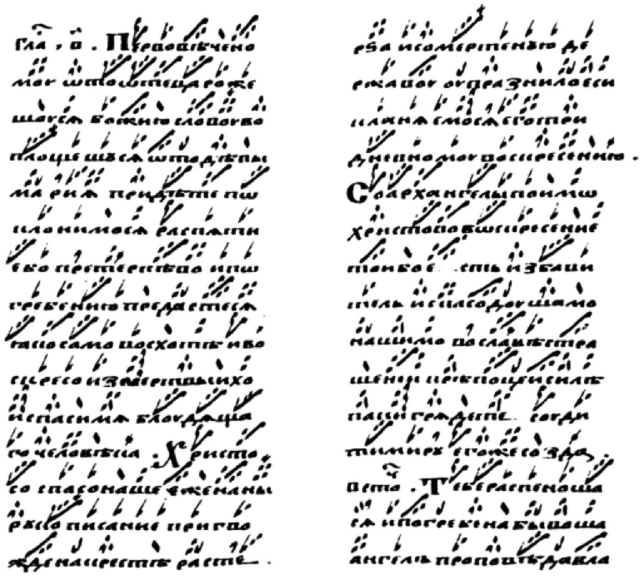
Another change during the 18th century is based on changes in economy and social structure. The upcoming and well-off bourgeoisie spotted Classical music as a welcome pleasure. Together with the nobility they supported instrumental music and opera. Not only to listen to the concerts, but also to show their wealth. Music magazines and music supplies (notes) were printed and readily available. The typical music genres of the Classical period as sonata, symphony, opera, and the different variation techniques are characteristic for Romantic music (1800-1920) too. The music of the Romanticism and the Classical period must be looked at as a unity. Of course there is an even stronger and more powerful emphasis on melody, dynamics, harmony and rhythm. The Romantic period was the time of great national and personal emotions. Music was also strongly influenced by literature. Famous virtuosi like Beethoven or Chopin composed pieces expressing intensity, passion and deep tragedy, writing for concerts to be performed in

front of large audiences. The Classical period simplified notation of tonality and became more complex. To boost the emotional expression composers used chromatic melodies full of tension and dynamics ranging from *ppp* (piano pianissimo) to *fff* (forte fortissimo). The piano replaced the harpsichord. Vocal music like popular ballads, as well as operas became even more important.[7]

The music of the 20th century (1900-) is at the beginning still affected by Romanticism. But in the course of technical inventions and modernization, established methods were replaced by innovations. In the early part of the 20th century there was a great desire for giving music new forms of expression by extending traditional tonality and using innovative techniques in rhythm, tonality, form and unusual instrumentation. Arnold Schönberg developed atonality and later the twelve-tone technique. The technique is a means of ensuring that all 12 notes of the chromatic scale are sounded as often as one another in a piece of music while preventing the emphasis of any one note through the use of tone rows. Aleatory elements became important, allowing the performers to change fragments of compositions. Electronic sound generation and its integration into modern and vanguard music brought about new compositional possibilities.[10]

Musical notation

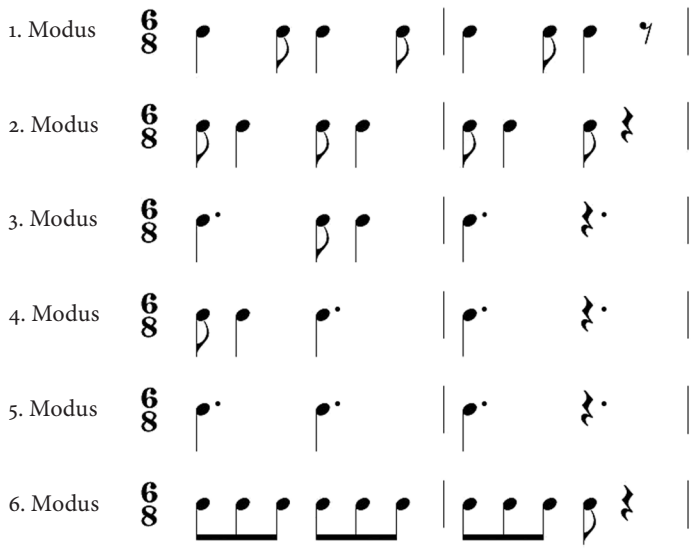
The first completely deciphered notation system comes from ancient Greece. According to different sources it is regarded to have already been used about 250 BC or in the 7th century BCE. Symbols placed above the syllables in a text indicate pitch and duration of a respective tone. Possibly these text syllables directly correspond with the string names of the Kithara, an old stringed instrument of ancient Greece. In Europe this old Greek notation system was buried in oblivion with the fall of the Roman Empire. In the 9th century symbols known as neumes (gr. Νεύμα = sign) were used as mnemonic devices for Gregorian chant. This neumatic notification was without staff-lines and is also called cheironomic (using hand signals to direct a vocal music performance), in campo aperto (without staff) or adiastematic. The single neumes indicate the hand-gestures of the choirmaster and the general shape to be sung. Indeed, there was no standard neumatic notation and Byzantine, Roman and German symbols differ from each other.



Old-Russian neumes going back to Byzantine examples (17th century).

The adiastematic neumatic notation was gradually replaced by two-colored staff lines, to clarify the exact relationship between pitches. These lines represent the pitch between the notes C (yellow line) and F (red line). In the 11th century Guido d'Arezzo added (for pedagogical reasons) first a third line between the F- and C-lines, later even a fourth. He invented the hexachord system, with six pitches named *ut, re, mi, fa, sol* and *la*, with a semitone between mi (E) and fa (F). He also replaced the colored lines by alphabetic characters and introduced the clef to determine the position of a note.[8]

In the 12th century modal notation was common. It is the first system of rhythmic modes for a more precise notation of polyphonic music. The six rhythmical modes consist of short pattern of long and short note values corresponding to the metrical feet of classical poetry. This method was quite limited with fixed repetitive patterns. Modern transcriptions of the six modes are usually barred in $^{6}/_{8}$. The modal notation can't demonstrate syncopation or even time signature.[9]



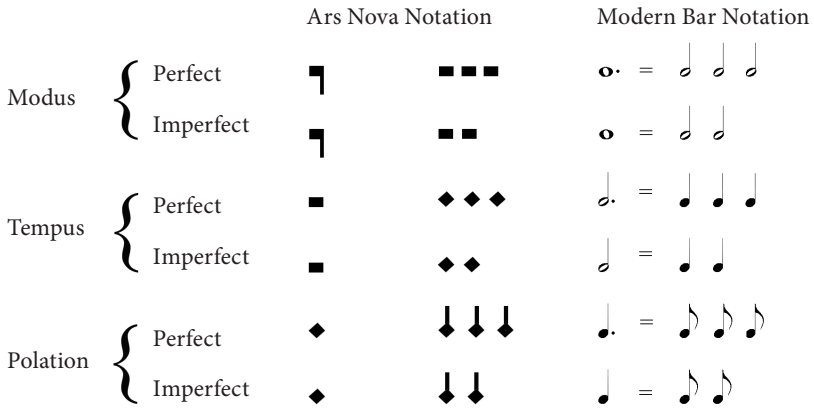
The rhythmic modes. Modern transcriptions of the six modes are usually barred in $^{6}/_{8}$.

Mensural notation grew out of the earlier modal notation. This notation system became necessary to describe precisely measured rhythmic durations in terms of numerical proportions between note values. While the modal notation only admitted a fixed quantity of rhythms, the mensural notation systematically used note shapes standing in a well-defined, hierarchical numerical relation to each other: the maxima (duplex longa), longa, brevis (double whole note) and semibrevis (whole note), with brevis and longa being the most important. The perfect duration of a longa is three brevis, but the time value of the longa could change according to its immediate context in certain situations. The metric value is dependent on the neighborhood of other notes and their value.[10]

Notes of mensural notation.

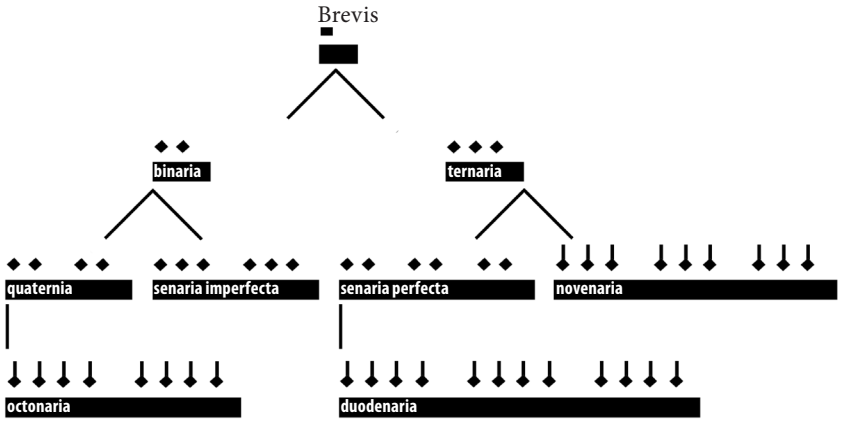
The Ars Nova introduced the imperfect mensuration with binary subdivisions in addition to the perfect mensuration with its ternary subdivision. The

division of the longa into brevis was called modus, that of the brevis into semibrevis was called tempus and that of the semibrevis into minims was known as prolation. Modus, tempus and prolation could be both perfect (major) or imperfect (minor), because they all can be divided into groups of three or twos. To indicate the proper division of a piece at the beginning they used special signs, equivalent to the modern time signature: tempus perfectus was indicated by a circle, while tempus imperfectus was denoted by a half-circle. The use of rests, ligatures, numeric proportions and coloration was another means to allow greater rhythmic complexity.[10/11]



Notes of Ars Nova Notation.

At the beginning of the 14th century the Trecento period created a new variation of mensural notation system in which the brevis is not only divided into three perfectly subordinated values but also into imperfect two values. It was a result of pioneering new forms of expression along with a disentanglement of the preceding age with its ternary form as veneration for the Trinity of God. The groups of semibrevis were now enclosed by bar lines and had the duration of a brevis. Values were indicated by the first letter of the respective division group as for example "t" for ternary or "q" for quaternary. Consonances were unison. Fifth, octave, thirds and occasionally fourths were treated as dissonances. Also accidentals occurred more frequently. Lyrical, secular songs like the two-voice madrigal or the monophonic ballata are characteristic for the Trecento.



Division pattern of the Italian Trecento notation.

With regard to pholyphony, musicians of the late Middle Ages developed more sophisticated and subtle rhythmical refinements. Besides new signs[10/11] the introduction of syncopation as a vital element to deliberate disruption of the two- or three-beat stress pattern found its way into music. Shifted syncopation chains have been the consequences.[11]

Before the invention of letterpress printing choirs often had only one single handwritten copy of a work written on vellum. Therefore, the notes were drawn quite big with black note heads. With the increased use of weaker paper the white notation became usual, because the paper was less able to withstand the scratching. Other colors and filled-in notes with "small" value were used routinely as well.[10/11]

Moreover, a further subdivision of the values proceeded. Maxima, longa, breve, semibreve and minima were complimented by crotchet (quarter note), quaver (eights note) and semiquaver (sixteenth note). As aforementioned, another achievement was the use of proportion increasing or diminishing the value of a note.[10]

Mensural notation uses symbols that represent the relationship between the value ratios. The relationship between breves and semibreves is referred to as tempus or time. The relationship between semibreves and minims is referred to as prolation. To illustrate a diminished variant they took the original tempus and prolatio signs and added a vertical stroke through it. While tempus perfectus is indicated by a circle, the diminished variant is represented by a vertical stroke

through this circle. Accordingly tempus imperfectus is denoted by a half-circle and its diminished variant by a vertical stroke through a half-circle. It is the same for the signs for perfect and imperfect prolation. The diminished values are always marked by a vertical stroke through the original sign indicating a reduction of all temporal values by a factor of two. These stroked signs are also called cut-signs. But besides the set of tempus and prolation they also had meter "briefings". To indicate the change of meter either a new mensuration sign was inserted or numeric proportions are appended to the tempus-sign. For example the numeric proportion "2" indicates double tempo (proportion dupla) and usually has the same effect as a cut sign. The proportion "3" was used as well and indicates that all notes will be reduced to one-third of their value (proportion tripla). But there were also fractions as "$^3/_4$" or "$^3/_2$". For instance the proportion "$^3/_2$" indicates three in the time of two.[10/11]

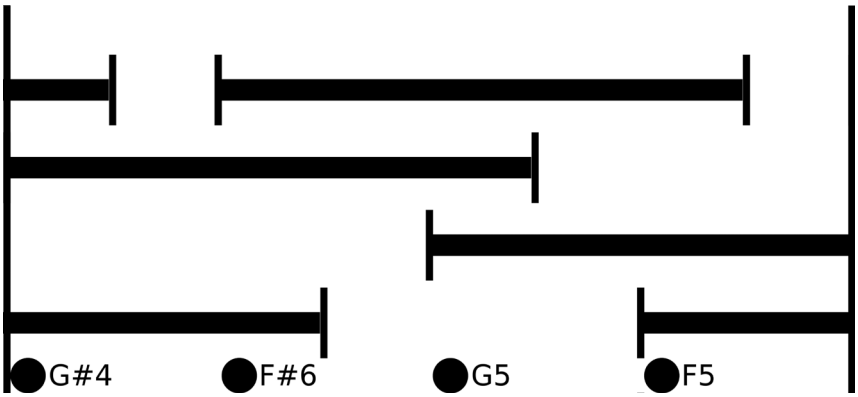
After around 1600, mensural notation gradually evolved into modern bar notation. The mensural note values changed: longa became quadruple whole notes, breves double whole notes, semibreves whole notes, minima half notes and so forth. These notes have been preserved until today.[10]

In the 13th century lines were used to divide compositions into segments. These lines had nothing to do with modern style bar lines and did not reflect a meter but have just been used as an orientation. Not until the 17th century was the bar used with every measure being the same length and being associated with time signatures.[8]

Another form of musical notation is the tablature that first occurred around 1300. Polyphonic vocal music was transferred into a notation system for instruments indicating where and when a finger should be placed to generate a note. There are different forms of tablature as for example the keyboard tablature representing the keys of the instrument or the string tablature based upon a diagrammatic representation of the strings and frets of the instrument. Other instruments can play organ tablature, while string tablatures are instrument-specific fingerboard notations.[12]

Graphic notation, especially in the field of New Music, was an inevitable development in the 20th century that went along with advanced requirements regarding rhythm, tonality, compositional dramaturgy and unusual instrumentation. Aleatory with its accidental processes, Musique Concrète recording and arranging surrounding sounds into compositional work of art and electronic

music with its spacious possibilities of sound creation are integral parts of a new musical evolution.



Ephraim Wegner, *Pattern* (2013).

In digital sound creation or sequencer programs the piano-roll notation or direct text input proved worthwhile. Similar to the note roll single touches are drawn in this simplified notation variant. Therefore it is possible to feed the computer with information about pitch, duration and volume of a tone. Using programs like *C-Sound* or *SuperCollider* the musician has to enter data in form of codes into the computer. Algorithmic composition often based on geometric, stochastic or other mathematical methods works on the same principle.

Each epoch had its own way to duplicate compositional works. In earlier times copyists usually copied each part out of the orchestra scores. Later in course of the introduction of the letterpress printing copies of musical compositions could be published in large numbers and reached a broader public. With the help of dies, of etching and engraving tools printing plates were produced. Because of its excellent quality, music engraving became the preferred method in European publishing houses and remained the primary way to print until the twentieth century, when offset printing was developed. The advent of the computer and corresponding softwares like *Finale, Sibelius* or *Lilypond* replaced the traditional music engraving method.[8]

Music in the 20th century

At the beginning of the 20th century the world was absolutely absorbed by the fascinating new options of technology and modernization. The old outdated values didn't live up with the modern feeling of being alive and there was an immense striving for new means and methods to replace the classical Romantic aesthetics. This all-embracing pioneer spirit also left its mark on music. As a result different styles of new music arose. First, musical creations were clearly influenced by the 19th century tradition, but step by step experiments with parameters such as rhythm and involving surrounding and electronic sounds broke down classical music theories. Polystylism is therefore a typical occurrence of the 20th century. The majority of the audiences reacted scandalized and opposed to theses new stylistics. Concert premieres were often scandal performances and got horrible press but at the end of the day, the press with its polarizing and defaming scribbling brought the new music into the public eye. The more people accepted new music pieces the more anticipation for sensation increased. The outcome of this was an enormous compulsion for originality, modernity and immensity often leading to consequences such as fashionable superficiality and repetition without any inspiration. Composers started to explain their works to a confused audience informing them about theoretical and aesthetic substructures of their musical pieces. There was a strong experimental, intellectual and technical examination of unsolved problems from previous periods. Getting informed was often necessary and helpful for the listeners to get the hang of this sometimes strange and disconcerting sounding music. After the public interest flagged there remained only a small elite group of supporters while the majority preferred old-style Classical music. Nowadays supporters try to win more listeners over contemporary music by offering a wide range of events and workshops all over the world.[10]

Conclusion

Musical, compositional and aesthetic innovations that have gained acceptance in the course of the history of music and characterize our modern music notation and auditory understanding went through long development stages. Composers and interpreters of new music composition should keep this in the back of their mind and realize that experimental intonations worked-out within a relatively short time bring different challenges with regard to instrumentation as well as compositional process.

By using exceptional playing techniques it is possible to elicit tones from a music instrument that come astonishingly close to the sounds of electronic music. An electronically generated sound still always differs from the sound of an object or instrument. Hence, it also makes a big difference whether one makes instrumental, electronic or electroacoustic music. I find it helpful to classify instruments, objects, sound-recordings of surroundings noises and electronically generated sounds concerning their common characteristics and differences.

In principle all these sound sources can be combined with each other. Especially the resulting aesthetics are interesting. A classification of the sound generators concerning their application strengths and weaknesses and specific aesthetics could be useful for compositional decisions. Comparably with the orchestra score one is in charge of a system providing a helpful overview.

Of course a classification of completely electronically generated music would be conceivable according to sound characteristics, e.g. by making distinctions between different synthesis forms. Nevertheless, I plead for a broadly drawn-up classification including all sound sources. The following example should illustrate my motives: you take a violin and try to find out its greatest possible sound variety, because you want to make music with it afterwards. Of course you come upon acoustic limits on the basis of instrumental construction. It is the same with producing electronic sounds: although it is in principle possible to reproduce almost any frequencies, the actual sounds are constrained by the software and by the loudspeakers and other hardware. Combining both the sound possibilities of violin and computer definitively gives you a bigger scope for action. Whether it is really necessary depends on the composer's musical idea, but such knowledge may help to develop an individual music style.

While creating musical systems being performed by others it is important to write down the idea in an understandable way. Thus experimental music needs other forms of notation than the traditional musical notation. It is also necessary to think about an exact fixing of the musical process. To leave decisions to the interpreter gives scope to improvisation and allows the musician to develop his own interpretation of the composition. In completely improvised music combinable play techniques serve for making music together, often without any other directives.

The application of electronic sound production can vary strongly. Thus it is possible to develop instruments that generate either complicated musical pieces

or just play one tone after the other by pressing a key. Some input media instruments can be used for playing from the sheet, although the tones generated by the instrument do not correspond to the assigned value. This is possible with classical music instruments such as piano, guitar or violin being tuned differently, as well as with synthesizers, keyboards, etc., with each key representing a sound. The notation still remains readable, nevertheless the result changes by these new allocations. So a well-tried sign system is broken down and used in an experimental manner.

Musical processes can also be implemented by the input of text, by direct manipulation in graphical user interfaces or by controllers. By means of sensors or cameras it is possible to receive data from the environment to generate music. According to the composition of the data generating subject and the setting conditions defined results as well as strongly diversifying and aleatory compositions can be engendered. Another factor affecting the reproducibility of the result are analysis technology and its precisions. With such procedures the setting and related functionality should be described as well as possible. Sometimes it is required to make a construction plan.

Thus either the instrument must be attuned to the notation or the notation to the instrument. Besides, it is important that unstandardized instruments are accessible for the interpreter. Another possibility is the application of self-made software living up to the respective requirements.

The history of electronic sound production has been closely connected to modernity and mechanization. The development of early electronic sound generators has often taken place on behalf of industry or government. The reasons are manifold. In case of the Vocoder, for instance, it was about encoding voice or compressing messages for transmission.

With the mechanisation of all areas of life a strong optimism towards progress developed. Technical innovations should grasp all areas of being and make life easier. This also happened with musical instruments: at the beginning of the 19th century there was already the idea of substituting whole orchestras and equipping home musicians with musical innovations. By means of elaborated programming environment, various sampling techniques and huge data volumes of instrumental sound recordings it is meanwhile possible to reproduce orchestra music completely on the computer.

In my opinion it is rather more exciting to search for new experimental aesthetic possibilities than using well-known aesthetic forms. This can be done with the help of approved procedures or absolutely detached of them. So one is able to handle recurring musical means and avoid clearly relatable stylistic forms. These allocations result from the lineup and recurring motives in harmony and rhythmic. Within the different kinds of music there exists a more or less closely defined classification. Even in experimental electronic, improvised and new music these classifications take place. Here, however, the ambition for innovation is stronger than in music styles based on more conservative patterns. Experimental electronic, improvised and new music generates music under the proposition of constant innovation.

Which associations of listeners trigger such processes? What is happening when there is no common denominator? When a clearly defined, previously agreement about events is missing? Could it be a common ground not making any commitments? And… is it possible to achieve these associations by a composition exclusively existing of quotations?

1. http://de.wikipedia.org/wiki/Musikinstrument
2. http://www.musikinstrumente-abc.net/musikinstrumente-klassifikation.html
3. http://de.wikipedia.org/wiki/Partitur
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12. http://de.wikipedia.org/wiki/Tabulatur