STUDIA UBB MUSICA, LVII, 1, 2012 (p. 71-78)
(RECOMMENDED CITATION)

THE EVOLUTION OF THE INTERFERENCE OF NEW TECHNOLOGIES IN MUSICAL CREATION

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SUMMARY. The present study follows the new technologies adopted in musical creation and production. We diachronically pursued the first steps of technologies involving electronics in musical processes. We presented examples of devices and inventions with applicability in music, which stood the test of time. The diachronic perspective includes the present and, in the end, we highlighted the main direction of the present time: the virtualization of devices due to computers, hence, the enormous potential, very little exploited, of musical software in musical creation. The second part of the study presents specific examples from the author's own works presented as case studies where new technologies help and renew musical creation.

Keywords: technology, electronic music, computer, software, virtualization, composition

1. Introduction

The development of any type of technology had, sooner or later, repercussions on the artistic environment, too. The technical and pragmatic as well as creative way of thinking made technological development possible regardless of period and influenced artistic creation more than one might imagine.

For example, ever since metalworking became more accessible, the brass instruments have known unprecedented development, both from the point of view of construction and from that of the interpretation technique.

Another example is the evolution of the piano that has been closely connected to the techniques of working and forging cast iron, of the steel used in making the strings and with the evolution of the industry needed for the compulsory hybridization of the percussion system (key balanced with led, metallic axes, metallic rods, felt buffers, gavels made of wood combined with felt etc.).

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2. Historic Landmarks

In what follows, we will mark a few hallmark moments in the evolution of electronic music, mostly generated by technological evolution.

The discovery of producing, stocking, control and use of electricity has triggered an entire evolution in all forms of art. A conclusive image is that of the system for stage illumination, where Edison's light bulb was making its presence rapidly felt in theatres.

In the world of sound, the first attempts of producing sounds from electricity without a mechanic intermediary (which would generate oscillations later to be transformed in electrical oscillations) were those of **Thaddeus Cahill** (1867-1935) – an American inventor. He managed to invent and build a complex instrument, very evolved for its time - *Teleharmonium*.

Fig. 1

Teleharmonium – first version

This is a very clear example of the influence of technology on art as the purpose of this instrument was not to generate new timbres, but to transmit music at a distance, through the network wires of newly invented telephone. The inventor intended to create a musical network for several hotels, having an instrument player in front of the *teleharmonium,* acting as a transmitter, and acoustic devices as multiple receivers, based on the infrastructure of the telephone. In describing his invention (patent number 580 035) Cahil uses for the first time the term *synthesizing* (sonorous a.n.). One of the characteristics of this instrument is its weight – 7 tons – the first version, almost 200 (two hundred) tons and almost 18 meters long – the second version. Moreover, the quantity of electricity consumed was very large even for our days. The first demonstration of

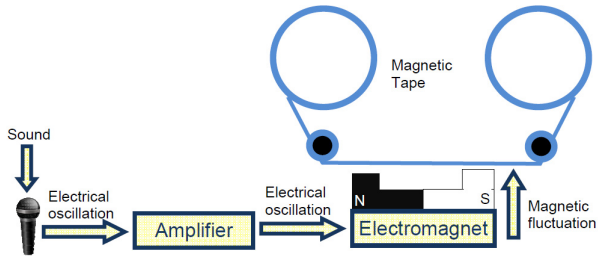
this instrument was made in 1902, with the broadcasting of the piece *Largo* by G.Fr. Haendel, from Cahil's plant (in Washington) through telephone wires, to a restaurant in Baltimore. After a period of glory, the *Teleharmonium* suffers rapid decline due to the problems caused by electric interferences of telephonic cables which perturbed telephone calls.

Another important step in the evolution of musical creation through modern technology was marked later on, when a system was created for sounds to be recorded on mediums easy to manipulate with relatively low cost devices – the **magnetic tape**. The device using magnetic tape is called **tape recorder**.

The first versions of this invention used a metallic wire which was being magnetized by different magnetic fluxes to be read afterwards. Due to the fact that the magnetic wire was relatively fragile, in the shape of a cylinder and not very thick, meaning that only a small part of a wide range of frequencies could be recorded, several other variants were researched; among them, a thin, plastic tape over which magnetic material was pulverized and fixed was preferred. The new method had obvious advantages: the width of the tape ensures a larger quantity of recordable information, plastic was more flexible and easier to manipulate and especially the fact that two or more tapes could be combined by using adhesive tape, facilitating thus the editing of sonorous material.

The functioning principle of this invention is very simple. Mechanical sound waves are transformed by the microphone in electric waves. They are amplified and sent to an electromagnet, whose current is modulated by these electric waves so that the frequency and amplitude of electric waves are transformed in an oscillating magnetic field (vibrating) with the frequency and amplitude identical to that of electric waves. The frequency of oscillation of electric waves transforms, within the electromagnet, in the frequency of interchanging the magnetic poles and the amplitude of electric waves changes into intensity of the magnetic flux. These two components, frequency of interchange of the magnetic poles and intensity of the magnetic field, "impress" the magnetic material on the tape which has a certain linear speed against the generated magnetic field; therefore every centimetre of tape contains a multitude of interchanges of poles and of magnetic intensity.

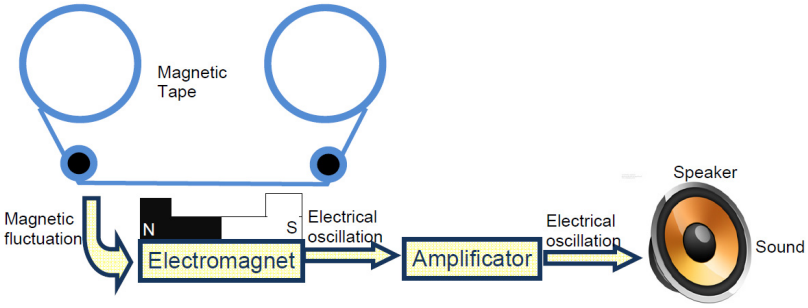
Fig. 2



Recording on magnetic tape principle

In rendering the tape the same principle is being used, only in reverse and very little: an electromagnet is influenced by changes of frequency and magnetic intensity on the tape and its magnetic field becomes oscillating exactly up to the moment it is being influenced by tape. Oscillations are transformed into oscillating electric current whose frequency and intensity are amplified and sent to a speaker, where they are transformed into mechanic energy, that is, sound waves of the same frequency and intensity with the magnetic field of the tape.

Fig. 3



Rendering sound from magnetic tape principle

Initially, this invention had not been especially intended for musical recordings, but musicians and especially composers showed great interest for it. This interest comes from the fact that existing sonorous events on tape can be directly and simply influenced: tape can be cut, combined with other tapes, the result can be recorded / rendered with other speeds than the original and the direction of the tape can be reversed. We have therefore three methods of work which can be combined and have great potential in musical creation: editing (cutting and combining), modification of recording / rendering speed and reversing the direction of the tape.

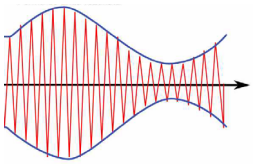
In London, the BBC had an entire department (BBC Radiophonic Workshop) dealing only with this type of sonorous organization. They worked with pieces of tape ranging from 1 centimetre to 10-15 meters long in devices for reeling and charging the tape recorders. This way, with pieces of tape processed not only through the methods described above but also through re-recording through certain filters or acoustic frames of sound, musical sounds of new timbres and different durations were generated and patiently organized to form musical pieces to be used especially for the credit titles and scores of radio theatre plays, TV series and science fiction movies, documentaries as well as for everything connected with technology and the future.

Following a flourishing period, when a few composers with technical talent emerged – engineers such as Delia Ann Derbyshire, John Baker, Glynis Jones and others, the activity of *BBC Radiophonic Workshop* was stopped due to lack of funding, but also due to the invention of a new device, mush easier to handle, **the analogue synthesizer**.

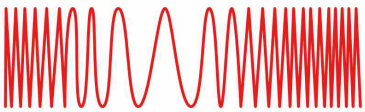
The invention and capitalization of the analogue synthesizer was a very important step in the development of musical creation based on modern technology. From this moment on composers can create not only the score of a piece, but also the sonorous generator, with the possibility to have very fine control of details, otherwise very difficult to obtain with the help of acoustic instruments. Due to its functioning principles, the analogue synthesizer allows for choosing of one or several types of primary waves, generated by one or several oscillators, to be combined in various ways, filtered with one or more types of filters, disposed in a sequence or in parallel, with the possibility to modulate both filters and oscillators of low frequency generating frames.

The principles of generating and combining sound waves in analogue synthesizers existed mostly due to the evolution of radio transmission, which had great impact on sonorous synthesizing because of the principles of combining waves. The principles used in radio transmissions have also been adopted in creating new forms of sound waves. The most used ways of radio transmission with direct applicability in sound waves are:

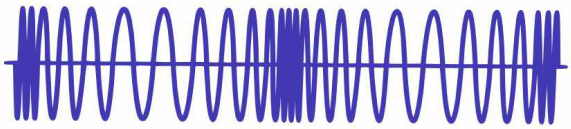
- Amplitude Modulation (AM)



- Frequency Modulation (FM)



- Phase Modulation (PM)



Amplitude modulation (amplitude change of a bipolar carrier wave according to the shape of a unipolar modulating wave, mathematically represented by the values of the modulating wave multiplied by those of the carrier wave), used in very long-distance radio transmissions, generated electronic music – additive synthesis and *ring modulation.*

Frequency Modulation keying, used in high quality radio transmissions (where a carrier wave is modulated by another in the area of frequency by change of amplitude), generated the FM synthesis, a procedure which remained in history due to its use during the 80s and the 90s by a legendary instrument: the Yamaha DX7 synthesizer, used in many types of acoustic productions – from experiments to rock music.

Synthesis based on principles of radio transmission by phase modulation has generated several synthesizers (series CZ) produced by Casio.

The appearance of digital control techniques as well as of those for stocking information has created new ways of control of the electronic medium and of synthesizers. Consequently, for the first time, the multitude of tunings of an analogue synthesizer could be stocked in one of its digital levels and used when necessary. Tunings became finer because there was a digital command and not a potentiometer dictating the electric value of a certain component – a code which could be stocked with maximum of accuracy. The synthesizer becomes therefore a more versatile instrument.

The evolution of digital technique and of informatics in general does not stop here. Based on mathematic, quantifiable and digital formulae of sound or on the basic acoustic models, sounds very close to the purity of ideal models of wave can be generated with the help of a computer or digital synthesizers. Therefore, the bases of the virtualization of acoustic synthesis are laid, virtualization which nowadays is involved in almost all activities.

The computer, besides the multitude of possibilities offered in various fields, is involved in most present musical productions. When speaking of live performances broadcasted by mass-media or of recordings and tuning of materials on various supports (CD, DAT tapes, DVD or BR), as well as of composition or experiment – the computer and digital techniques gradually become indispensable.

Therefore, a multitude of music programs or groups of programs have been created for recording, editing and live mixing, integrated in computers or special devices – all of them offering mostly a virtual working medium. Only what is recorded during a concert or during recording sessions remains “real”, the rest, beginning with editing and continuing with processing, finishing and mastering in an intangible medium – the virtual-digital medium, where all sound waves become easy to manipulate codes, having at the same time the important advantage of not deteriorating in time.

3. Virtualization

Sound synthesis is replicated in the virtual medium, hence giving birth to a multitude (hundreds) of virtual synthesizers, some of them mere copies of real analogue synthesizers (Moog, Yamaha or Korg). Virtual mediums imitating a complete studio also appear, represented by software such as *Propellerhead Reason*, *Cubase*, *Protools* etc. The editing of scores moves from the printing house to the house of every composer, to their computer, making creative work much easier from the point of view of the graphic arrangement of scores. The software already established and used on a wide scale are *Sibelius* and *Finale* (both commercial software) and *MuseScore* (free software with editing possibilities comparable to those of the commercial software).

The virtualization of all elements of musical production, from creation to recording on any type of support, has offered composers several directions. We will highlight a few of these directions, focusing on three works composed in the research project type TE, *The artistic and social impact of the contemporary music of the 21st century from the perspective of the relationship composer-performer-audience*, financed by C.N.C.S.I.S. – U.E.F.I.S.C.S.U. with the contract no. 5/5.08.2010.

One of these directions is represented by the processing of sounds taken from the acoustic environment, using a procedure similar to the technique used by the *BBC Radiophonic Workshop*.

Consequently, in the work *Golem for clarinet, piano and electronic music*, belonging to composer Cristian Bence Muk, spoken words in Hebrew from the Exodus were recorded and processed in various ways, with the help of the virtual studio *Propellerhead Reason* and of the *Audacity* software, by reversal and different rendering speeds. The work also contains a moment of Hebrew folklore where the acoustic clarinet, together with the piano, is juxtaposed over virtual retorts of the clarinet, realized in a process of acoustic sampling and organized in a virtual sample-player, with a procedure similar to that of small pieces of magnetic tape used by the composers of the *BBC Radiophonic Workshop.*

Another direction is represented by the use of musical or rhythmic phrases rendered in a loop (*loop playing*).

This procedure was used in the work *Skizo Folk* for clarinet and electronic music written by the composer Răzvan Metea. He used the *Reason* software in order to create the electronic score. Here, the composer creates the phrases to be rendered in a loop both by omission or addition and by alteration of elements from pre-recordings. Therefore, the work method is extremely versatile, allowing for the creative realization of new elements from pre-recorded materials.

In the work *Klarinetix* for clarinet and electronic music belonging to the composer Ciprian Gabriel Pop, a third direction of musical creation with the help of electronic music is revealed: creating new sounds by using virtual synthesis. Therefore, the composer uses three virtual synthesizers from the software *Reason – Subtractor* (subtractive synthesis), *Malström* (graintable synthesis) and *Thor* (combined syntheses) as well as modalities of automatic and quasi-aleatoric control of their parameters through combinations of the module *Matrix Pattern Sequencer* (for details on all modules used in *Klarinetix* you can visit the section of Reason tutorials on the website *ciprianpop.eu*).

The world of technology is in continuous development, maybe more than we can imagine. Based on the same principle that new ideas and technologies are immediately adopted by the arts, we nowadays witness an interference of arts as well as interdisciplinary performances, where the involvement of multi-media and of the newest methods of sound generating, light control, scenography etc. are controlled by the device with the widest and more rapid circulation in all fields – the computer.

Notice: "This article (specialty study) is part of the TE research project The artistic and social impact of the contemporary music of the 21st century from the perspective of the relationship composer-performer-audience (Project director: Lect.univ.dr. Cristian Bence-Muk), project financed by C.N.C.S.I.S. – U.E.F.I.S.C.S.U. with the contract no. 5/5.08.2010."

Translated by Roxana Huza

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