

## *Acousmatic Music and its Extension towards Instruments*

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It can seem contradictory to talk about acousmatic and traditional instruments as a component of the same intention; the basics of the acousmatic concept is that you listen to music without witnessing how sounds are produced, your imagination constructs the context, it becomes pure listening through sound images. What happens when there is an instrument which is playing at the same time, are we still in an acousmatic situation or else are we in front of what is often called a “mixed” situation, closer to the traditional concert music performance?

As it often happens, there is not a unique and only answer to this question, it mostly depends on the point of view of the composer and how he conceives sound and the relation of the instrumental sources and the fixed sounds. I am quite radical when discussing this point: *acousmatic* is *acousmatic!* It describes a listening situation more than a musical current. No visual aids (be it instruments or video or dance), only sound arriving to our ears through an array of loud-speakers. In 1993 I wrote an article titled; “What about acousmatics?”; giving a definition of what, to myself, the term meant:

From an esthetical point of view acousmatic music concentrates on the poetical and spectral richness of sounds, and plays with this very particular characteristic of sound hearing in which the perception of an acoustic phenomena is associated with its cause; hence the perception of a sound whose cause is unknown or unrecognizable for our perception, induces the listener to imagine non-existing causes and to perceive music as a complex creative phenomena in which musical sense and musical sounds have to be interpreted simultaneously, with generally very little relation with our perceptive reality. The question is not to find out how sounds are made but how their combination will generate imaginary perceptions of imaginary realities in our mind.<sup>1</sup>

I tend to like this definition, it’s more an explanation on how one should listen to acousmatic music and how our mind makes sense of this kind of listening. I also wrote in those days a different approach to it: Can I recognize something I listen to

<sup>1</sup> Teruggi, D. 1995. *What about acousmatics?* In *Journal of Electroacoustic Music*. Vol. 7. London: Sonic Arts Network

as being acousmatic? Is acousmatic in the listening or in the intention? This is what I wrote in 1991:

When questioning how would it be possible to determine that a music is more acousmatic than another, I would rather tend to direct my detective magnifying glass towards the way of thinking about sound and how it is used, rather than on the judgment of the result. Certain music by Ligeti or Xenakis “sounds” acousmatic although this intention never existed in these composers. Conversely, certain works by François Bayle (the case is rare, nonetheless) could be understood as being the product of very complicated instrumental writing, with some “special effects” added, which would be extremely distant from the composer’s intentions.<sup>2</sup>

These writings are some 30 years old; I don’t think I ever continued on this road of defining what is or isn’t an acousmatic music. I have however many times in conferences and courses explained what the acousmatic situation is; and how we listen acousmatically, not trying to define what acousmatic music is, just explaining its functioning. This is because as I suggest in the second quotation, our ears may make us think we are listening to something acousmatic when it isn’t, so I rely in the definition made by the composer, who may define his own work with different possible adjectives other than “acousmatic”, as electroacoustic, electronic, musique concrete, cinema for the ear, electronica, fixed-sounds, tape, computer music or whatever term the composer considers more adequate to define his musical content. In any case, if I assist to a concert and there is no instrumental performing, only loudspeakers, I’m sure I am within an acousmatic situation, whatever is given to my ears to listen.

And here is where I can start using the word “extension”! I use the expression *extension towards instruments* as a way of enlarging the musical scope and at the same time indicating that I am abandoning the pure acousmatic listening situation, not pretending that there exists an acousmatic music with instruments, but considering it as an enlargement whose origin is within acousmatic thought and practice. However before talking about the extension, I would like to talk about the “magic” of the acousmatic situation. Some 70 years ago acousmatic was considered an unnatural way of listening music, since music was strongly associated with instrumental performance; the absence of performers was disturbing and considered a non-musical act. Since then, the situation has totally changed and listening only to sounds has become an accepted and widely diffused situation. There are also many acousmatic approaches which have diversified the limits of acousmatic music, this is why it is difficult to define acousmatic music and much more reasonable to talk of the acousmatic situation, which is what I say in my first quotation.

<sup>2</sup>Teruggi D. 1991 *Quelles sont les conditions...*, in *Vous avez dit Acousmatique?* collective work, Ohain : Éditions Musiques et Recherches, p19.

### *Instruments and their use of Sound*

One of the great intellectual heritages of Pierre Schaeffer<sup>3</sup>, but not only him, is that any sound is potentially usable when composing music. The realm of traditional instrumental sounds strongly increased during the XXth century and sounds from any origin were progressively used in music. For many centuries music was produced through a limited number of specialized sounds, produced by musical instruments; *specialized* means here that they were only used for musical purposes and were thus differentiated from other sounds, mainly everyday sounds. All other sounds were considered nonmusical or non-adequate for musical production.

The slow introduction of new sounds in performing music during the XXth century (new instruments, everyday objects used as percussions, etc.) was strongly upset by the arrival of *Musique Concrète* at the end of the forties. The fact that recorded sounds could be combined to make music was a totally new perspective for musical composition. This was followed by the use of electronically generated sounds in *Elektronische Musik* at the beginning of the fifties and these two tendencies marked a total renew of the musical fact and progressively of musical thought. It was not immediately a total revolution, initially limits were introduced as to which sounds were more “adapted” for music; however, at the beginning of the sixties it was widely accepted that any sound could be used for music, that it was the composers’ decision as to which sounds were more adequate to his ideas.

What this revolution implied was that the technology of sound production followed the evolution of technology itself and that from sound-recording to computers, any new device capable of producing sounds could be used in musical practice. Any kind and type of sound is potentially usable in music, and *any* means *any*, no boundaries, no forbidden sounds or relations, music has developed an unlimited approach to sound where the only limits are those of composers’ minds. We could quote Schaeffer here, speaking about Edgar Varèse after his death in 1965, he then said: “Like us, Varèse wanted to incorporate music into all the sounds of the universe”<sup>4</sup>. It is a wonderful way to turn the concept around; music goes into all the sounds...

### *Different roads to Sound*

Two tendencies have developed since then: composers using technology as an expansion of the instrumental practice, and composers concentrated in sound listening

<sup>3</sup> Known as the founder of *musique concrète*, Pierre Schaeffer (1910-1995) was a composer, writer and pioneer of radio technology, notably creating the research branch of the Office de Radiodiffusion Télévision Française (ORTF), which he directed from 1960 to 1975. His main contribution to musical thought is found in his book: *Traité des objets musicaux*, first published in Paris, Éditions Le Seuil, 1966, the English version *Treatise on Musical Objects*, was published by University of Southern California, 2017.

<sup>4</sup> Pierre Schaeffer in the Television series, *Les grandes répétitions, Hommage à Edgar Varèse (1883-1965)*, 2e chaîne ORTF, program broadcasted on 20/04/1966, directed by L. FERRARI, S. G. PATRIS, n° INA: CPF 86622743.

and the effects produced when combining sounds without any visual support to create music. This last tendency, very active today, was called *Musique Acousmatique* during the seventies, by one of its strongest defenders: François Bayle. Composers may swim between both tendencies; they are free to bathe in any domain that will adapt to their musical intentions.

I am myself a strong defender of Acousmatic Music finding in pure sound listening a new realm of perception as described in my article of 1995<sup>5</sup>, I enjoy the situation and find it has brought a new way of thinking and listening to music. As a composer I fabricate my own sounds and set them together to construct structures of increasing complexity; sounds can have any origin; actually, more than thinking in terms of sound, I think in terms of color and action or how sounds evolve through time, what is their behavior. Acousmatic composing permits to explore the limits of listening, inventing totally unheard sounds using any kind of sound source, transforming existing sounds to create new structures, using everyday sounds, using synthesis to invent new realities, using space as a medium to convey complex movements and invent “impossible” quasi realistic solutions that fascinate our ears and permit our imagination to discover unexpected reactions. Acousmatic music also permits a unique listening experience through Acousmoniums, which are large arrays of loudspeakers installed in concert halls or any kind of space and used to enhance music during a concert, a kind of performance where the composer or the performer adapts the sound of music to the hall and introduces spatial and intensity variations to sound.

Nevertheless, I am also very fond of instruments and the sounds they produce. Since any sound is potentially usable in music, this also includes instrumental sounds which may be considered as highly perfected “sound-producers” and can be used as recorded sources or on stage. In parallel to my Acousmatic works (circa 40), I have composed many works including instruments ranging from soloistic works to orchestral works (circa 30), always with non-instrumental sounds or invented sounds performing simultaneously with the instrument. This kind of situation in which on-stage instruments are performed with other sounds is often called *mixed music*; strange denomination because it is actually a mixed situation and not a kind of music that mixes other music. It is also called *live-electronics*; however, this denomination concerns more the fact of performing live with technological devices, with or without instruments. The way a sound situation is named depends largely on the composer; there have been discussions regarding how this kind of music should be called in order to create a specific vocabulary, however every composer names his music as he likes; either to make it clear to the audience what kind of sound situation he is using, either to differentiate himself from other denominations in order to create a personal realm that applies only to himself.

I name my music as *Acousmatic*, when it doesn't imply any live situation; and when using instruments, I use a rather obsolete denomination which is, for example, music for *Piano and tape*, referring to the ancient denomination of “magnetic tape”, which actually implies recorded sounds on a media. I have been using this denomination for

<sup>5</sup> Ibid 1995

more than twenty years and up to today nobody has ever asked me what do I mean with the word “tape”. In a more colloquial way when somebody asks me which kind of music I compose, knowing that the person doesn’t know anything about this kind of music, I tend to say that I make music with my computer; “I create and design the sounds with which I build my music”. Incomplete denomination that however seems to open some kind of imaginary door in peoples’ mind. I am against no particular denomination; I just choose mine to communicate and let other composers communicate through their own conceptions.

What is important is not how composers name their music, but how they conceive the function of sound in their music and by extension how does the use of instruments imbricate with their sound ideas and define their works. There are actually two ways of “thinking” sound: sound as series of parameters where pitch, intensity and duration relations are highly considered; or as a material where its evolution, changes and timbre generates perceptual impressions. These two ways are not exclusive and of course all sounds have pitch, intensity and duration as well as timbre, evolutions and density; however, the important issue is what are you listening to, or what does the composer want you to listen to, where does he put his priorities which will influence the way the listener receives and reacts to music.

When I say I am an Acousmatic Music composer this doesn’t only mean that I compose for “fixed media” (term largely employed nowadays to describe the fact that there are no performers) but that I privilege the impact of sound in the listeners perception. There will be pitches, intensities and durations but the main listening aspect is how sounds interact among them and create new and changing structures for our ears. This is why, when introducing instruments to interact with my “fixed sounds” (you will see that I wasn’t always a “fixed sounds” composer, I used to work with real-time sound generation), even when writing melodies and rhythms, the “sound” aspect is primordial as well as the relation with the fixed sounds. As we will see in the following paragraph, many different situations exist in which “technologically produced sounds” can interact with an instrument. In an article written in 2017 I conciliate both tendencies with the following sentence:

These two trends, expansion towards instruments and acousmatics, are not opposing forces, but two approaches to sound. One articulated on the presence of the performer and the strength and meaning of the live musical act, where music is created before our eyes. The other is based on the abilities of our imagination to construct an enriched perception of the sound phenomenon and transform it into musical power.<sup>6</sup>

### *Different ways of “expanding” Acousmatic Music*

There are different ways of dealing with the extension of Acousmatic Music towards instruments. These are the five categories I identified in an article written in 2016:

<sup>6</sup> *L’invention du son*; Article written for the Catalogue of the Festival Musica, Strasbourg, 2017

- 1) Instrument and tape,
- 2) Electronic instrument played live,
- 3) Instrument processed in real time,
- 4) Instrument processed in real time with tape or recorded sounds,
- 5) Instrument controlling a device from sensors or according to the player's performance.<sup>7</sup>

I will quickly describe each situation so to analyze the different options a composer has. There is a previous situation which is purely acousmatic and this is the use of recognizable instrumental sounds within a composition; this can be the recording of an instrument performing a sequence or isolated sounds. Our perception immediately recognizes the performing situation and the listening is oriented towards the instrumental situation; the doubt subsists as if it is an acousmatic music or the recording of an instrumental music?

### 1) Instrument and tape

This is probably the oldest mode of interaction between sounds and instruments. It describes an instrument that plays with musical sequences made from composed and pre-recorded sounds that can interact in different ways:

- a) Recorded sounds are played simultaneously with the instrument;
- b) The recorded sounds intercalate between two instrumental parts.

As examples of these two approaches, the founding work is the first version of *Musica su due dimensioni* by Bruno Maderna (1952) for flute, cymbal and magnetic tape as well as the interpolations for *Déserts* by Edgar Varèse (1953) as an intercalation example; work composed at the GRMC with the assistance of Pierre Henry. Without forgetting André Hodeir's short study for tape and piano, *Jazz et Jazz* (3'02) created by the GRMC in 1952 which is the first work in GRM's catalogue for instrument and tape.

It should be noted that the term "tape" indicates the initial medium on which the music was recorded: the magnetic tape. This name continues to be used today, even though magnetic tape as a technical medium has been abandoned for many years. Note also that the term also continues to be used in other languages: *Tape* (English), *Bande* (French), *Tonband* (German), *Nastro* (Italian) or *Cinta* (Spanish).

The method combining instruments with tape continues to be very widespread, mainly due to its ease of implementation. The technical means required are simple: audio file, reproduction device, amplification, and it does not require great technical skill on the part of the operator for it to work. Many performers perform concerts independently, ensuring the launch of files and the general balance themselves.

<sup>7</sup> Portraits Polychromes Number 23: *Hors-série thématique sur les Musiques Mixtes*, Paris Ina GRM 2017

## 2) Electronic instrument played live

In the early days of electroacoustic music<sup>8</sup>, the only way to use different technologies was to record the result on a medium; the magnetic tape was the only medium to broadcast or have music performed. With technological developments, mainly the arrival of transistors, it was possible to design the first synthesizers at the beginning of the 1960s – this means devices integrating several modules producing sound signals within the same environment (oscillators, filters, generators noise generators, envelope generators), with the possibility of combining them and playing them live<sup>9</sup>. With synthesizers, a split occurred between those favoring the creation of works of electroacoustic music on a medium (Acousmatics); and those who, not satisfied with fixed-media, aspired to create music in real time.

Since the appearance of these first synthesizers in the mid-sixties<sup>10</sup> (Buchla, Moog, Synket, etc.), many composers began to use these machines to perform or improvise music (notation of patch configurations was not easy on analog synthesizers and was often limited to general instructions or descriptions of patches or combination of modules which defined the nature of the sound to be produced). These new tools arrived at a time when experimentation and improvisation were very popular and an important place was given to the performer in the creation of music during concerts. Among the first works we can cite *Silver Apples of the Moon*, by Morton Subotnick in 1967.

This trend continues to be very active, as evidenced by so-called “electronica” music, most of which is based on live improvisation on different devices and very often analog synthesizers, either vintage or reconstructed. The same evolution of magnetic tape was observed with computer-produced sounds. Initially, given the time required to calculate a sound, the music was fixed on an analog magnetic medium. With the evolution of the computing power of computers, composers began to work with real-time computers, the first large devices of which were developed at the end of the 1970s and beginning of the 1980s.

## 3) Instrument processed in real time

The next stage is that of the traditional instrument whose sound is captured and modified by an electronic or digital device. The sound of the instrument becomes a source for new sounds that are modified, shifted or multiplied through different analog and digital devices. The difficulty with analog devices used to lay in the difficulty of reproducing the same effect, due to the variability and unreliability of analog devices. But the gradual arrival of digital systems firstly through processing devices such as Harmonizers or Flangers, as well as the first digital delays and, after that, computers allowing several sound-processing devices to be programmed and combined, it was possible to ensure better reproducible actions.

<sup>8</sup> Although there were precedents, I place the beginnings of electroacoustic music in 1948 with the first “concrete music” composed by Pierre Schaeffer.

<sup>9</sup> The first synthesizers were mainly used in Pop-music.

<sup>10</sup> We certainly must mention the pioneers: Ondioline, Ondes Martenot, Trautonium, Hammond Organ, who from the 1920s offered innovative (and often bulky) devices for instrumental playing.

This modality was very successful given the coherence it created between the source – the instrumental sound – and the processed sound coming from the same source. This allowed and still allows to extend the possibilities of the instrument either by transposing the pitches, or by shifting the interventions in time until creating rhythmic structures or to modify the timbre of the instrument by adding other components to it.

Two major uses then emerged and continue to be used: the real-time processor as a tool for enriching the sound produced by the instrument, which allows spectral modifications or enrichments and complex shifts of the instrumental playing over time, or the use of the processor as a tool capable of analyzing parameters of instrumental playing and generating sequences of sounds complementary to or related to the playing of the instrument. The general objective of these two approaches is to expand the possibilities of instrumental playing to situations of great complexity where an instrument seems to be a soloist in the middle of an orchestra constructed by the sound of the instrument itself.

Nowadays, real-time instrument processing is relatively easy to implement. The capture and control tools as well as the programs which allow the processing are well stabilized and allow excellent reliability and simplicity of implementation. It has not always been the case; during the first experiments in the early 1980s, their implementation was very laborious and the reliability of the device, despite the digital tools, quite low. Gradually, experiences and uses have enabled easier practice and very high reproducibility and transportability of the devices.

#### **4) Instrument processed in real time with tape or recorded sounds**

A simple extension of the previous situation, which brings potential complexity, is the addition of either a tape or using the instrument to trigger recorded sounds. This modality makes it possible to considerably vary the sound context of the work by introducing sounds from sources other than those of the instrument. In some cases, by using sampling functions, played passages or fragments are recorded and triggered at other times, creating a sort of duet with the instrument itself.

The level of processing of the instrument can also vary greatly, we find situations where the sound of the instrument is slightly colored, a kind of scent different from a known sound. We also have situations where the sound of the instrument is completely drowned out by other sounds and, except for seeing the performer during the concert, it is difficult to recognize the initial source. This allows us to understand the great diversity of situations available to the composer in his technological work and the different types of sound balance that he can develop in his work.

#### **5) Instrument controlling a device from sensors or according to the player's performance**

This is the final stage, it implies that different capturing devices make it possible through the physical playing of the performer, or the sound produced by the instrument; to generate, control, trigger preset or improvised actions according to a series of constraints. This is the current trend where the composer will build a technological tool for processing, synthesizing or triggering, based on his own needs and his musical

project. The technological tool is directly part of the musical project and participates in the writing process, most often controlled by the composer himself.

In some cases, improvisation plays a very strong role in the musical result, especially when it comes to composers or sound artists who will build the device and play it themselves. Moreover, they can be instruments in the traditional sense, but also “sound bodies” which serve as sound generators which are subsequently recorded, modified and amplified. In the field of “electronica music”, this type of situation is very common; the composer constructs an acoustic sound production device which gives the music a particular coloring and dynamic. Then, thanks to a subtle set of processing based on capture or recording of the source, he constructs a sound universe that can be an expansion of the original sound or a diversion of the sound towards other sound possibilities.

It is common to see in concerts several associated devices to process sounds played live or pre-recorded, synthesis devices controlled by external sources or prepared sequences which will be added to the rest. The composer and the performers decide at the time of the concert which devices will be implemented.

### *Who is in charge of a performance using technology?*

In the first decades of electroacoustic music, composers worked with assistants during the composition process or/and during the concert. The musical assistant, as he is often called, fulfilled a complex and sometimes poorly recognized role, between a technician and performer, often having to improvise in order to make things work. Production conditions were often difficult and in contradiction with the traditional implementation of instrumental playing, where once the instrument is in place the performer arrives and plays the music. Here, long hours of installation and calibration of the equipment made the process slow and subject to considerable variations between each performance with technical risks for the outcome of the music.

The improvement of technology and the appearance of software specialized in real-time processing<sup>11</sup> have considerably simplified the implementation of processing devices. Also, recording tools such as microphones or sensors have been specifically developed to take into account production constraints and the particularity of each instrument. Therefore, it is much easier nowadays to imagine, design and implement a composition for a mixed environment. For complex and ambitious projects, a new technical profile has developed in expansion of the initial concept of musical assistant, which in France is called a RIM (*Réalisateur en informatique musicale*)<sup>12</sup> or musical computer director, responsible for following a composer from creation to concert by providing him with knowledge of the existing tools, and sometimes going beyond existing possibilities and designing innovative tools associated with a musical project.

<sup>11</sup> We can mention here software like MaxMSP, GRM Tools or Ableton Live...

<sup>12</sup> This term was first used by the Ircam in Paris to describe skilled musicians well in knowledge of the inhouse developed tools and working with composers who were often developing a research program

Composers have also developed strong expertise and many compose complex technological works in complete autonomy ensuring the production and the execution or clearly defining the context necessary for the production through the work by a third party. Here the question often arises of the portability or re-production of a work in the near or distant future with new technological environments; a completely new problem in the musical world where the conservation of means and concepts for the implementation is essential to the survival of the musical work. There are many works for which the production technology has disappeared and which are therefore technically non-reproducible; in certain cases, thanks to recordings of a performance, the technological environment can be reconstructed and emulated through more recent devices. The current trend in order to assure the re-production is to sufficiently describe the intentions and the expected result of the work. This permits to modelize the required actions carried out in order to have a clear description of the actions to be emulated in new environments.

### *The art of making music*

Up to now I have described the different directions through which the expansion towards musical instruments can be developed. These descriptions tell us nothing about the musical intentions or the reasons for which a composer would choose such or such situation. First of all, there is the attraction a composer may feel regarding the use of extended technological devices to express his musical ideas; it is not indispensable to use technology, many wonderful music is composed on “traditional” instruments and let us hope this will continue for a long time since instrumental sound is one of the most wonderful inventions of humankind. Then, the questions are: what to do with technology, what is its function, which relation with instruments if there are any, what kind of sounds for a composition, which skills are needed?<sup>13</sup>

My impression is that the relation between the composer and the use of technology has also evolved through past decades. In the fifties, when *Musique Concrète* and *Elektronische Musik* emerged, well and less-known composers were invited to work in the recently created studios (generally inside a radio institution which was the only place where sound-recording technology was available), in order to discover the new possibilities of technology but equally to test the impact of the ideas among musicians and strengthen the importance of the studio. Many composers thus discovered the possibility of electroacoustics; I have already mentioned Edgar Varèse being guided by Pierre Henry and like him many composers that composed only one work as an ex-

<sup>13</sup> As I have suggested earlier, today composers are generally skilled in the use of computers and other technology. This is due to the fact that in general musical training includes the knowledge of technology which is a valuable tool for composers even when they don't use electroacoustics, just for writing their scores. Another important element also has changed the situation and this is the simplification of the use of software, not that software is easier to use today, but software has become increasingly “user friendly” over the last decades.

perience, like Olivier Messiaen (1952), Henry Sauget (1957), Darius Milhaud (1954) Earl Brown (1963) or Jean Barraqué (1953)<sup>14</sup>.

Other composers walked into the studio and stayed there forever, here we mention once again Pierre Henry who arrived in the studio in 1950, when Pierre Schaeffer was looking for a young composer and Olivier Messiaen recommended this promising percussionist who became one of the greatest figures of *Musique Concrète*. Another extraordinary visitor was Karlheinz Stockhausen to the WDR studios where he composed some of his great works; he didn't use the concept of "acousmatic" he preferred the concept of electronic, but his works were indeed landmarks for many composers.

We also have to mention composers like Pierre Boulez or Luciano Berio<sup>15</sup> who independently of their experiences in studios in the fifties, remained attached to instrumental music and only in later years they started including live technology in their music. In the sixties the situation tends to evolve, many composers become interested in technology and the arrival of the first synthesizers accelerate the diffusion of this new practice; education also started to be interested and many conservatories and universities started regular training courses from different approaches, either acousmatic, or synthesizers or live-electronics. The sixties are also the period of the first computer sounds which would reach wide diffusion and use, at the beginning of the eighties, among composers and home users.

What I intend to say is that in early days few composers had access to technology<sup>16</sup>, there were many assisted visitors to studios and only a few of them embraced electroacoustics as a musical choice. As time goes on and technology slowly invades our personal sphere, an increasing number of composers choose the electroacoustic way and dedicate themselves to this modality even from a young age. Many composers today don't have a traditional musical training, they just dive into technology as their first musical experience, it is not very expensive and there is at least an audience of friends or other composers available. Musical practice has thus undergone a strong change and the number of composers as well as the roads to access music have totally exploded.

### *How to compose with technology?*

Nevertheless, the central question remains: what to compose? Technology is a mean which doesn't make composition necessarily easier; technology conditions the

<sup>14</sup> All these composers worked at the GRM studio, which until 1958 was called the GRMC (Groupe de Recherche en Musique Concrète), most of them under the guidance of Pierre Henry.

<sup>15</sup> Luciano Berio like Luigi Nono and Bruno Maderna were more than visitors! They created a Studio within the RAI premises in Milan which was one of the important highlights in the fifties. As other studios they invited composers like André Boucourechliev and John Cage to compose and to discover the possibilities of technology. Luciano Berio somehow renounced at the end of the fifties, he was not interested in the "acousmatic" situation, only when real-time technology was mature enough, he resumed his experiences.

<sup>16</sup> I use the word "technology" with a certain freedom; it ranges from old tape-recorders, to digital devices to any computer software one may think of.

way we think and make music and this is particularly present in instrumental music. When composing for any instrument I keep constantly in mind what the instrument can do and which are the limits of what it can do (I consider an instrument a technological object, evidently). When expanding music to other sounds, this implies new technologies, with their limits and conditionings however broad technological devices may be. Composers choose in which sound domain they want to work in: for many of them the instrumental world is largely enough and music will always find new ways of expression. Others prefer to “extend” the realm of sounds through different technologies in order to enlarge the performance or timbral possibilities even to the extreme, as in Acousmatic music, of not using instruments and composing music with no visual or recognizable production device.

That is the first point; which technology should be used. This must not be seen as a life decision; composers may extend progressively their sound domain, from traditional instrument playing to extended performing techniques on the same instruments, to synthesizers, transformations or accompanied by other sounds... They experiment, change, choose and decide sometimes based on personal choices, others due to circumstances (as for example the availability of such and such device, or working with a performer that uses certain devices) generally having sound ideas in their minds and trying to achieve their musical conceptions.

The second point is what to do with any technology. What kind of relations between instruments and their extensions, what sound environments, which kind of control... Many questions and decisions composers have to undertake, which is not in itself a problem since composers *want* to compose. It is a part of the evolution of a composer to deal with all these questions and figure out which way to follow and what role do they want technology to have in their musical works. *What to do with any technology* is not only a question of relations and choices, it also reaches the way a composer writes music, his melodic, rhythmic or timbral decisions, his conception of sound produced by technological devices, his explorations in the sound of instruments. I tend to think that composers build a possible sound universe for their music, which may change or evolve but tends to remain coherent through time.

### *What are my compositional views then?*

When I was a young student my theory book began with the following sentence: “*Music is the art of sounds*”<sup>17</sup>. This definition totally suits me; however, it is not clear what “art of sound” means: the art of combining sounds? The craftsmanship of music? The art of transferring ideas to sound? Several possible answers of which I prefer the concept of an “art of inventing sounds with which to compose music”, which is actually the definition I give when I talk about my own music.

<sup>17</sup> A. Danhauser, *Teoría de la música*, Ricordi, Buenos Aires, 1960. The French composer Adolph Danhauser (1835-1896) wrote his *Théorie de la musique* in 1872, and this book is still a reference today for studying the theory of instrumental music!

I started having a traditional but poor musical education. When I was 18 years old, I decided I wanted to be a composer, not knowing very well what that meant. I then started studying piano and musical training from scratch for five years, while studying Physics, which is what I originally had intended to study. At a certain point having acquired a tape-recorder, I started making sound experiments with the piano and other sound producers, improvising, playing in improvisation groups, composing short music for films and having a lot of fun with sound manipulation.

When I was 25 years old, I moved to France and studied “Musique électroacoustique et recherche musicale” at the Paris Conservatory for two years, in the course which had been initiated in 1968 by Pierre Schaeffer but which was in those days directed by Guy Reibel; however, Schaeffer was still present until 1980 when he retired. After that I started working at the GRM in 1980 and developed all my professional life there as well as in the Research department of Ina<sup>18</sup> until my retirement in 2017. This is, in a very short description, how was my professional life. From 2018 onwards, I’ve finally become a full-time composer.

In the meantime, I never stopped composing, mainly concert music, acousmatic (40 works) and with instruments (29 works), but also ballet, radio, theatre and occasionally music for films. As I said earlier, as much as I love the acousmatic situation, instrumental sound has always fascinated me and I regularly compose works with instruments accompanied with technologically produced sounds. This is one of the central points of my thought which means that I see the instruments as magnificent sound generators which perfectly contribute to the extension of the acousmatic situation.

It wasn’t always this way, even if my first “mixed” work was for piano and tape (*E cosi via* for piano and tape, 1984); when I wrote the score, in my mind it was a work for tape and piano, and you can see this through the fact that the top score is the tape and the lower score the piano. Actually, I composed all the tape, leaving blanks for the piano and then I started writing the piano score, based on the sounds and action of the tape. It was really an extension from acousmatics to the instrument. That was my starting point, it would take several years before I went back to instrument + tape!

In the mid-eighties there were several large research projects running at the GRM and one of these was the Syter system<sup>19</sup>, a real-time sound processor controlled by a mini-computer which was relatively easy to program and very powerful for sound processing. I worked a lot with this system being in charge of teaching its functioning to composers and having composed several works for instruments and real-time processing (the tape part of *E cosi via* was also composed with Syter). Two of my mayor real-time works *Xatys* for saxophones and Syter (1988), and *Syracus* (1992) for percussions

<sup>18</sup> Ina: Institut National de l’Audiovisuel; in charge of the preservation of France’s audiovisual heritage; also a center of production, training and research and containing also the GRM (Groupe de Recherches Musicales) which I directed from 1997 to 2017. I also directed the Research and Experimentation department from 2001 to 2016; department in charge of research in the preservation domain.

<sup>19</sup> For more details about the Syter system and technology at the GRM, see D. Teruggi: *Technology and musique concrète: the technical developments of the Groupe de Recherches Musicales and their implication in musical composition*, in *Organised Sound: an International Journal of Music Technology*. Cambridge University Press, volume 12, number 3, December 2007.

and Syter were composed using real-time processing of the sound of the instrument. This was a different situation; the sounding element was the instrument and the extension was the sound-processing which totally depended on the sound produced by the instrument; if the capture of the sound failed, all the transformation process would fail. The crucial point was then how to obtain the best sound from the instrument without any external interferences and avoiding feed-back loops on the loudspeakers, it was not a mere amplification but trying to capture the sound as close as possible to its production, including very subtle sounds.

Today, thirty years later, there have been many technical improvements in the quality and precision of microphones and loudspeakers which permit a better capture of sound, but at the end of the eighties, it was quite a performance to process instruments having to control the processing parameters on the computer with one hand, the input level in a mixing desk with the other hand, and assuring the sound diffusion in the concert hall<sup>20</sup>. I did this for 6 years, performing my own works and other composers works, I was the official “Syter performer”; and then one day I realized that every concert was a moment of great tension in which I was more worried about the technical result than in the musical interpretation by the performer and then decided I would stop doing real-time processing and go back to a more traditional situation of instrument with a tape<sup>21</sup>.

There was a second reason for going back to tape other than the dependance on the sound produced by the instrument; and this was the diversity of processing that could be obtained. Even if the Syter system was very powerful, its action can be simplified to two points: either processing the timbre of the instrument, thus modifying the original timbre of the instrument and adding spectral components or modifying the spectra of the sound; either processing the evolution of sound through time based on a temporary memory that reproduces the sound after a certain lapse of time, with different types of modifications. And, of course, the combination of spectral and temporal actions. This could bring a certain redundancy in the processing and very subtle calibrations needed to be done in order to obtain results that would fuse and enrich the original sound.

I never got to the situation I described in point 5 (Instrument controlling a device from sensors or according to the player’s performance), where the sound produced by the instrument controls other sound sources or interacts with the performance; maybe I stopped a bit early, however I’m extremely happy with the instrument + tape situation and have continued to explore this situation mainly with solo instruments but also three times with an orchestral ensemble.

<sup>20</sup> This can be a very tricky situation, you rehearse in a studio with dry acoustics and at a short distance from the performer; then you go to a large hall and things work totally different, all the amplification levels have to be modified and the diffusion in the hall adapted to the circumstance.

<sup>21</sup> I must say that I reprogrammed these two works on recent systems in 2002 and then it was much easier from a technological point of view; more reliable processing systems (GRM Tools) and specialized microphones.

*What possible relations between the instrument and its tape extension*

If Music is the art of Sounds, which sounds are to be used when composing any work. That is the composers' choice, to decide what sound situation he will use in a particular work depending on his general ideas on sound and the particular sound situation he is going to explore. When it comes to choosing sounds, two important criteria can be the spectra of the sound or the behavior of the sound, but other components may intervene as the reminiscence a sound may have for the composer, morphological aspects of it, or how a sound affects our listening.

In my case a musical project is first of all a sound project; I imagine or start exploring a sound situation and then slowly build the sounds that will be the matrix of the work. When an instrument is present it tends to be (not always) the sound leader; this means that most of the sounds used in the tape part will derive of the sound of the instrument. In order to do this work, I work with the performer (when composing for soloists, I never composed abstractly for an instrument but always in relation with a performer of the instrument with which I experiment possible sounds) and record short sequences or isolated sounds. I then process the recorded sounds and obtain a large variety of sounds, often generating new timbers very different from the original source. This process of transforming the instrument sound has the advantage of creating series of derived sounds which are quite coherent with the original source, from a spectral and formal point of view. This creates "families" of sounds sometimes close to the original sometimes so distant that it is difficult to imagine that the origin is the instrument.

I thus create my starting material, which actually begun when I first recorded the instrument through the sounds and sequences that I asked the performer to play. Composition, for me, begins from the very moment you start imagining the music and conceiving the elements that will intervene. Then takes place the actual composition of the work, which means bringing together the sounds and writing the score. I used to separate these two processes, but more and more tend to do it simultaneously or only with small time-gaps.

The fact of advancing together is very important for me to avoid the *E cosi via* syndrome in which I first composed the tape, almost as an acousmatic work, and then added the instrument. The opposite situation, often encountered, are the works in which the composer writes the instrumental part which tends to be autonomous in itself and then figures out what can be added as a tape or as real-time transformations. Working both parts simultaneously for me guarantees a good complementarity between both parts. Among the salient works composed with this method, we find: *Summer Band*, for bandoneon and tape (1996); *Autumn Song*, for piano and tape (2008); *Struggling*, for percussion and tape (2000)<sup>22</sup>; or *Voix légères sur des flots* (2001), for children choir and tape<sup>23</sup>.

<sup>22</sup> Percussions are in itself a sound world, so I tend to choose a group of them with which to work.

<sup>23</sup> Excerpts from my work can be found on Soundcloud under the name of **danter**: <https://soundcloud.com/user-770526998>

Over the last years, I tend to use as always the sound produced by the instrument but I also include other sounds with no relation to the instrument. This extension to other sounds enriches the expressive possibilities and diverts listening to different sound universes. A first attempt was done in 1995 with *Crystal Mirages* (1997), for piano and tape, and more recently *Una storia antica* (2021), for flute and tape; and *E basta così!* for piano and tape (2022). Every work has its own set of sounds which were “composed” only for that piece; even if many of the sounds are not used, in general I never use them again; one could say that those sounds are worn-out once they have been used in a work. I am constantly looking for and inventing new sounds...

### **The relations between instrument and its extension**

Here we start talking of the relation between both sources, how they dialogue, or contradict themselves, or fuse so that no part is recognizable. I have worked different relations among both parts:

- The instrument is the leader and the tape expands or magnifies the sounds of the instrument in a duet relation, (*Crystal Mirages*),
- The instrument dialogues with its double in the tape, here non processed instrumental sounds are included to create an illusion of two instruments, together with other processed sounds (*Summer Band*),
- The tape creates a concerto like situation on top of which the instrument will be a soloist (the end of *Crystal Mirages*, *Una storia antica*),
- Both parts are totally penetrated without fusing in a relation in which they are totally complementary, as if one were the right-hand and the other the left-hand (*Autumn Song*),
- The instruments are totally autonomous and the tape creates transitions between different movements; mainly explored in *Reflets éphémères* for orchestra and tape (1997) and *Syracus*,
- A dense and massive tape (actually almost an independent acousmatic work) is confronted to an orchestra which underlines and expands the rhetoric of the tape; the concept is that the tape is the general frame and the orchestra draws the details (*Sounding landscapes* (2007) and *Circling waters* (2011)<sup>24</sup>,

### *How to make things work together*

There are other more technical and practical considerations which are necessary to be taken into account when performing a work for instrument and tape. One of the most difficult issues for a composer is learning how to listen the result of his music; not listening with his intentions and ideas, but with his ears in order to judge the final result and detect any imperfection. This implies listening during the composition process and, as we will see now, in the performance situation:

<sup>24</sup> I could add here, something I have never used, the situation in which the tape is a long drone without any particular “soundmarks” on top of which the instrument freely plays or improvises.

- Spectral distribution of sounds. If the instrument and the tape work in the same spectral region, there is a risk of one masking the other; this may have the consequence of making it very difficult to equilibrate their levels. When functioning in different registers this assures a good spectral complementarity and clearness.
- The use of reverberation. Except for the piano, the harp and some percussions, most instruments don't have an internal reverberation; they function with the reverberation of the concert hall. If the complementary sounds have a strong reverberation, this will difficult the dialogue between both parts; some sounds will be sharp and the others damp creating a perception confusion. Unless reverberation is considered as a kind of halo which englobes the instrument.
- Amplification. It is recommended, mainly in large halls, to slightly amplify the instrument, this equilibrates better the sound produced by the instrument and those of the tape and permits to equilibrate both in intensity. Beware of a too strong amplification which may erase all the instrumental subtilities. In order to create a sound level independency between both sources, it is recommended to place the tape loud-speakers in front of the instrument and not behind (see next point). The tape is very effective and gives a strong clearness when coming on the sides of the hall, however trying always to obtain a good fusion with the instrument. A tape performer should always remember that the more distant the loudspeakers are from the audience, the more the acoustics of the hall will intervene in the behavior of sound.
- Stage returns. Performers have to be able to listen to the tape sounds, not through the general amplification for the audience but through specific loud-speakers placed near the performer. These loudspeakers don't have to be very big or powerful and low frequencies can be equalized so only medium and high frequencies will go through; this assures a good reproduction for the performer permitting him to identify important elements on the tape and at the same time doesn't interfere with the global level of the work.
- Stopwatch. I tend to ask soloists to listen to the tape and synchronize themselves in function of outstanding elements on it. Sometimes I even place landmarks so they can orient themselves. However, it is not always possible and, even if possible, it is always safe to have a stopwatch so the performer knows exactly his position in relation to the tape. The stopwatch can be triggered by the performer or else triggered by the tape performer or even by the tape itself.
- Click-tracks. If there are many tempo changes and very precise synchronisms a click-track is absolutely necessary. The performer feels at ease in this situation even if it can sometimes be slightly unpleasant for listening. In some cases it is possible to place the click-track one or two measures before a tempo change and then after a couple of measures silent it down. Performers are nowadays quite accustomed to their use and they will say which situation they prefer.
- Tape triggering. Tape can run all along the work or intervene in different moments, with eventually precise moments in which the tape needs to be triggered. The tape performer at the mixing desk can do the triggering or else the performer can trigger the tape with a Midi pedal. This guarantees a high precision in synchronization.

- Tape Score. How should the tape score be written? It can be a very simple graphic representation as a straight line indicating where it starts and ends, or a highly developed graphic drawing where all the sounds are represented. The difficulty lies in finding the good equilibrium between both ends; a simple line doesn't help at all the performer and a highly developed drawing may contain many unnecessary details for the performer. Personally, I tend to underline the strong moments in the tape, as crescendos, attacks or other landmarks and, of course, I always write the time indication from the beginning of the work or of the section, so the performer can also synchronize easily.
- Rehearsals. There are two kinds of rehearsals, music rehearsals and sound rehearsals. In the first case what is rehearsed is the performance of the work; in the second case it is the relation between instrument and tape within the concert hall which is rehearsed. If possible, the musical rehearsals should be done before the concert hall rehearsal, however often this is not possible and rehearsals become a moment of tension (hoping there are no technical problems independent of the work which tend to strongly reduce the duration of the rehearsal). During the sound rehearsal there are many things to check like the amplification of the instrument, the stage returns, the global amplification, the equilibrium between both sources.
- Making the work transportable. The circumstances of contemporary mixed music performance tend to the situation in which the composer is generally present each time the work is performed. But how to assure the fact that it will be played when the composer is absent or, as it sometimes happens, the instrument performer plays in different locations and assures the equilibrium of the instrument and the tape. What is difficult to define is the equilibrium in sound level between the instrument and the tape; this sometimes can be described (for example with a note saying that the instrument has to be heard on top of the tape at a certain moment, or, vice versa, the tape has to fuse or cover the instrument), however it may be very variable even between one section to the following one. In this case, it is wise, if possible, to have a good recording of the work, in which the composer clearly shows the desired equilibrium and clarity among both components.

Many of these points depend on the experience of the performer with mixed situations<sup>25</sup>; if they are experienced, they will have specific demands regarding stage returns or time tracking issues and will be at ease with click-tracks or MIDI pedals; if not, it can be a stressing moment because of the difficulty of playing with a purely sonic partner who “plays” with a totally rigid tempo and doesn't “listen” at all the instrumental performance. Probably the best performances are those done by performers who listen to the tape and are capable or reacting to it or adapting their performance to the sound levels of the tape.

Time is very tight in the organization of a concert with mixed means and often, mainly for a first performance, there is little time for working on the sound of the

<sup>25</sup> It goes without saying that it also depends on the experience of the composer who, beyond his musical intentions, will know the difficulties and ambushes when putting together an instrument and recorded sounds.

music during the rehearsal. However, this may be crucial for the success of the work because the way the two sources are equilibrated permits to clearly listen to all the aspects of the instrument and the tape without creating confusion. There can be a slight tendency to overamplify the instrument and the tape, thus increasing the overall level to obtain an equilibrium. From my point of view this is never a good solution because the more you increase the level, the more influence you get in return from the acoustics of the hall which may induce loss of clarity and excessive reverberation. The solution lies in the opposite action; bringing down the levels in order to improve the clearness and find the good intermediate level that will permit the best results. Easier saying than doing, it may be very frustrating that many details in the tape or an excellent dialogue between tape and instrument are “erased” by the acoustics of the hall.

*Several aspects are essential for me in my creation:*

When working with technological devices, I have some strong ideas about sound and the way sounds should articulate or evolve. This is not based on a theorization about sound and music but the result of experience and experimentation. Before ending this article, I would like to express them so to explain what attracts or interests me in my musical work. As I said earlier, probably the starting point is my pleasure in inventing and working with sounds; I have often compared it to the work of a jewelry maker who takes raw material and from it carves the stones, builds the setting for the stones and slowly builds a complex structure that is not only coherent but beautiful to observe. In any case this concept of beauty is very important for me; I want to enjoy my music and, if possible, transmit the enjoyment to the listener. Here are the main trends of my thought concerning acousmatic works as well as mixed situations:

- 1) The work on sound material, its richness and flexibility as well as its coherence, which makes me organize the work around a few basic sound elements that I will process and transform multiple times until obtaining a wide variety of objects. The treatments applied to the sounds, have been and are of very diverse orders, which can be done with tools already existing like in the GRM Tools, up to more recent tools. Each new work is a new universe of sounds, with its own rules and constraints, upon which the musical structure is built.
- 2) Pitch. Particular attention is given to the area of pitch. Toned axes articulate my works functioning as poles of attraction or repulsion, generators of movements or developments, often involving harmonic relationships to generate tensions. This is also valid in instrumental writing in which melodic and rhythmic aspects are used to generate homogeneous organizations.
- 3) The spectrum. This third aspect, more subtle for our perception, is the one which will condition the spectral balance of my music. This concept involves the organization of the sections of the work in relation to the sound material, its spectral richness and the connection of different sections to each other. The organization of the spectral balance throughout my works is intimately linked to the formal aspect

of the works; with sections highly polarized in a spectral region and sections where the entire sound spectrum is present.

- 4) The formal articulation of my works takes into account the aspects previously described. All my composition work revolves around projects designed over long periods of compositional time. The projects are imagined in relation to different kinds of material, instrumental, dramatic or spectral, and a continuous experimentation around different articulation concepts for each work. The material can have an important incidence in the structure of the work; my works alternate compositions with separate movements, or continuous evolutions through time.
- 5) Space. Since the arrival of high-performance tools and after the first steps in the 80s where it was difficult to control and reproduce movements in space, I have been working since 2004 mainly on multi-track works, 8 tracks most of the time with experiments in 30 tracks. What interests me is the movement of sound in space in a situation of circularity and being able to compose in a multi-track space similar to the concert presentation space, with tools that allow me to finely control the movements. The correspondence between type of sound, movement and perception of sound through movements, is another characteristic that I exploit extensively in my multi-track works, whether acousmatic or with instruments. The presence of an instrument provides a spatial polarity which allows me to move the sounds away from the instrument or position them as close as possible, to ensure spectral fusion.

*And the audience in all this?*

Through the slow evolution and expansion of the modalities of contemporary music, the audience has adapted its listening to changing situations and new reception possibilities. Mixed music plays on the musical action produced in a concert situation, with a percentage of risk and with the visual relationship that the listener establishes between the instrument and the non-instrumental sounds. As much as the game is clear with traditional instruments when it comes to causes and effects, in the field of technological music, it remains relatively mysterious. The same gesture on an electronic keyboard can generate a very subtle sound or a myriad of actions; the only relationship that remains is that of the gesture that triggers something. Nevertheless, musical activity continues to arouse great attraction; predominantly in mixed instrumental music where technology is positioned as an extension of the instrument, where the musical fact tends to reside in the playing of the performer. In many electronic types of music, devices of all kinds allow musicians to generate, in unusual situations, incredible sound worlds, which expands even more the musical and stage possibilities of music.

A recurring question that a listener may ask himself, is: why do you need a tape? And why do you need so many loudspeakers? Regarding the first point, probably the introduction of technologically produced sound in musical performance has been one of the mayor revolutions of instrumental music. It has changed the relation to sound and way the listener perceives music. However, the essential point is the will of

composers to go beyond sound, to explore new regions and to experiment with new musical situations. Regarding the need for loudspeakers, it is a question similar to that of “do you need so many violins” in an orchestra. Multiple loudspeaker arrays permit to use the concert hall space in a totally new way, breaking down the frontality of the musical act and creating a new perspective for listening.

I deeply enjoy composing with sounds; the art of sounds; and exploring unknown worlds for my pleasure and with the intention of sharing them with the listener. The listener is free to enjoy or dislike what he listens to. Ultimately, it lies in his point of view and in his interest to discover new sound worlds, whether played, written, improvised or mysterious.