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Electroacoustic performance as an act of creation: in praise of the bric-à-brac

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Abstract

This paper first achieves a rapid historical survey of the technologies of electroacoustic music, analog and digital, creating a complex *bric-à-brac* (hodgepodge) fundamentally constitutive of the studio/stage experience. Then, the article presents various current trends (recent interfaces, keyboards, MPE). The new possibilities of the current generation of equipment may, at last, be able to offer very good performative possibilities to the digital music studio, perhaps allowing a renewal of some of the most interesting analog practices. This complex situation can be understood and perhaps mastered with two conceptual approaches, the vocal and the percussive models. In turn, this leads towards an ecological approach to electroacoustic music practice and analysis.

Keywords electroacoustic music; studios; musical technology; analog; digital; current trends; MIDI; MPE; ecology.

Introduction

Il n'y aurait pas à se scandaliser de la disparition de l'interprète si avec lui ne s'abolissait pas une partie du « merveilleux musical » (BOULEZ 1966: 207)

Since the 1960s, electroacoustic music has aimed towards live performance, both with fixed media pieces with sound distributions systems or different “acousmoniums”, and with live tools such as synthesizers, microphones, sound sources and various real-time sonic treatments. Since the mid-1980s it also became possible to perform totally digital pieces live and carry on the analog live habits and methodologies.

In the wake of Boulez, Berio, Manoury, Murail, Dufourt and many more, real time digital music was the musical challenge of my generation born in the 1960s. Now is perhaps a good time to reflect on 40 years of digital live performance. I often wonder if we did attain our goal. Did real time really solve the problems of refined musical expression of electroacoustic music, limited for so long by poor sonic tools, compared to acoustic musical instruments or sophisticated tape-music? Many great composers (Vaggione, Stroppa, Chion...) do not think so and still prefer mostly fixed media pieces.

On the other hand, today the sonic possibilities are truly immense, both for the studio and for the stage, and often very pleasing to the ear. But are we up to the task of making quality music with those technologies? Or are we a bit lazy still or simply drowned in too many options? In this regard, the current resurgence of modular synths, with their rather poor “analog” sounds and limited sonic options, but also their many performative possibilities, seems to make some sense. Could they be more than just a commercial push to keep the technology market alive?

This article argues that live composition, improvisation and performance are now more possible than ever and that we may now achieve satisfactory artistic results, provided we do not lower our musical expectations.

I Musical Performance in analog electroacoustic music

« Nous avons, et nous continuons d'avoir une approche tout-à-fait instrumentale de la musique électroacoustique. Ce n'est pas du tout, comme on peut le croire, une musique de machines : nous utilisons les machines comme les chanteurs utilisent leur pharynx ! [...] Ces idées étaient tout à fait naturelles. Elles ne faisaient que transposer des gestes très simples, musicaux, sur un plan électromécanique. » (Julien 2004).

There are several historical steps that gave even the most “acousmatic” and “fixed media” electroacoustic music some of the performative habits that it has kept until this day. Let's discuss some important elements.

In the 1930s and 1940s, live performance of electric music was, as with instrumental music, the usual practice. At the time, a curious musician (Varèse, for instance) could find the electric organ, the electric guitar, some electric pianos, the theremin, the ondes Martenot, the Trautonium and a few other electro-mechanical instruments. Less obvious but even more important, the music scene was then and since very much impacted by microphones, amplifiers, radios, turntables, mixing tools, oscillators, filters, compressors, echo and reverberation chambers (physical rooms), and so on. All of those implied a real-time performance and artistic as well as technical skills. For instance, in 1936, Pierre Schaeffer, then in charge of the professional formation of the technicians at Radio France, wrote a series of “Studies for Musician-Mixers” which showed that he, and many of his colleagues around the world, were very aware of the aesthetic impact of electrical technologies on music. Since 1941, he remained very close to his assistants (Henry, Poullin, Tanguy, de Coupigny...) because he found in them the right mixture of technical skills and musical sensitivity.

Before an objection comes to the reader, I am well-aware that Schaeffer, in his *Musique concrète* approach, turned his back on “instrumental” electroacoustic music. It is no small feat that he realised early on (1941-44) that the recording and manipulation of sound inversed the musical process in a radical manner. In his view, sound recording equipment allowed a reversal of the traditional approach to composition (Schaeffer 1952: 25). He therefore advised to compose differently than instrumental music and to find other, non-instrumental, ways. But he did use tools in an interpretative manner, if hidden in the studio, imagining right in 1948 a “organ of turntables”, truly a kind of sampler (Schaeffer 1952: 7-8).

Something along those lines can be said of Eimert, Bayer and, mostly, Stockhausen in the WDR *Elektronische Musik* Studio: at first, Eimert and Bayer conceived a rather instrumental electric studio, with the help of Meyer-Eppler and Trautwein (Stockhausen 2001). But then, they collectively realised (perhaps also with some influence of Schaeffer's radicality) that one had to be more ambitious in the exploration of new sounds. Stockhausen came up (1953-59) with his various additive synthesis methods with the limited analog tools of the time, before picking-up speed with subtractive synthesis (filtered impulses and noises) from 1955 on. Even if this was not always discussed in detail, the actual practice of electroacoustic music forced the composer to be more conscious of the studio ecology and technique. For some (Henry, Stockhausen, Koenig, Zuccheri...) this was pleasant and exciting, for others (Schaeffer, Boulez, Berio, Nono...) this was cumbersome and tedious, if necessary.

The analog electroacoustic studio, 1960-75

What did a musician find at the time of the first technological plateau¹, around 1960? Figure 1 gives an impressionistic idea, even “cleaned-up” for the pictures:

¹ Since the late 1970s, I have been very active in recording studios of all types and still am daily. Most of the information gathered here comes directly from this experience. A few general publications cited along the article can help the curious reader. *Computer Music Journal* (MIT Press), *Keyboard Magazine* (CMP), *Sound on Sound*, *Electronic Musician* are all ideal media to keep up with technology, not forgetting YouTube or the proceedings of the

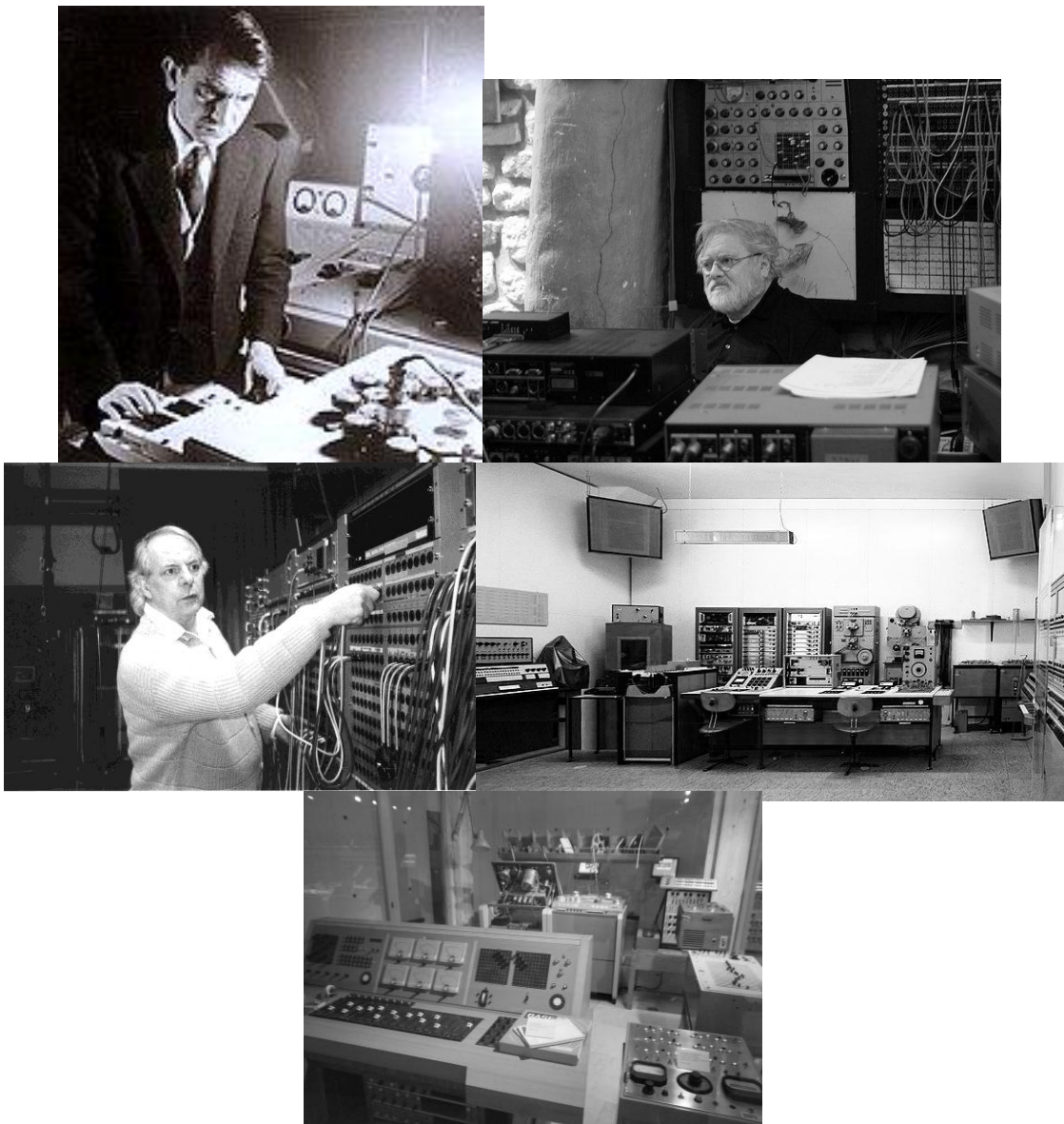


Fig. 1 Schaeffer in the Paris Studio 1953, Henry in in home 2008, Stockhausen in the WDR Studio, 1994, the Siemens Studio (c. 1959) in its current Munich museum and the Milan RAI (c. 1958) studio in its current museum.

First, as in the 1930s and 40s, one could find the electric but rather traditional ondes Martenot with their ribbon, keyboard, levers, tone buttons, and various speakers, the electric organs of numerous kinds, eventually with rotating Leslie cabinets, perhaps some other types of keyboards or an electric guitar and amp. There were also microphones, turntables and tape recorders, plate/spring reverbs, amps, compressors, filters, scissors, adhesive and tapes, and many sound sources. It is also important to note that Schaeffer and his colleagues were experienced radio producers. *Musique Concrète* performers were thus always very aware of the performance aspects of the acoustic sounds produced, their miking and their recording. This means that sound recording right from the beginning in 1948 (Schaeffer 1952: 10-12) was directed, staged, and

various international electroacoustic conferences (ICMC, EMS, JIM...).

performed, even if the early sound quality was poor at first. To this common set-up, the electronic music studio added oscillators, noise sources, filters. It also relied more on the faders, amps, plate reverbs, tape recorders, scissors, adhesive and tape, as means to shape and color the too basic sounds of the oscillators. Ten years later, the electroacoustic music studio had added more complex oscillators, filters, faders, amps, reverbs, delays, as well as effects such as a ring modulator, synthesizers, specialised electric instruments of many kinds...

As you can understand, studios rapidly became quite cluttered. All this equipment created in fact an environment with a complex ecology, a *bric-à-brac* (hodgepodge) chock full of tools of all kinds² that the user had somehow to master. This is most important: an electroacoustic composer, perhaps with an assistant or two, had to understand the tools, had to make sense on the individual modules and of their interactions, in order to produce a more or less mastered result and maintain an aesthetical quality. The equilibrium was difficult to reach between the musical aims and the actual practice, requiring manual expertise or, even, much manual labor. Stockhausen speaks about the *Gesang der Jünglinge* sessions:

I sat in the studio with two collaborators. Two of us were handling knobs: with one hand, one of us controlled the levels and, with the other hand, the speed of pulses from a pulse generator which were fed into an electric filter; a second musician had a knob for the levels and another for the frequency of the filter; and the third one would manipulate a potentiometer to draw the envelope - the shape of the whole event - and also record it. (...)

So, everyone had a paper on which different curves were drawn. We said ‘Three, two, one, zero,’ started a stopwatch... we'd all do our curves, individually produce one sound layer which was the product of our movements; and this resulted in an aleatoric layer of individual pulses which, in general, speeded up statistically. But you could never at a certain moment say, ‘This pulse will now come with that pitch.’ This was impossible to predetermine. Then we'd make a second, third, fourth, fifth layer - the number of layers was also determined and I'd synchronize them all together and obtain a new sound.’ (Mannion n.d., see also Stockhausen 2001).

The impact of such practices on musical thinking was important and arrived at a strategic moment (c. 1955-60) when serial composers were reevaluating their aims and methods. It can be argued that, along with a better experience of the performance of complex serial music, this led directly to post-serial music. Bruno Maderna evoked the aesthetical impact of such procedures in a Darmstadt conference:

La rencontre avec les moyens électroniques a véritablement bouleversé mes rapports avec le matériau musical. [...] Lorsque j'ai commencé à composer avec les moyens électroniques, j'avais surtout peur de les utiliser de manière inadéquate ; j'ai décidé de m'abandonner à mon intuition musicale plutôt que de me laisser guider par des considérations rationnelles (Maderna 1957).

After a hard-working first phase, one must say that the composers and their helpers became quite proficient in the studio and, despite the work, started to find excellent musical results (*Gesang der Jünglinge* (1956), *Artikulation* (Ligeti, 1958), *Notturmo* (Maderna, 1956)), *Visage* (Berio, 1961), *Violostries* (Parmegiani, 1964), *Presque Rien* (Ferrari, 1967-70), *Jeïta* (Bayle, 1970) and so many others...). The next step was to bring this music creation on the stage, in front of a public, starting

² Cf Pierre Henry's or Stockhausen's whole houses or, even, all studios that I have ever seen, great or small. In opposition to Boulez's early criticism (1966: 28-86), I argue here that this *bric-à-brac* is a positive situation, one that allows innovation despite its initial clumsiness.

with Stockhausen's *Mikrofonie I* (1964). This led quickly (1960-70) to ergonomic improvements of the tools, leading directly (Laliberté 1994) to the invention of the modular synthesizer as an ergonomic electronic studio and to specialised effects. This proficiency of the musicians and the adequacy of their equipment reached a definitive plateau, the analog studio ideal around 1975. The magnificent book by Allen Strange, *Electronic Music Systems* (1982) sums the musical expertise of this period, both aesthetical and technical.

Drawbacks of analog equipment

Obviously, even with the better equipment of the 1970s, analog studios had many drawbacks for music composition, and as a student in the early 1980s, I do remember the aging equipment well. To name a few:

- Poor global sonic quality
- Sound palette limitation: most sounds were variations of saw and square waves
- The number of oscillators was always too little. Thus, rich additive synthesis was rarely obtainable
- Poor ADR or ADSR envelopes
- Organ keyboards with no touch sensitivity (except for Buchla or expensive systems)
- Limited patching options, especially compact systems such as the Minimoog
- Instability (oscillator drift, mechanical and calibration problems...)
- Noise
- Cables problems: too short, broken, not enough of them
- Fragility of potentiometers (dirty, broken...) making performance difficult
- Analog equipment suffered from heat, cold, dust, transportation...
- Calibration and maintenance costs that were maybe ok for institutions and large studios but problematic for an average musician.

On the other hand, this led to a multiplication of various devices, each with its own characteristics, to compensate for the individual weaknesses, in a very creative headlong rush. ARP oscillators and filters, for instance, were of a third generation and much more stable than the original Moog ones. In turn, the multiplication of alternative modules added to the *bric-à-brac* effect and augmented the complexity of the studio. Again, Strange's book give a good idea of this.

The more ambitious devices could become complex, figure 2:

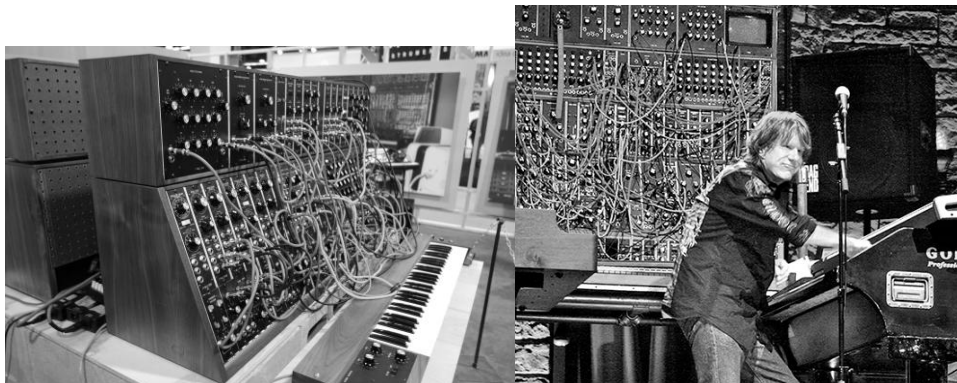


Fig. 2 a medium-sized Moog System 55(1973) and Emmerson's "Monster" synth (1971)³

³ The 55 now costs around \$35000, much less than the \$150000 or more of the Emerson "Monster" synth (Moog 2021).

The more or less massive popularity of electric sonic equipment and its integration in song, rock or dance music since the 1950s, was both helpful and problematic. On the one hand, it helped create a small but true industry: Moog, ARP, Oberheim, Gibson, Fender, Vox, Marshall, Yamaha, Roland, Korg, and so on, became salient features of popular culture. This market greatly augmented the amount of money invested and lowered the costs, especially after 1966. More diversified and better equipment⁴ was produced, mostly for pop music, but found itself in electroacoustic studios, figure 3:



Fig. 3 Schaeffer with his (reluctant?⁵) hand on a Moog module atop a Coupigny

Therefore, from this point on, this article cannot separate “popular” music and “research music”⁶. With such tools, while quite popular⁷ electroacoustic music became sometimes more banal, especially under commercial musical pressures⁸. Commercial synthesizer music — a trend after Wendy Carlos’s deserved successes with 1968 *Switched-on Bach*— too often became slightly conservative variations on organ/piano music, producing more “music of notes”, although with an electric timbre, than ambitious electroacoustic sonic constructions. Add to that the paradoxical losses brought by polyphonic instruments around 1975, despite their harmonic convenience: the left hand was now busy playing basses and chords, not available anymore to modify the sound parameters like it used to with modular or compact synths⁹.

Despite those limitations, the analog plateau was musically important and retains to this day a positive image; it is even idealised by many nowadays, especially after the aggressive marketing campaign for neo-analog musical equipment. Analog modular synths are trendy, once more.

II Musical Performance in digital electroacoustic music

Let us now shed some light on the digital version of the electroacoustic studio, its history and its drawbacks.

⁴ Commercial concerts imposed a professional sonic and instrumental quality of the equipment.

⁵ I heard him denouncing synthesizers, much to our dismay in Laval University’s electroacoustic class, as being the “atomic bomb” of music.

⁶ I doubt there ever has been a strict border between the two since 1900.

⁷ The baby-boomers were fond of novelty: for instance, the Phillips disc collection “Prospective 21^osiècle” was broadly sold and bought.

⁸ Some moments of Psychedelic Rock, Jazz-rock and Progressive Rock can often be considered as popular electroacoustic music. I would argue that this is in part due to a McLuhanian effect: common tools can lead to similar music.

⁹ A few synths of the time still allowed refined musical control for instance the Yamaha CS-80 (1976) with its polyphonic aftertouch, ribbon, pedals and very good programming.

Typical setups/environments in 1985-2000

The unavoidable¹⁰ computerisation of the world brought many solutions to the previous problems for live performances¹¹:

- Consistent sonic quality, if a bit “digital” sounding¹², especially at first (Fairlight CMI, Synclavier, Dx-7, D-50, M1...)
- Much more diversified sound palettes: new types of synthesis, hundreds of sampled waveforms, envelopes with many more stages
- Improved communication standards: MIDI, wireless mics and guitars. MIDI allowed easy communication with the computer and other sound modules that allowed in term the great development of software such as sequencers
- Development of digital toolkits and stable programming environments: Csound, Max, Supercollider, GRM Tools, ...
- Through MIDI, the basic musical controls were expanded: generalisation of velocity and after touch, standardisation of pitch and mod wheel / joystick, expression and sustain pedals
- Little or no maintenance (it worked or not) of the hardware and total dependency on easily fixed software
- Much lowered costs¹³, for much improved performative qualities. Thus, the small studios, the home-studios, became the new basic means of music composition, principally for their comfort and for the luxury of time that they allow, for a very decent, if not totally professional result.

After the analog plateau, the digital MIDI studio became an important standard and remains so, with improvements, to this day. Considering the rapid evolution of digital technologies, this is quite a feat: the MIDI standard is now almost 40 years old! This inevitable but still major success of the digitalisation of musical instruments coinciding with the invention of MIDI and the considerable development of the home studio transformed many things. Let’s review some important steps.

1: Composers, both in avant-garde and popular music, started to work with affordable small systems, often at home rather than at major studios (Barrière 1986). Tristan Murail constitutes an early influential case: much of his electroacoustic music was made in his home studio and many of his significant instrumental pieces were written with his personal digital environment (which became Ircam’s Open Music).

2: Those early systems, because of a reduction of costs and a general tendency toward leanness, became simplified in some respect. The famous DX-7 from Yamaha (1983), and a few others became the new standards, fig. 4:

Pros	Cons
Digital Fm synthesis (sonic richness and some realism)	Complex synthesis paradigm, new and unknown at the time

¹⁰ Not only a satisfactory industrial option, but this was also unavoidable because digital tool, once developed, are much cheaper to produce and to maintain than mechanical or electrical technology, much easier to improve through software and allow much more complexity for reduced costs.

¹¹ I do not deal with “classical” computer music in this paper as it was not performed but programmed *out of time*, to speak like Xenakis.

¹² The brightness bordering on rashness of those early synths was due to poor digital to analog converters and problematic filters or to the low 8-to-12-bit resolution.

¹³ For instance, since 1970 organs and synthesizers cost between \$1000 and \$3000. The prices have not changed! This means that in terms of “absolute” value, they are much cheaper now than in 1970.

	Very limited visual display (2 lines of alpha-numerical LCD) for a complex synthesis. Even worse with the rack versions (TX-816, Tx81Z...)
with velocity sensing	Limited velocity (0-100, not even 127)
16 voices of polyphony	But monotimbral. No complex orchestration possible directly, only in re-recording
Many realtime controls possible: pitch bend, modulation, sustain, volume pedal, volume fader, data entry, breath control	Only 2 physical faders and 2 wheels, plus the capacity to plug 2 pedals and a breath controller
Aftertouch	<i>Mono</i> aftertouch
32 presets	Can lead to laziness
Fully programmable	But complex to learn

Fig. 4 Pros and cons of the DX-7

Because of the complexity of programming, and limited programming interface, and because of the high quality of the presets prepared by David Bristow and others, many/most users limited themselves to a lazy organ/piano playing (as with polysynths) and using only presets. Thus, specialists with a side business of synth programming could flourish¹⁴. Other companies rapidly understood this and made preset-only “synths” (Roland D-50, Korg M1...) and samples readers. To this day, those three synthesizers remain the most sold and bought. Most of the standardisation of General MIDI and basic daily use comes directly from the choices made at that time¹⁵.

3: This led to the “lean” home studio paradigm: a synth/master keyboard, a computer, a MIDI interface and a digital (or analog) recording device for the final mixdown. Perfectly suited to the “all-digital” sound of 1985-90.

Compare the “messiness” of a big modular system, fig. 2, to the « lean » MIDI setup, figures 5 and 6, not forgetting all the rest of the necessary equipment: amps, reverbs, mixers, other instruments, mics...

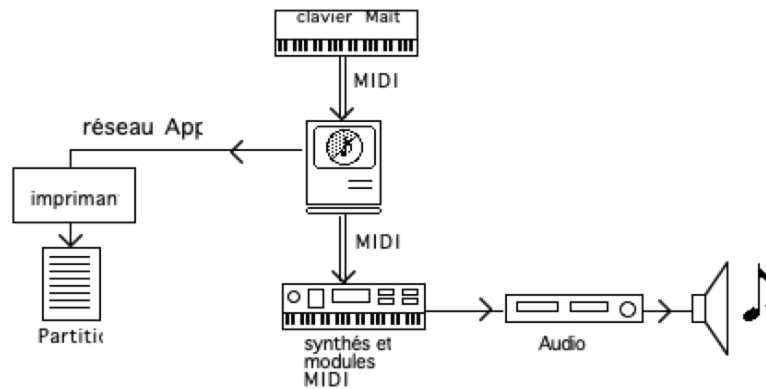


Fig 5 the lean MIDI Studio, 1985

¹⁴ It was already the case for high-profile analog systems and modular synths since the late 1960s.

¹⁵ Global volume is controller 7, modulation is controller 1, sustain pedal is controller 64, etc. The sound bank of General MIDI is closely related to the Roland sound banks of the 1990s.

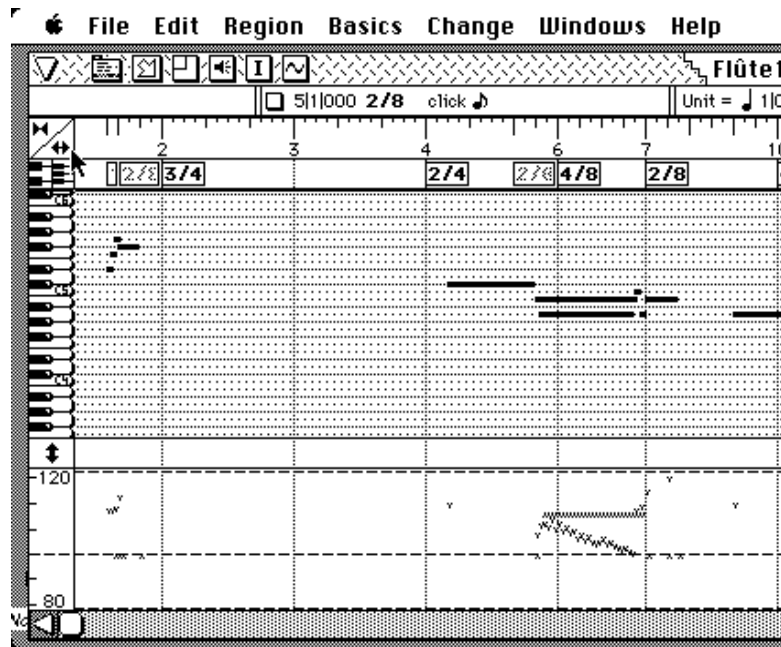


Fig. 6 Editing screen, MOTU *Performer*, 1989

4: But soon this lean version became too limited. Sampling became prevalent around 1990, implying or at least inviting to some acoustic home recording. As a kind of African American *musique concrète*, Rap/Slam/Hip Hop needed real voices and sounds, as well as cheap¹⁶ synths and drum machines.

5: And voices, guitars, wind instruments and acoustic percussions still were still relevant, for most composers. Even more so with the “grunge” or “unplugged” trends of the 1990s, this gave a great incentive to samplers (Chamberlin (1948), Mellotron (1963), Fairlight CMI (1979), Synclavier II (1983) and the affordable ones, those that really changed the way people worked: the Emulator, the Ensoniq *Mirage* and, mostly, the Akai *MPC-60* or *S series*).

6: This led rather quickly to the audio version of the previous MIDI sequencers: the DAW and its plugins (*Pro-tools* 1989, *Cubase Audio* 1991, *Logic* 1993...).

7: And to the development of other digital recording devices: VCR/Betamax, DAT, ADAT, CD, DVD, USB sticks... Thus, the recording studio became mostly digital.

8: In turn, this put a “pressure” on home studios to develop better acoustics, to record some personal sounds rather than using sound banks. This is most important in electroacoustic music, where a personal sound bank is required.

What I’m demonstrating here is that from the lean workstation of 1984, the electroacoustic studio became also a *bric-à-brac*, albeit digital or mixing both analog and digital equipment.

¹⁶ Out of economic necessity at first.

Since 2005

Since the beginning of the new millennium, this tendency has not slowed down at all. New software and new hardware come up almost daily and the best of them become integrated in the studio ecology. To name the most important of the last 15 years:

- OSC/UDP, Ethernet, Bluetooth, HTML, Internet and wireless audio systems
- A logical emergence of new software platforms: Live, ChucK, Falcon ...
- USB MIDI, MPE / MIDI 2.0
- A very surprising stability of the main programming platforms and software: *Max*, *Csound*, *Supercollider*, *Pro-Tools*, *Logic*, *Cubase*, *Finale*, *Sibelius* and a surprising stability of MIDI in general. This means that time invested by the users is not wasted!
- Bettering of interfaces development of pads and faders, the legacy of *MPC-60*.
- A pursued quest of good gestural interfaces, traditional (keyboard, wind, brass, guitar, ribbon, faders, levers, pedals, joysticks, ribbon ...) and new inventions (Roli, Expressive E, Arturia, Eowave, Leap...).
- A surprisingly significant return of analog and/or hybrid modular synths (Eurorack, Buchla, Moog, Behringer, Korg/ARP...), sometimes with very low costs.

Typical setups/environments today: a complex ecosystem?

For instance, let us have a look to my small but professional studio, figure 7:



Fig. 7 Studio *La Grainerie* in 2021

What do we see here?

- A Computer, screens and person at the center

Inputs

- Plain input modules: keyboard, mouse, trackpad...
- More advanced inputs: webcam, joystick, gamepad, trackball, iPad, smartphone, graphic pad, Leap Motion... using the plain USB, Ethernet, Bluetooth or WIFI
- Master keyboards or MIDI/MPE/USB/Bluetooth instruments = intelligent (?) piano /organ /synth /guitar /sax / trumpet / marimba/ drums...
- Microphones

- Electric instruments/hardware (guitar, bass, hardware synth (analog, hybrid or digital))
- Control pedals (sustain, volume...)
- Percussive pads (fingers or sticks)
- Wind/brass/breath controllers
- MIDI faders, rotaries, pedals and buttons...
- Sound cards ADC
- MIDI 1.0 or 2.0/ MPE / musical USB/Ethernet/Bluetooth /WIFI modules
- Other interfaces: atypical controllers, self-made devices... Using the above protocols...

Outputs

- Images on screens/projectors
- Sound on computer speakers
- Sound cards and DAC
- Mixing desk and sound correction devices
- Speakers (2 to 8, or more) and sub-woofer(s)
- MIDI/USB/Ethernet/Bluetooth/WIFI output for specialised musical/sonic devices
- Plain USB/Ethernet/Bluetooth/WIFI as well for more general engines, actuators, devices...

In the computer: another level of metaphors

- DAW = intelligent multitrack tape machine and its numerous plugins
- Complementary specialised software driving the sound cards (various sound banks, score editors, digital simulation of old analog equipment, synths, effects...)
- More general programming languages and toolkits (*Max (Live)*, *SuperCollider*, *Csound*, *GRM Tools*...)

This is quite a lot but not even luxurious by today's standards.

The main point is this question: how do we make sense of all of those? Do we really deal with this richness of choice, or do we still react in the lazy too-many presets attitude inaugurated by the Dx-7? For instance, let's look at part of the list of plugin presets available here for the DAW and other software, figure 8:

Addictive Keys	L1 limiter Stereo_Effect	S1 Imager Stereo_Effect
Amp1Tube 4	L1+ Ultramaximizer Stereo_Effect	S1 MS Matrix Stereo_Effect
Amp1Tube 5	L2 Mono_Effect	S1 Shuffler Stereo_Effect
ARIA Player VST Multi	L2 Stereo_Effect	SampleTank 3
ARIA Player VST	L3 MultiMaximizer Mono_Effect	SampleTank 4
AudioTrack Mono_Effect	L3 MultiMaximizer Stereo_Effect	Saphira Mono_Effect
AudioTrack Stereo_Effect	L3 UltraMaximizer Mono_Effect	Saphira Stereo_Effect
BassStation	L3 UltraMaximizer Stereo_Effect	Saturation Knob
BassStationStereo	L3-L1 Multi Mono_Effect	SatX
Black76	L3-L1 Multi Stereo_Effect	Sibilance Mono_Effect
BrickwallLimiter	L3-L1 Ultra Mono_Effect	Sibilance Stereo_Effect
BritishChannel	L3-L1 Ultra Stereo_Effect	Sibilance-Live Mono_Effect
BusCompressor	L316 Mono_Effect	Sibilance-Live Stereo_Effect
C1 comp Mono_Effect	L316 Stereo_Effect	Siren
C1 comp Stereo_Effect	Leslie	Smack Attack Mono_Effect
C1 comp-gate Mono_Effect	Lie	Smack Attack Stereo_Effect
C1 comp-gate Stereo_Effect	LinearPhaseEQ	SoundShifter Pitch Mono_Effect
C1 comp-sc Mono_Effect	LinEQ Broadband Mono_Effect	SoundShifter Pitch Stereo_Effect
C1 comp-sc Stereo_Effect	LinEQ Broadband Stereo_Effect	SpaceDelay
C1 gate Mono_Effect	LinEQ Lowband Mono_Effect	StealthLimiter
C1 gate Stereo_Effect	LinEQ Lowband Stereo_Effect	Strobe2
C4 Mono_Effect	LinMB Mono_Effect	Strum Session 2
C4 Stereo_Effect	LinMB Stereo_Effect	StudioRack Mono/Stereo
Center Stereo_Effect	LoAir 5.0/5.1_Effect	StudioRack Mono
ClassicClipper	LoAir 5.1_Effect	StudioRack Stereo
ClassicComp	LoAir Mono_Effect	Submarine Mono_Effect
ClassicEQ	LoAir Stereo_Effect	Submarine Stereo_Effect
ClassicLimiter	Lounge Lizard Session 4	SunsetSound
CSRHall	MasterMatch	SuperTap 2-Taps Mono/Stereo_Effect
CSRInverse	MaxxBass Mono_Effect	SuperTap 2-Taps Mono_Effect
CSRPlate	MaxxBass Stereo_Effect	SuperTap 2-Taps Stereo_Effect
CSRRoom	MaxxVolume Mono_Effect	SuperTap 6-Taps Mono/Stereo_Effect
Cypher2	MaxxVolume Stereo_Effect	SuperTap 6-Taps Mono_Effect
DeEsser Mono_Effect	MBandComp	SuperTap 6-Taps Stereo_Effect
DeEsser Stereo_Effect	MBandImage	Syntronik
DeEsser	MBandLim	T-RackS 5 Metering
Doppler Mono/Stereo_Effect	MetaFilter Mono/Stereo_Effect	T-RackS 5
Doppler Stereo_Effect	MetaFilter Mono_Effect	T-RackS CS Black 76
Double2 Mono/Stereo_Effect	MetaFilter Stereo_Effect	T-RackS CS Brickwall Lim
Double2 Mono_Effect	MetaFlanger Mono/Stereo_Effect	T-RackS CS British Channel
Double2 Stereo_Effect	MetaFlanger Mono_Effect	T-RackS CS Bus Comp
Double4 Mono/Stereo_Effect	MetaFlanger Stereo_Effect	T-RackS CS Classic Clipper
Double4 Mono_Effect	MicR	T-RackS CS Classic Comp
Double4 Stereo_Effect	MondoMod Mono/Stereo_Effect	T-RackS CS Classic EQ
Drawmer S73	MondoMod Mono_Effect	T-RackS CS Classic MBand Lim
DropMu	MondoMod Stereo_Effect	T-RackS CS CSR Hall

Fig. 8 Partial list of available plugins 2021

Every line here is a complex software module, each with its own parameters, quirks, strengths and weaknesses. Each with a learning curve and time demands on the composer. Is this too much? Yes, obviously. Who really uses 12 types of reverberation?! On the other hand, having all of this at hand, every day, with no extra cost other than the yearly updates, gives the musician plenty of time and opportunity to learn. Most users do learn much, in fact, if only to give some sense to their investments. There is also a trick: there are in fact more similarities between various instances of similar modules than it can seem at first glance. Once you know, say, a reverb unit in depth, the others become rather familiar quickly, providing that you take some time to study them a bit. Is it not exactly the same with many musical aspects? Once you know, say, a scale or a mode in depth, the others are much easier to learn and explore.

Two models and constructed proficiency

In many previous work (Laliberté 1994, 2004, 2005, 2013), I also pointed out that one can find trends and undercurrents that unify the various equipment and software despite their superficial differences. They are indeed more coherent and unified than what may seem. For instance, we are greatly influenced by the expressive demands of a vocal tendency, a percussive tendency and the mixed field that their interactions generate. We are also alert to the underlying algorithms, sonic paths and module structures and recognized quickly enough the main features of different modules.

Take a synthesizer, for instance. Because the resemblance of most of them to the spoken or singing voice operation and to important instrument archetypes, as experienced users we rather simply “feel”¹⁷ how to create a pitch with a keyboard or such, adjust its volume with a pedal or a

¹⁷ André Leroi-Gourhan talks much about such behavior in his famous books (1964-65). He talks about the “machinal”, “by rote”, the automatic but semi-conscious that is necessary to perform complex procedures such as

slider, change its timbre with some filter-like tool, etc. Even the “complex” DX-7 fitted that vocal model¹⁸. I have shown (Laliberté 1994) that the vocal model is behind a great number of musical inventions; in many ways, the electric guitar with its full range of effects, the ondes Martenot, the theremin, the electric organ and the synthesizers are quite similar. On a piano-like or a percussion-type instrument, we understand right away that the various strikes on keys/pads/surface give both the pitches/sound complexes, the volumes and the timbres of individual sounds. On a delay system, it is usually simple to figure out that the delay times, the volumes of the echoes, the feedback or timbre qualities operate in such a way, and so on, despite the different graphics or even labels. In a word, a professional musician is well-prepared to find her or his way through such a dense *bric-à-brac*. Most of electroacoustic composers love it, in fact.

What to conclude from this? First, that today’s abundance is not as confusing as what may seem. Despite superficial or more important differences, a skilled musician can find her or his way, basing the learning process on underlying similarities. Second, however, now more than ever, the temptation to be lazy is strong; insensitive button pushers and preset users are numerous. A basic acceptable sound quality is easily obtained and could become a trap for the unwary. But has it not always been the case for music? I have the intuition that when the organ appeared, choir masters were worried that this would bring a lowering of singing quality. And this must have happened in uncaring groups. But has sung music become bad overall? Obviously not.

Researchers in media (Tiffon 2011) have shown that new media do not completely replace old ones but add to them and change the hierarchies. Television has not killed cinema nor radio but those two became less culturally important. Now Internet tools have added their capacities, clearly diminishing television’s domination, but TV (or cinema, or radio, or books...) are still present and active. Therefore, the key for a good, i.e., artistically satisfactory, use of digital or analog musical tools is to remain demanding and active, to beware the lazy push-button attitude and keep pushing the developers and luthiers to do better. Generalised programming software allow one to become his own luthier.

III Current trends and interesting improvements

As examples of a proper demanding attitude in this digital musical plateau, what can still be done to improve the performance of electroacoustic music? Here a few interesting cases that go in those directions.

The *Leap Motion* (2021)

This is a general USB infrared cam developed since 2008, optimised for the detection of the movements of the two hands, wrists and 10 fingers with their several joints, figure 9:



driving a car.

¹⁸ Once the user understands that the modulation index is akin to a filtering.

Fig. 9 Detection of 2 hands by the Leap Motion

As a user, the most surprising feature of this rather cheap¹⁹ tool is its sensitivity. The precision here is millimetric, rather than the centimetric precision of the Kineckt or webcams. This makes one realise how poor other gestural interfaces can be. This sensitivity changes everything: it's the precision of proper musical instruments (Cadoz 1989). A properly setup *Leap Motion* can sense and transmit to a general software very relevant and subtle motions of the fingers. But it's a non-touch instrument, like a theremin. Despite the lack of tactile feedback, it does give haptic, aural and visual feedback to the user and strangely enough, this gives some illusion of physical contact, providing that the mapping of the fingers details is properly done to the right sonic features. As force-feedback joysticks or plain 3D joysticks already have shown, the accumulation of degrees of freedom is the key for a rich user experience and an applicability to complex musical tasks. In the demonstration, I have shown a decently working polyphonic theremin/Martenot, each finger controlling pitch, timbre and intensity independently.

Eowave Ribbon Mark 2 (2021)²⁰

This tool is both an instrument (audio+CV) and a USB MIDI 12-bit controller, a gliding ribbon + pressure + a sensitive copper touch plate, figure 10:



Fig. 9 Eowave Ribbon Mark2

As can be seen, this is very reminiscent of the Martenot ribbon. This monophonic ribbon possesses three degrees of freedom: X position, pressure on the ribbon and pressure on the copper plate on the left side. This information is transmitted as MIDI pitch bend (12 bits) with two other 7 bits controllers. Once again, the most surprising is its millimetric sensitivity. This leads me to worry with Cadoz that, prior to this generation of interfaces, we settled on poor gestural interfaces (wheels, sliders, pedals), beside the usually decent keyboards. I believe that the density of the underlying grid and the scaling of the gestures are quite good in this case. 12 and 7 bits of resolution appear quite good in use. I have had a great time with this interface strongly reminding me of the old Moog ribbon and Buchla touchplates that we had in my home university in the 1980s. With this ribbon, the key once more is a proper and musically interesting mapping of the transmitted values, but *Max* is very flexible for such tasks, as I believe that my demonstration showed.

MIDI Polyphonic Expression (MIDI.org 2018)

A third very interesting case is an addition (2015-2018) to MIDI, just before MIDI 2.0 (2020), figure 11:

¹⁹ It costs around 90€.

²⁰ When available, it costed around 270€. The Covid crisis slowed down many of these small companies.



Fig. 11 A Roli Seaboard

I acquired a Roli *Seaboard*²¹ to do the first (and satisfactory) tests. With this addition of MIDI, each finger on the small keyboard becomes an independent device, each with its own volume, controls, aftertouch, pitchbend... The Roli makes use of five degrees of freedom, + the notes, for each finger: note on velocity (“Strike”), note off velocity (“Lift”), pitch bend (“Glide”, X axis) polyphonic aftertouch (“Press”, Z axis), and polyphonic controller (“Slide”, Y axis). This is possible due to the silicone gel under the rubbery surface, sensing location, pressures and quantity/directions of motion. A typical mapping would be to control the notes on and off²² with the “keys” and velocities, the brightness along the Y axis, the vibrato depths with the polyphonic aftertouch (Z axis) and to change the pitches through a lateral (X axis) motion akin to a Martenot keyboard. Thus, I could program a quite convincing simulation of the famous Yamaha CS-80, Martenot or totally different behaviors. This combination of 5D and proper programming is, in my opinion²³, the beginning of an important musical trend for keyboard music and electroacoustic interpretation. For instance, instead of controlling pitch variations with an auxiliary command, the pitch wheel thus immobilising the important left-hand, one has the capacity to subtly modify the pitches with a basic, normal and very ergonomic keyboard gesture.

Expressive E: *Touché*²⁴

Once again this is a most expressive USB MIDI/CV device. It presents itself as a four degrees of freedom “lever”, figure 12:

²¹ When available, the smaller one costed around 350€. They remind me of a late proposal made by Robert Moog (1992) in an ICMC conference.

²² This is a rarely used possibility of the first MIDI protocol, quite effective to control transitorities through various ways of lifting the fingers.

²³ Soon, Expressive E (2021) will market for 1800€ its “Osmose” keyboard similar in many ways but with 7 degrees of freedom: “Tap” (on velocity), “Press” (pressure on the key), Press & Tap, “Pitch” (lateral movement), poly aftertouch (bottom of the keybed), “Shake” (vertical), “Strum” (different level of pressure), pressure difference... This is apparently derived from the famous Haken continuum keyboard (2021).

²⁴ The full version costs around 400€.



Fig 12: Expressive E Touché, with two MIDI keyboards

A kind of multiplication of the famous Martenot “*touche d’expression*”, the pressures on the wood surface are detected independently in four directions: up, down, left and right. Internally, the gesture analyses are done in 12 bits (Pottier 2021), but they are transmitted with plain USB MIDI. This tool has both great looks and, most important, great feel, even with real wood under the fingers, giving a rich tactile feedback to the user, along with the very well calibrated resistance of the underlying springs. It comes with a great bank of sound/gesture presets (UVI/Falcon), even if such a big bank of sounds can be overwhelming.

Once more, the most surprising: how sensitive it is, even in plain MIDI. Typically, this is used to control volume and various aspects of timbre through well-controlled pressures. In my demonstration, I mapped the “up” direction to the volume of a triangle wave, the “down” direction to a mixing of a square wave, the “left” to a brightness filter and the “right” to a delay send. This gave much life and sensitivity to a simple synthesizer patch. In the new Arturia *Polybrute* keyboard (2021), a *Touché* can be used to do crossfades between patches, modulation several parameters at the same time. This is easily implemented in a *Max* model, if desired.

With all those fun tools, I build myself a few nice instruments : a polyphonic theremin, a complete Martenot combining a keyboard, the *Ribbon* and the *Touché*, a very decent CS-80 emulator and a rather full and very expressive musical environment, allowing subtractive synthesis, FM, physical modeling, with either a plain keyboard, the *Ribbon*, the *Seaboard*, the *Leap Motion* or a MIDified guitar as controllers, not forgetting various pedals and feet controllers, and a microphone to sing into. It’s now up to me to make decent music with all of this... On my website (2021), the reader can listen to some examples, to make her or his own judgment of the attained musical quality.

Conclusion: ecology of a necessary *bric-à-brac*

In memoriam R. Murray Schaeffer (1933-2021)

After showing in this paper that the *bric-à-brac* is a constitutive part of the electroacoustic music composition, the next step of this phase of my research will be to consider the studio or stage more seriously as ecosystems (digital and analog...). This ecosystem involves people, devices, networks, interactions, complementarities and each entity is critical: change one of them and the system changes. It is, however, too early to share the results of this research.

Linking this fact to my previous research, this is a very “percussive” trait: due to the relative poverty of one element, a true musical richness comes of the whole by complementarities. For instance, a single tabla sound is of little musical impact but the whole range of sounds, gestures and rhythms of this pair of drums is wonderful. Similarly, a small sound on a digital set-up may be non-significant but a range of them can be if we work hard enough.

In this light, the trends that this article underlines, the analog plateau, with its wonderful interactive possibilities but with technical problems, the digital plateau, with its wonderful sonic possibilities but sometimes limited interactions can be bridged by today’s current interactive and most sensitive tools. I am very optimistic nowadays because the technology is really getting here. Now the difficult part: it is up to us to make proper music!

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