Latin American NIMEs: Electronic Musical Instruments and Experimental Sound Devices in the Twentieth Century

Martín Matus Lerner
Desarrollos Tecnológicos Aplicados a las Artes
EUdA, Universidad Nacional de Quilmes
Buenos Aires, Argentina
mmatus@unq.edu.ar

ABSTRACT

During the twentieth century several Latin American nations (such as Argentina, Brazil, Chile, Cuba and Mexico) have originated relevant antecedents in the NIME field. Their innovative authors have interrelated musical composition, lutherie, electronics and computing. This paper provides a panoramic view of their original electronic instruments and experimental sound practices, as well as a perspective of them regarding other inventions around the World.

Author Keywords

Latin America, music and technology history, synthesizer, drawn sound, luthería electrónica.

CCS Concepts

• **Applied computing → Sound and music computing** • Applied computing → Performing arts • *Social and professional topics → Historical people*

1. INTRODUCTION

In previous editions of The International Conference on New Interfaces for Musical Expression, Latin American researchers have presented interfaces and instruments of their own authorship. The Pandiva [5] and Illusio [6] from Brazil, Santiago [16] and Osiris [18] from Argentina, and the Chilean Arcontinuo [8] may be mentioned as examples.

However, in many relations on the history of music and technology, there exist partial or total gaps regarding the emergence and evolution of NIMEs in Latin America during the twentieth century, as well as the figures who developed them. This paper aims to provide a panoramic map of some of the experimental music and sound devices developed during this period in Latin America by musicians, researchers and electronic luthiers, for the creation of their own works or as technological support for other composers (up to the earliest computer-based instruments). The main objective is to make a historiographic contribution to the NIME community, in the context of its first edition held on Latin American territory.

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2. EARLY EXPERIENCES

2.1 The singing arc in Argentina

In 1900 William du Bois Duddell publishes an article in which describes his experiments with "the singing arc", one of the first electroacoustic musical instruments. Based on the carbon arc lamp (in common use until the appearance of the electric light bulb), the singing or speaking arc produces a high volume buzz which can be modulated by means of a variable resistor or a microphone [35]. Its functioning principle is present in later technologies such as plasma loudspeakers and microphones.

In 1909 German physicist Emil Bose assumes direction of the High School of Physics at the Universidad de La Plata. Within two years Bose turns this institution into a first-rate Department of Physics (pioneer in South America). On March 29th 1911 Bose presents the speaking arc at a science event motivated by the purchase of equipment and scientific instruments from the German company Max Kohl. In this demonstration, a phonograph reproduced a recording of Italian Singer Eva Tetrazzini's voice, while the sound emitted was caught by a microphone. The current modulated by the microphone fed the speaking arc. The press at the time notes that those invited to the event were "a select group of our intellectual element, journalists and even 'some ladies'." [27]. The event was a great success according to public opinion, and had unheard of repercussion for a university event, acquiring the dimension of a theatrical event. Ramón Loyarte describes it as "a performance" and the scientists as "actors", Bose being spoken of as "a high-hearted magician"[1].

2.2 The Multi-Organ

Juan Blanco was a key figure in the electroacoustic and contemporary musical creation in Cuba. In 1946 Blanco gives at UNEAC (Unión Nacional de Escritores y Artistas de Cuba) the first concert of concrete and electronic music in that country. In 1942, besides obtaining a degree as Doctor of Civil Law from the Universidad de La Habana, he'd also presented at the Patent and Trademark Office the descriptive memory and graphic information of a musical instrument of his invention: the Multiórgano (Multi-Organ).

The operating principles of this instrument are based on the reproduction of loops made with the old technique of recording on magnetic wire (Figure 1). It's provided with twelve loops, each with the recording of one note of the chromatic scale. These recordings are read by a magnetic head, and the signal is amplified by the activation of corresponding keys on a keyboard, with the possibility of adding different timbres depending on the loops installed. It is polyphonic and it is further provided with two pedals: one to change the intensity of the sound and another

[1] A hundred years later a commemorative experience was to be held at the original amphitheater [14].

one to vary the speed of reproduction of the wires, which allows for changes in pitch [29].

Even if Blanco never gets to build this instrument, it represents a pioneer project in Latin America, since its design anticipates principles used in later instruments such as the Chamberlin and the Mellotron (both based on magnetic tape recordings). The original design printed on ferroprusside was presented by Blanco at the international symposium “Musical Inventions and Creations: Denial of Utopia” in 1991 (Bourges) [9]. Juan Blanco's original schematic was collected by the UNESCO [17].

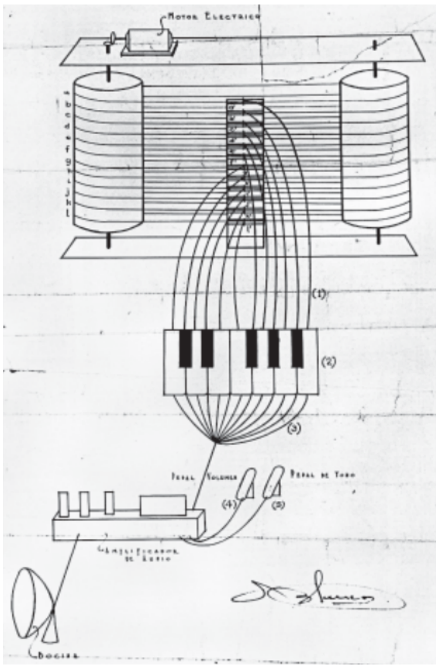

Figure 1. Diagram of the Multiórgano

3. INSTRUMENTS BY RAÚL PAVÓN SARRELANGUE

Mexican engineer Raúl Pavón Sarrelangue recalls that, after attending a concrete music concert at Radio France (Paris) in 1958, he felt that “the logical path for music (…) was by means of utilizing the enormous resources provided by music electronics”. As a consequence, Pavón builds a prototype for a one-octave music instrument, in which each note controls the reproduction of a magnetic tape loop. In trying to obtain a patent, he learns that this principle had already been patented, and was being used in several instruments [25]. Similarities may be observed between this instrument and the design of Blanco’s Multiórgano.

In the sixties, Pavón designs and builds an analog synthesizer which he names Omnifón (Figure 2). According to the description rendered by the author, this synthesizer had an oscillator with square, sine and sawtooth waveforms (with a 10 Hz to 20kHz frequency range), an envelope generator, a noise generator, and filters, among other modules[2]. Around the same time, researchers in different parts of the World were working on diverse analog synthesizers; the Synket by Paolo Ketoff and John Eaton in Italy, the multiple musical instruments by Robert Moog and Donald Buchla in the USA, and the Integrated Synthesizer by Erki Kurenniemi in Finland [22].

One of the concerns expressed in his book refers to a new profile of “technological artist” that is outlined in the twentieth century thanks to the use of new technologies in the arts. Pavón reflects upon the fact that since the sixties “a hybrid generation of scientist-artists has emerged, who are giving an enormous impulse to art in all its manifestations [25].

In 1970 Pavón, with Héctor Quintanar, founds the Electronic Music Laboratory at the Conservatorio Nacional de Música, where the first electronic and electroacoustic music concerts will be held in Mexico. In 1976 Pavón leaves his work in the industry, devoting himself completely to electronic music and the development of the Icofón. This is an instrument for the generation of images based on sound, using the visual results given by an analog oscilloscope in Lissajous mode being fed with audio signals. Even if the oscilloscope screen gives out monochromatic results, Pavón obtains color images by placing spinning color discs in front of the screen, a technique inspired by the first experimental color TV sets. The Icofón allowed not only the generation of still images; the author refers to the work with filmed sequences, color transparencies, multi-exposure, among other techniques and possibilities. On April 20th 1980 Pavón presents the Icofón in an audiovisual performance with multiple screens in Mexico. In this concert the electronic soundtrack was used to generate the visuals. Later he’d create a series of works for this new instrument, among which *Suite Icofónica* (1983) “probably inaugurates the era of multimedia electroacoustics in Mexico” [28].

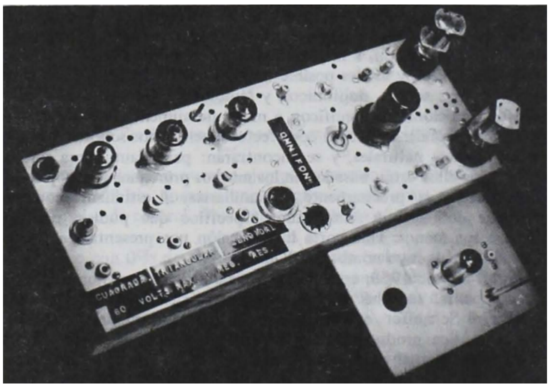

Figure 2. The Omnifón

4. EXPERIMENTAL SOUND DEVICES BY FERNANDO VON REICHENBACH

The CLAEM (Centro Latinoamericano de Altos Estudios Musicales) was inaugurated in December 1961 within the setting of the Torcuato Di Tella Institute (Buenos Aires, Argentina). It emerged under the initiative of composer Alberto Ginastera, counting on key funding by the Rockefeller Foundation. Among its main objectives were the formal training and perfecting of composers, as well as the diffusion by means of concerts and festivals. From its beginning and until its closure in 1971, besides providing formation to an important amount of Latin American interns, this center received the visit of international figures such as Pierre Schaeffer, Iannis Xenakis and Vladimir Ussachevsky, among others [21].

In 1964 Horacio Bozzarello is put in charge of building the first Electronic Music Laboratory at the CLAEM. Two years later this role is passed on to engineer Fernando Von Reichenbach, a researcher specialized in the creation of technologies applied to music and arts, who within this area will develop a series of original experimental inventions applied to electronic and electroacoustic musical creation. In 1967 the Electronic Music

[2] In his book Pavón mentions 1960 as the year of creation of the Omnifón, while Pareyón points out 1964 [24].

Laboratory is formally inaugurated, and it will come to position itself as the most important one in Latin America. According to Vázquez the incorporation of composer Francisco Kröpfl that same year, along with Von Reichenbach's inventive power "enabled an ideal means for interns to explore composing by unconventional media of difficult access at the time" [33]. Between 1968 and 1971 the Laboratory had Walter Guth, Julio Manhart and Enrique Jorgensen as technical assistants. Von Reichenbach would also give the course "Techniques of Electroacoustic Instruments" in 1969 [15].
At the CLAEM Von Reichenbach conceives a very original device: the Convertidor Gráfico Analógico (Analog Graphic Converter), also known as "Catalina". This system allows the control of synthesizers and audio processors by means of Control Voltage, based on visual information captured by an analog video camera. Its creation dates back to 1967 and the modules controlled originally were a Moog oscillator, a filter and equipment of his own construction (Figures 3 and 4).

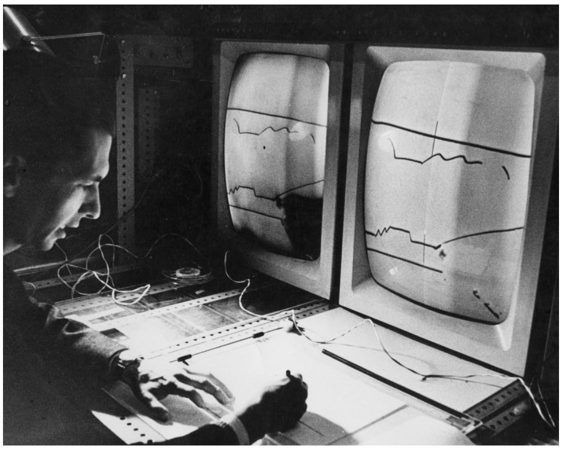

Figure 3. Von Reichenbach with the Convertidor Gráfico Analógico

Von Reichenbach explains that "the composer could take the paper sheet or roll home, and by means of a template which had the tempered scale on it, he could draw a melodic line and the volume alterations, filtering level or combinations of them" [11]. "Examples: a horizontal straight line produces a determined frequency whose pitch depends on its distance from the abscissa axis or reference line. An inclined line, however, produces a glissando. If the line is drawn free-hand, aleatory fluctuations are produced with a certain degree of control, similar to those produced by the performer on a traditional instrument, e.g., a violin" [34]. *Analogías Paraboloides* (1970) by Pedro Caryevschi was the first composition created with this device.
It is possible to situate Von Reichenbach's Analog Graphic Converter in the tradition of "drawn sound" devices [10], such as the ANS Synthesizer by Yevgeny Murzin (c1950-57) and the ORAMICS system by Daphne Oram (1962-65). However, the previous inventions are based on optic sound, whereas the innovation of this system lies in the work with analog video[3]. For his research in this field, Von Reichenbach will receive in 1971 a Guggenheim Foundation scholarship. In the same year, the inventor presents the application for its patent in the USA, under the name "Process and apparatus for converting image elements to electric impulses" [34], to be granted to the Torcuato Di Tella Institute two years later.

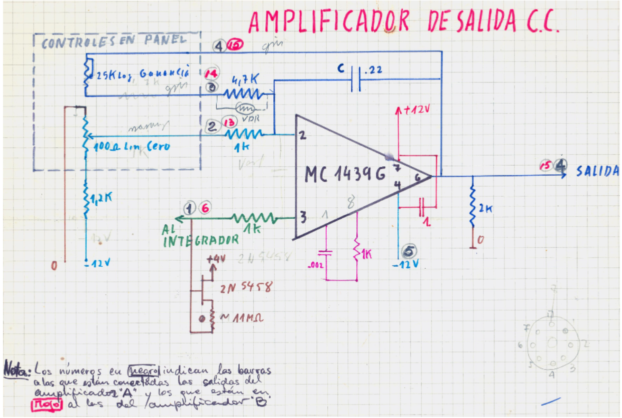

Figure 4. Original diagram by Von Reichenbach

Besides this system, Von Reichenbach conceives other original artifacts: a polyphonic filter by thirds and octaves based on a modified Bruel & Kjaer filter controlled by a keyboard, a visual patch panel for the interconnection of audio equipment and an analog system for multichannel sound spatialization. Von Reichenbach further designs a system based on the use of photoresistors that provides interactive sound for the immersive installation *500 watts, 4.635kc, 4,5 ciclos* by the artist Margarita Paksa, presented at the "Visual Experiences" exhibit (1967) at the Di Tella Institute[4].

5. ELECTRONIC MUSICAL INSTRUMENTS FROM BRAZIL

Since the 1960s, successful experiences in the NIME field have been carried out in Brazil. Pinto marks as a key milestone the electroacoustic music concert "Concerto da série Juventude" held in September 1961 at the Municipal Theater of Rio de Janeiro, directed by Henri Pousseur and interpreted by David Tudor. Works such as *Kontakte* by K. Stockhausen and *Scambi* by Posseur, among others, were presented. This concert was attended by Jorge Antunes, a student at the Escola Nacional de Música, who will then approach electronics through radio repair courses (from 1962 Antunes will also study physics at the Faculdade Nacional de Filosofía).
Since his youth, Antunes was interested in the possibilities of new technologies and the use of electronic sounds in musical creation. In 1961, based on a circuit taken from the magazine "Radio Técnica", the composer built a Sawtooth Wave Generator designed specifically with musical performance in mind. It had a frequency range of 0.4 Hz to 20 kHz and had an interface composed of switches, potentiometers and a modulation control (similar to a pitch bend wheel of more modern instruments). Also based on a circuit from a magazine, in 1962 Antunes elaborates a spring reverberation module.

[3] In the mid-sixties, Fausto Maranca and Jorge Menyhart built the "Fotomodulador Dinámico" (Dynamic Photo-modulator) for the Estudio de Fonología Musical (Universidad de Buenos Aires). This device allowed the mixing of electronic sounds, based on photoresistors. According to Menyhart, it was inspired by the Analog Graphic Converter, and by means of graphics it allowed "to control the envelope of several signals simultaneously without the need of a synthesizer like the Moog, instrument that unfortunately was out of the scope of the EFM" [19].

[4] In several interviews, it is interesting to catch a glimpse of how Von Reichenbach's particular inventive conception possesses an artistic-technological ethos that could be related to the more recent one of "hardware hacking" [11] [23].

Later Antunes will be attracted to the Theremin, building two versions of this classic electronic instrument. The first version of 1963, had an antenna with an original sculptural design (composed of wooden balls joined by aluminum tubes), designed to add visual appeal to the performance. This version was based on the original circuit, but its unique antenna allowed the control of the frequency, the amplitude being fixed (Figure 5). The second version (1965) had two antennas (for frequency and amplitude) and a design similar to that of the original instrument[5] [26].

Figure 5. Antunes playing his first Theremin in 1968

Some years later, between 1975 and 1978 Guido Stolfi designed and built the Sintetizador Modular Digital (Digital Modular Synthesizer) at the Escola politécnica da Universidade de São Paulo. This modular monophonic voltage-controlled synthesizer could be controlled both manually and by a computer in real time. It was built with a Hewlett-Packard 21MX computer and its software was programmed in Assembler[6]. It had several analog modules (filters, envelope generators, etc.) and the innovative aspect that the waveforms were generated by a digital oscillator. In addition, the system had a synchronization module for magnetic tape control, which allowed simultaneous playback of recordings (Figure 6).

Stolfi details that the computer has two versions of the compiler program to generate sequences of notes and parameters ("Score Music Compiler" and "Quick Compiler") [31]. Programs can be stored in memory to be executed, or stored on perforated paper tape for later reading. Among other options, it had possibilities for Fourier FFT analysis and the possibility of generating random sequences based on statistical distributions, based in turn on user-defined tables. Although this synthesizer was not used effectively by any musician, experiences with different musical styles were made: works by J.S. Bach, Anton Webern, Francisco Espuny and popular songs, among others. In the eighties, Stolfi develops the SOM sequencer software (for Apple II computers), and a sampler named Papagaio (which means "parrot", making reference to the imitative behavior of this bird).

Other synthesizers will be developed between the seventies and the eighties. Claudio Cesar Diaz Batista creates the CCDB-1 Synthesizer (1975) designed to be controlled by a guitar, while Ricardo Peculis creates a series of synthesizers, including the SPIN Poly-Synth (1983), with analog audio generation and digital control by means of the Spin microcomputer (based on a Zilog Z-80 microprocessor). That same year, Ivan Seiler creates the Modular Polyphonic Seiler Synthesizer, inspired in modular synthesizers such as Serge and Moog [26].

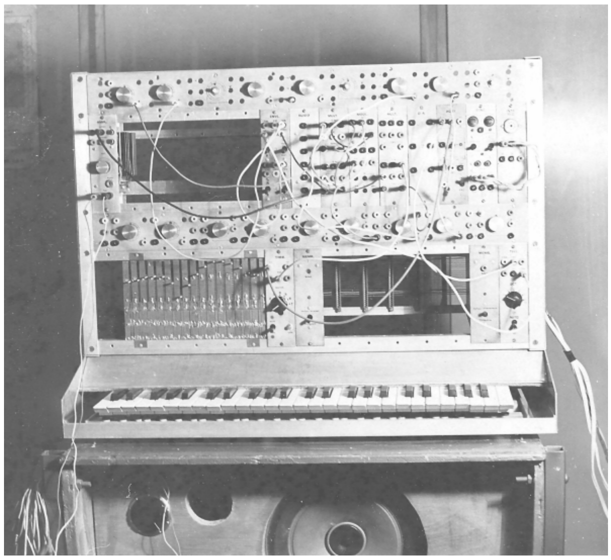

Figure 6. Sintetizador Modular Digital

6. COMPUTING EXPERIENCES BY JOSÉ VICENTE ASUAR

The Taller Experimental del Sonido started its activities in May 1957 at Universidad Católica de Chile (Santiago). Within this context, José Vicente Asuar would stand out due to his sound formation both in engineering and composing[7]. In 1969 Asuar began his investigations on applying computers to musical creation. Influenced by the work of Max Matthews with the Music series of programs and by the composition techniques applied by Hiller and Isaacson in the Illiac Suite, Asuar created the research group Grupo de Investigaciones en Tecnología del Sonido with the aim of inquiring on the possibilities of composing assisted by computers. In the computing center at the Universidad de Chile an IBM360 computer was programmed using the FORTRAN IV language. The computer delivered sequences of parameters based on the composing principles of serialism. The results given by the computer were transcribed by the researchers, who in addition made certain decisions (such as instrumentation and tempo, among others). The resulting works (including *Formas I* by Asuar) were presented at a chamber music concert on December 1st 1971 [2].

After an investigative stay in the United States, with Víctor Rivera and Cristian Vergara from the Grupo de Investigaciones en Tecnología del Sonido, Asuar designs a system (formed by a PDR-8 computer and a converter module created by them) which allows the digital control of analog voltages, to control an ARP 2600 synthesizer (1972). Asuar explains that by means of this system it is feasible to "investigate new ways of performing impossible to be carried out by human players, and it opens up a path toward the achievement of new articulations and sonorities beyond instrumental technique and traditional electronic music" [3]. Some results of these investigations are in the album *El Computador Virtuoso* (1973). According to Asuar, the use of computers in composing and musical processes was "inevitable", as a result of the levels of progress reached until then by the "scientific art" [2].

[5] In 1969-70 Antunes was a fellow at CLAEM.

[6] Initially, it was controlled by the computer Patinho Feio (considered the first Brazilian computer) built in 1971-72 by the team of the Laboratório de Sistemas Digitais (Escola Politécnica - USP).

[7] In 1964 Asuar is a visiting professor at CLAEM, teaching the course "Technique for the Composition of Electronic Music".

Figure 7. The COMDASUAR (LP cover art)

As from 1975, Asuar will continue his research in his own personal lab. In 1978 he'll create the first computer in Chile designed with exclusively musical purposes: the COMDASUAR (COmputador Musical Digital-Analógico ASUAR: the "Asuar Digital Analog Musical Computer"). Based on an Intel 8080 microprocessor, it's provided with an 8 Kb EEPROM internal memory, a 2KB RAM memory, besides six digital-analog converters (DAC) connected to two Intel 8255 parallel interfaces. As regards peripheral devices it's provided with a regular TV set, a keyboard and a magnetic tape unit for software storage. The system is polyphonic (6 voices) and multitimbral, and it allows digital sound synthesis as well as controlling external analog equipment for audio generation and processing (noise generators, LFOs, effects such as ring modulator, tremolo, phaser, reverb and mixers, among other modules). One of the key characteristics of the COMDASUAR is the incorporation of tools for assisted composing, which Asuar calls "Heuristics". These possibilities allow the computer to work with probabilistic-type procedures of generation and variation of values and musical series [4]. The album *Así habló el computador* edited in 1979 shows some of the musical results obtained by Asuar with the COMDASUAR, with a didactic approach (Figure 7). According to Fumarola: "The COMDASUAR has been useful not only for high-end computer-based composition but also for pedagogical and teaching purposes. Many of its features were an advance of computer music developments that came years later" [12].

7. FINAL REMARKS

Latin America has configured a fertile ground for experimenting in the NIME field throughout the twentieth century. It's possible to situate these experiences in relation to the four stages of electronic music proposed by Battier: emergence of the first electric and electronic instruments; laboratories; synthesizers and studios on stage; and computer-based instrumentation [7].

The cases described in this investigation were selected due to several reasons. An important aspect is that a significant proportion of these authors has transcended the mere fact of having made these specific innovations, making also relevant contributions to broader fields of their respective countries such as music, art and education. Another determining aspect is the relative difficulty to access documentation, both primary and secondary sources. Dal Farra states that "Latin America is synonymous with diversity and cultural richness, but it is also synonymous with a lack of support in terms of documenting and preserving its cultural heritage" [9]. This work aims to be an initial contribution to the NIME community, which we hope can be expanded through future research. Recent events such as the opening of the "Archivo de Música y Arte Sonoro FvR" in Argentina allow us to expect new contributions to the field[8].

The instruments and devices presented in this article were prototypes developed both in institutional laboratories and private studios. They were used for periods of a few years and most of them never got commercialized[9]. Referring to his Omnifón, Pavón reflects that his synthesizer represents in Mexico "an industry that died without having been born, by the work and grace of our traditional apathy and indifference (its fabrication was offered to several electronic equipment manufacturers)" [25]. In a broader sense, the difficulty in the sustained use of new instruments over time continues to be a relevant concern in the NIME field nowadays[10].

The inventors, composers and electronic luthiers who have conceived these instruments and experimental sound devices were influenced both by aesthetic trends and technological innovations coming mainly from the USA and Europe. However, both through the study of these inventions and by encountering the thinking of their creators, it is possible to affirm that their experiences were not mere imitations of foreign inventions. They possess unique traits of their own and were carried out by means of original strategies. Therefore, it is possible to understand these experiences as "processes of hybridization" which "more than leading us to assert self-sufficient identities, helps us to get to know ways of situating ourselves in the midst of heterogeneity"[11]. It's useful to study this type of processes defying "binary thinking, and any attempt to sort out the World in pure identities and simple antagonisms. It is necessary to notice that which, in the intertwining, remains different" [13].

Even if the analysis of the historical evolution and current state of science and technology in the region exceeds the objectives of this paper, it is difficult not to mention that currently these areas are given much less priority than more developed countries, a fact that has a determining influence in the NIME field, as well as in the field of art and technology in a broader sense. About the current educational situation in this area, a United Nations brief asserts: "The geographical distribution of science, technology, engineering and mathematics (STEM) graduates is also very unequal, with two thirds of them being in Asia – mainly in India (29.2 per cent) and China (26 per cent) –, only 5.2 per cent in Latin America and less than 1 per cent in Africa" [32]. As Alonso points out, in Latin America the "precarious technological distribution, added to the difficulties of access and meddling in the developments of applied science, unites the region, situating it in a derivative position *vis-à-vis* the nations that conduct

[8] The Archivo de Música y Arte Sonoro FvR (opened in 2018) is located in the Laura Manzo Library (Universidad Nacional de Quilmes). It has the documentary archive of Fernando Von Reichenbach, who served as a professor at this University. https://archivofvr.unq.edu.ar

[9] There are exceptions such as the Seiler DigiDrum, an electronic drum by Iván Seiler (1985) that sold more than 500 units [26].

[10] In a recent study Morreale and McPherson claim that "most DMIs fail at the longevity exam". They also wonder: "is non-continuation necessarily a sign of failure of DMIs?" [20].

[11] García Canclini understands by hybridization "socio-cultural processes in which discrete structures or practices, in the sense that they existed separately, are combined to generate new structures, objects and practices" [13].

primary research. This unequal distribution and its political and social consequences (…) constitute one of the most pressing grievances in our countries, in an era in which the global reconfiguration on the basis of technological ownership sets the pace of the world´s politics and economics” [1].

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