

# Considerations about space in acousmatic music. Expanding ideas into multichannel formats<sup>1</sup>

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## ***Abstract:***

*The relation between sound and space has always been a central concern for composers of acousmatic music and spatial distribution is undoubtedly a part of the conception of musical works. In this way, composers have at their disposal the possibility of defining which will be the final concert format for each of their compositions. On the other hand technological advances allow the listener to access and choose more than one way of listening to music and in recent years the installation of multichannel audio home systems has become more and more usual, while the concert venues have incorporated multichannel options as a standard for the concert.*

*However, stereo remains as the most widely used format for CD distribution as well as for radio broadcasting. This situation is undoubtedly decisive for the composer's perspective. In fact, composers in some cases think their music in stereo and afterwards need to extend their thought into 6 or 8 channels for the concert, or on the contrary they may originally think their sound discourse in multiple channels with the concert in mind, and after that are forced to think on a stereo reduction for recording and broadcasting. This talk will propose some compositional strategies, considering that the multichannel expansion of an original stereo can have similar textural characteristics that the orchestration in traditional instrumental music, and that the stereo reduction of a multichannel original may also be compared with the piano reduction of orchestral pieces. This approach does not rule out the use of computer applications, but takes more into account the textural characteristics of musical works in order to face expansion and/or reduction.*

## **Technological advances and aesthetic evolution**

Since the beginning of times we are able to find a relation between technological advances and aesthetic evolution. The sound of the instruments of each period has to do with the music composed in that period. This way, the technology in the 16th and 17th centuries allowed the construction of baroque instruments and the sound of those instruments has to do with the basso continuo which is completely identified with baroque music. In the same way, the appearance of the pianoforte with the ability to change dynamics during a performance changed everything again and became a seal of the romantic era. On our field, the quality of the recorded sound has become independent of the traditional acoustic concepts related to the perception of sound in a concert hall. More in this sense during the last 60 years the recorded sound developed a very noticeable paradigmatic quality, similar as the evolution of instruments has had before. For the acousmatic composers this is a central concern as their work has to perform both as pure music as well as recorded music.

As has happened throughout the history of music with the evolution of musical instruments, the evolution of the support on which the sound discourse resides has played a prominent role.... in the evolution of the musical style itself,... and this has been particularly noticeable in acousmatic music. Also the development of the recording industry has been decisive in the evolution of the characteristics of the support.

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<sup>1</sup> Paper presentation at the Colloque "Penser, construire et partager l'espace", organised by Influx (Musiques – Recherches), at "Espace Senghor", Brussels 26.4.2017

According to these ideas the acousmatic music composer is facing a double or perhaps multiple paradigmatic situation:

- on one side he has to define the final concert format.
- on the other side, he is supposed to create a sufficient, convincing and technically perfect version for distribution on CD also useful for broadcasting and streaming and in recent years probably also in a valid surround format as 5.1 channels.

## **Octophony, the late 20<sup>th</sup> century paradigm**

We may affirm that a new format becomes paradigmatic when the composers consider it as a reference for their finished work. On the 70's the most relevant space projection tools which were the Paris GRM's Acousmonium and the GMEBaphone (later CybernePhone) by the Bourges' IMEB group were thought as a performatic expansion tool starting from stereo compositions already completed by their composers. As time went by this situation evolved, and those tools together with their institutions and also some later ones but certainly not less relevant as the Influx Acousmonium of Musiques & Recherches began to allow Sound Projection from both stereo or multichannel originals.

As from the middle of the following decade there were already some composers thinking directly in 8 channels or even in a multiple of 8 as for example 16 or 32 channels. During the last decade of the XXth century an industry standard as it was the 8 channel ADAT could be found at the main electroacoustic research centres and during the 90's some composers also began to add it to their personal studios. We may compare this way of thinking the musical discourse directly in multiple loudspeakers to 19th and 20th century composers who worked directly for orchestra. This way of thinking consider the main concepts introduced by Pierre Schaeffer and confirmed or extended by Dennis Smalley who talks about Gesture, Texture, Energy and Trajectory. If we think our discourse in this way, then we may feel the need to compose directly on multiple channels.

On the other side having so many places with 8 or a multiple of 8 channel systems ready for concerts, many of us perceived these as small acousmoniums suitable for 8 or for instance 16 channel projection starting from stereo originals and in some cases we could see and even now we may see this practice in lots of events. Some composers perceived this as a challenge and decided to revise their stereo pieces getting alternative versions for the 8 channel diffusion standards.

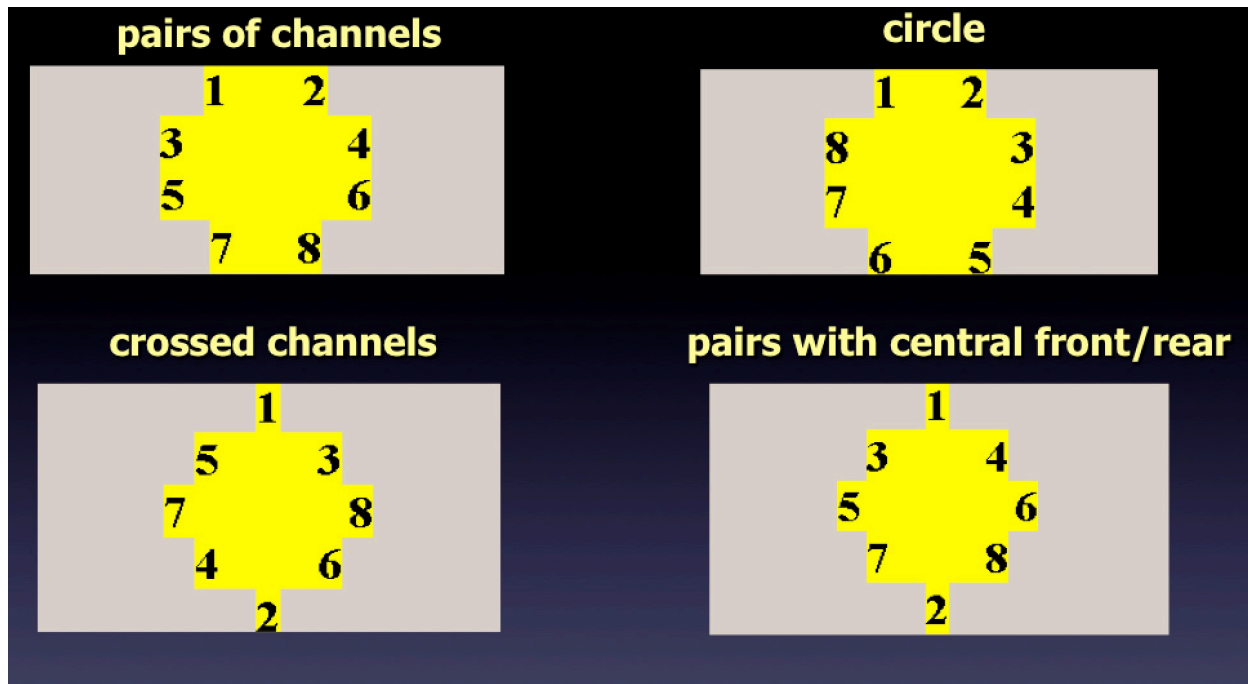
This challenge opened the door to our imagination offering us the possibility of working with great detail on the texture of the sound and even create new textures from the existing ones, just as it happens with the orchestration of piano works on instrumental music. At this point we may ask ourselves ¿which is the final version of a piece? ¿the multiphonic concert one or the stereo CD version for distribution and broadcasting? ¿perhaps both?

The evolution of the recording industry has no relation with art. We may affirm this as we did not get from the industry an octophonic format for massive distribution. On the contrary some years later, when the industry decided to offer a multiphonic alternative, they preferred the cinema industry surround in 5.1 channels as a new format, which of course impacted on acousmatic music composition.

## Some usual octophonic loudspeaker placements<sup>2</sup>

When the composers make their choice for octophony, the 8 channel placement becomes a part of the composition. The following image show some of the most usual octophonic loudspeaker placements.

Fig. 1 show four usual octophonic loudspeaker placements. There may be more, but these are the more usual and composers may work on these or any other disposition.



*Fig. 1 Four usual octophonic placements*

## Ambisonics<sup>3</sup>

Developed in the 70's by Michael Gerzon and Peter Fellgett at the Oxford and Reading universities in the UK with the support of the British National Research Development Corporation, *Ambisonics* is one of the most convenient and imaginative techniques developed around the idea of projecting the sound on space. It records a 360-degree sound field using a single-point microphone with four or eight capsules. The sound field is processed with their own proprietary UHJ encoding which is compatible with mono and stereo audio. *Ambisonics* was originally thought as hardware and software, and in that case it needs of course a dedicated equipment which is expensive.

There are some wonderful software implementations of *Ambisonics* that allow us to emulate any possible loudspeaker disposition, starting from a minimum of four, without the need to move the existing loudspeakers during the concert. I will just mention three of these alternatives: the *Ambisonics Tool Kit*<sup>4</sup> designed for the *Reaper*<sup>5</sup> multitrack digital audio workstation and for the *SuperCollider*<sup>6</sup> programming language for real time audio synthesis and algorithmic composition, developed with the support of the Center for Digital arts and Experimental Media at the University of

<sup>2</sup> As from this point we'll consider any multiple of 8 as corresponding to the same 8 channel basic idea or paradigmatic unity, so all graphics / examples will be related to 8 but it may be extended to 16, 24, 32 etc.

<sup>3</sup> <http://www.ambisonic.net/>

<sup>4</sup> <http://www.ambisonictoolkit.net/>

<sup>5</sup> <http://reaper.fm/>

<sup>6</sup> <http://supercollider.github.io/>

Washington and by the Bergen Center for Electronic Arts, Norway; the *ambilib~ Tools* for Pure Data<sup>7</sup> developed at the Cornell University Electroacoustic Music Center, in the USA; and the *ICST Tools* for Max<sup>8</sup> developed by the Institute for Computer Music and Sound Technology at the University of the Arts, in Switzerland.

## **Strategies for the octophonic expansion of an original stereo composition**

Instead of leaving these issues in the domain of a software tool, no matter how perfect it may be, I prefer to consider it as an accessory and introduce some more handmade criteria for sound manipulation. On a paper presented at the Sonic Arts Network Conference 2004 in Leicester (Schachter, 2007), I referred to some qualities of the acousmatic discourse as well as to the difference in sound reception from the public compared to its perception by the participants of an interactive performance. These considerations about the audience's perception are applicable to the case of the expansion from an original acousmatic stereo piece into a multichannel sound setting.

To talk about *Gestuality*, we need to mention first the *Gestalt Theory* (Wertheimer, 1923). According to the *Gestalt*, we naturally perceive the whole more than the sum of its parts. Starting from this idea, in an acousmatic discourse we can recognize different elements that we perceive in accordance with our focal aptitude to comprehend the texture of that discourse. We may call these elements as *Gestural Saliencies*, and the perception of these will depend on the distribution of the sound energy along the timeline as well as on its position and spatial displacement. More about this, Dennis Smalley (1985) writes about the Level and Focus perception and introduces the idea of *Focal Depth* as a textural concept when he writes that :

“ *we feel the need to change our perceptive focus happening for diverse levels during the process of listening Gesture has to see with trajectory, with the application of energy and it is joined to causality* ”.

According to Smalley the perception of sound gesture is tied with the perception of its texture and this is central to the comprehension of the whole discourse.

## **Manipulation of Gestural Saliencies as a possible strategy for multichannel expansion.**

Starting from these ideas, on a paper presented at the EMS 2009 Conference<sup>9</sup>, I introduced the idea of Gestural manipulation as a possible strategy when doing the transcription of a given texture, originally conceived for a certain spatial loudspeakers allocation, in order to maintain its essence into another different distribution.

In other words, we may consider the Gesture of the sound discourse as ruled by its *Gestural Saliencies*, and departing from there we may emphasize them, altering their relations of intensity and thus giving them the ability to impact on our perception in a different way as they should at their original placement and with their initial energy distribution. By doing this we'll be able to obtain a more vivid sound image than the one embedded in the stereo spatial allocation. We may call this procedure *Gestural Emphatization or Emphasizing*.

<sup>7</sup> <http://digital.music.cornell.edu/ambisonics-in-puredata-pd/>

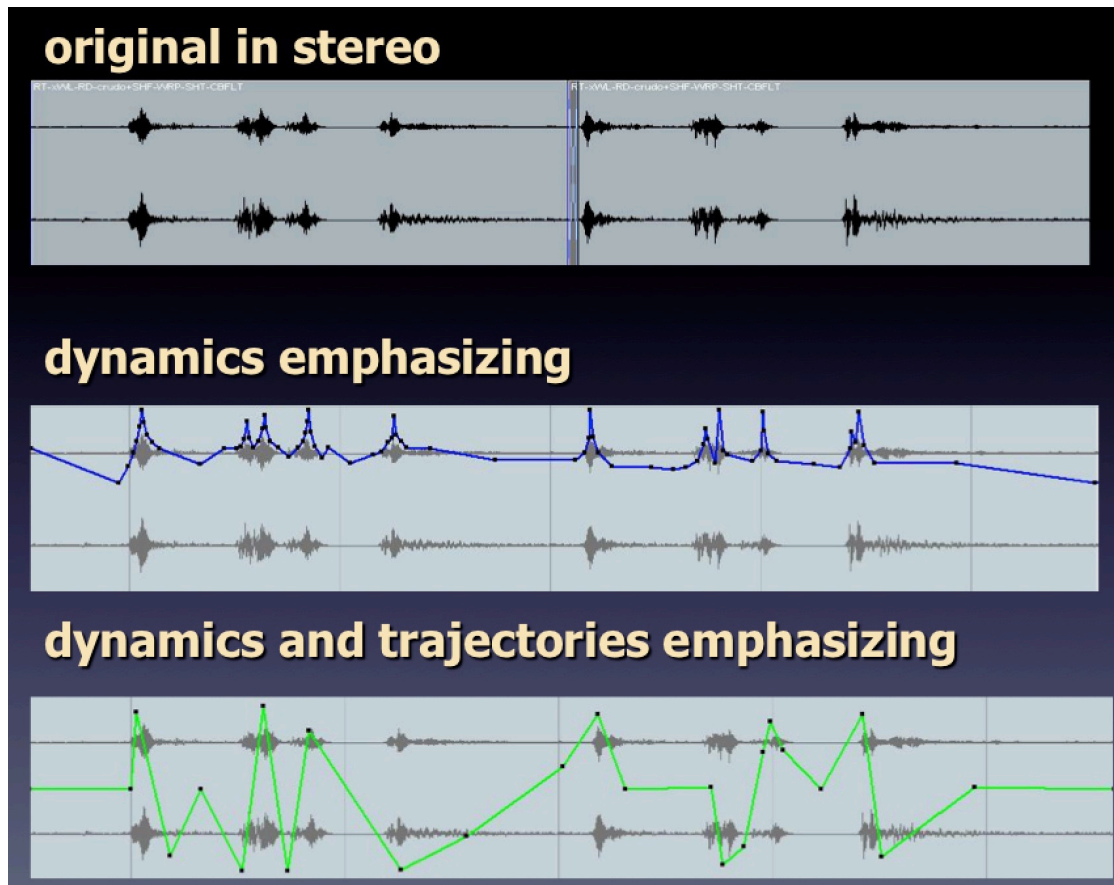
<sup>8</sup> Max-MSP, whose last version is Max 7, by Cycling'74 <http://www.cycling74.com>

<sup>9</sup> Electroacoustic Music Studies (EMS) Conference held on Buenos Aires on 22th to 25th June 2009: <http://www.ems-network.org/ems09/proceedings.html>

To do this we may just clone the stereo original to four stereo pairs and by editing dynamics we can remark different saliences on each of these clones, remarking what in fact is already there with an innovative spatial distribution. Always working on those clones of the original stereo piece, we may also do a Stereo Image Intervention, editing the trajectories and altering in some way the channel energy distribution, applying different criteria for each of the stereo file clones.

## Gestural emphasizing

Fig. 2 shows a basic gestural emphasizing procedure combined with the edition of trajectories:



*Fig. 2 a. b. c. Gestural emphasizing*<sup>10</sup>

First we have the original stereo recording<sup>11</sup>. As this is an original stereo mix, it works fine with the so called *by pairs* disposition<sup>12</sup>.

The second includes *Dynamics Emphasizing*. Here we can see about twelve accents added to the original, in all cases as reinforcement of the original gestures. There may be of course many different dynamics emphasized alternatives assigned to different clones of the original, so that the gestural perception gets a great textural depth.

The third case includes also the edition of trajectories so that each pair may have a different energy distribution between left and right. The result should be an even more textural enhanced version of the

<sup>10</sup> The examples are available at: <http://www.schachter.com.ar/spacesound2017/examples.html>

<sup>11</sup> Corresponds to the first stereo version of my piece *Cifra Oscura*.

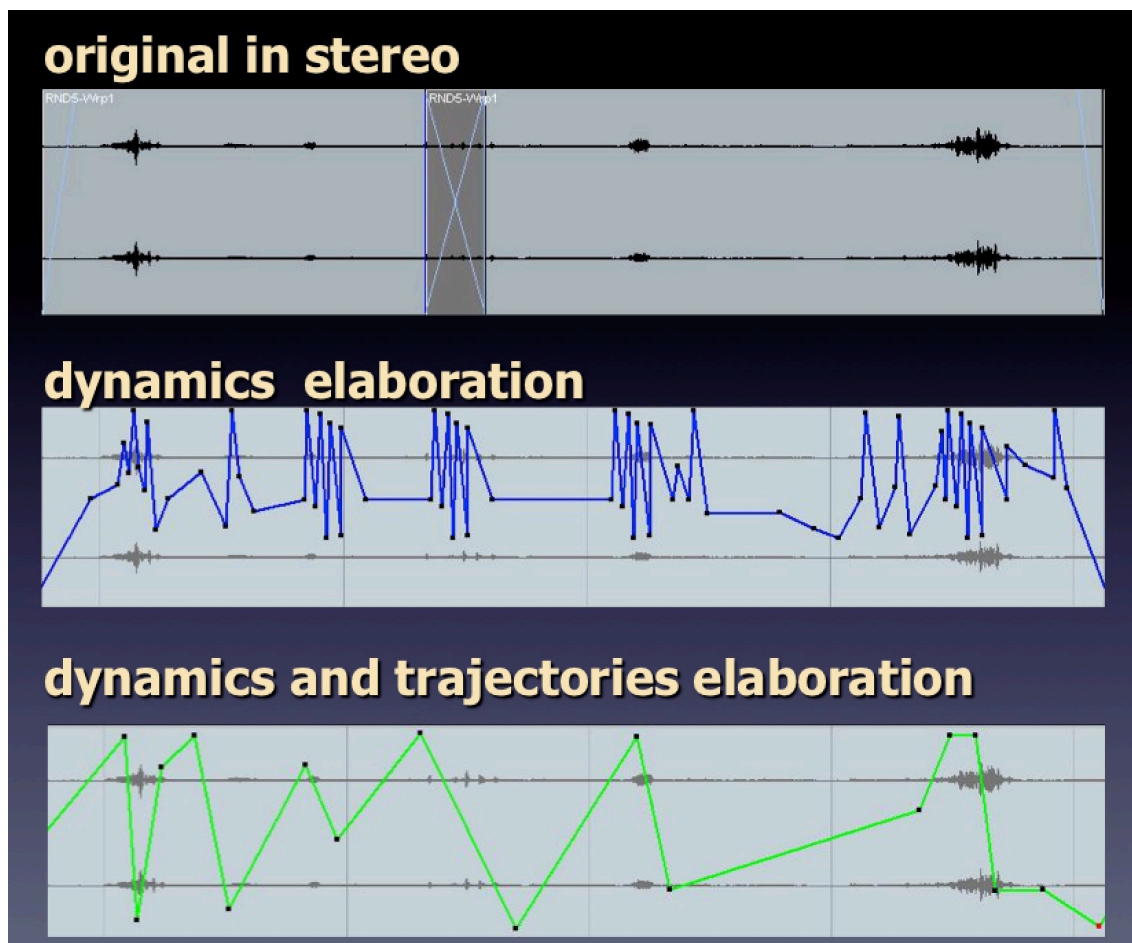
<sup>12</sup> Usually we call *by pairs* any channel number disposition where channels 1, 3, 5, etc. are always the left side and 2, 4, 6, etc. on the right side

original. Of course, it is not a question of contradicting the original idea, but of making use of the multiplicity of channels to obtain a major textural richness.

## Gestural elaboration

Going a step forward, a different and for sure very effective strategy, is to do a deeper intervention on the texture creating *new salencies* which are not present in the original and we may call this strategy as *Gestural Elaboration* and is for sure a compositional strategy that should always remain on the hands of the composer. This can be very resourceful since these *new salencies* may be placed in some loudspeakers while not in others. Thus, we may impact the listener with a much complex texture as the result of *Gestural Elaboration* is the textural expansion of the original

Fig.3 shows one of the possible gestural elaboration procedures also plus trajectories elaboration:



*Fig. 3 a. b. c. Gestural elaboration*<sup>13</sup>

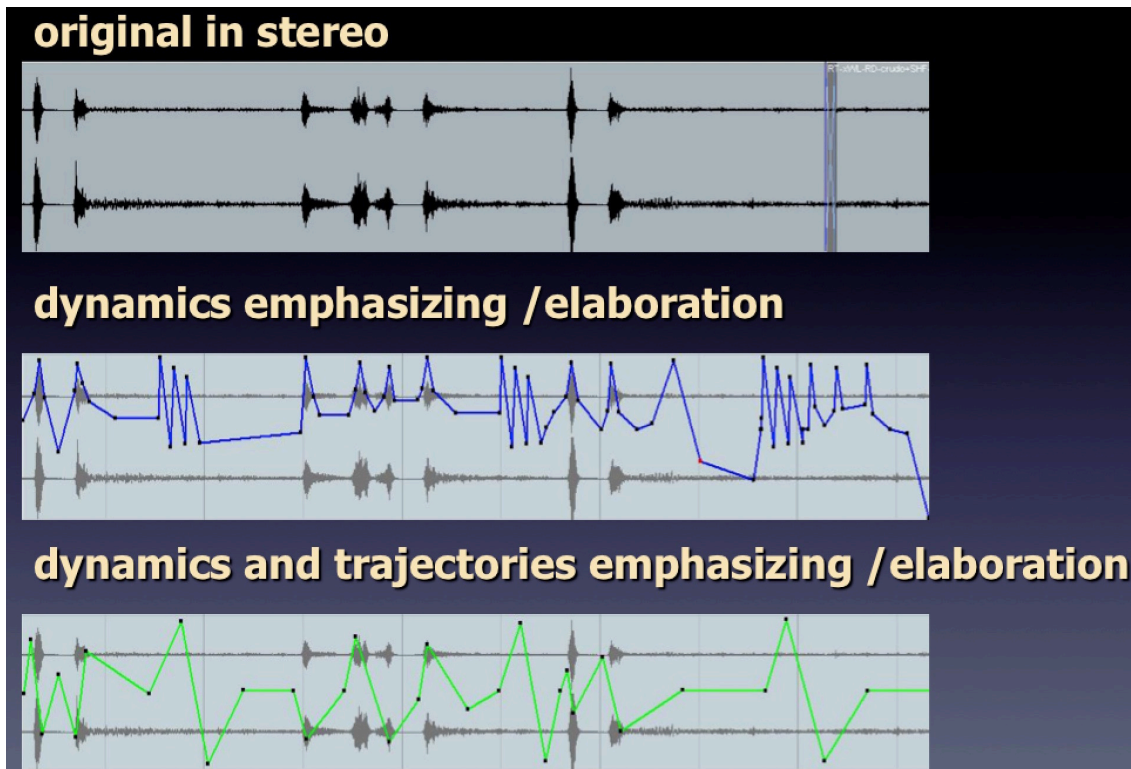
We also start here from the original stereo version which in this case is a different excerpt from the same piece. Now we apply *Dynamics Elaboration* that is a deeper intervention on the texture. We may observe that there are not just accents applied to existing gestures but also new gestures appear on the existing materials through energy manipulation. Same as before, we may also get different dynamics elaborated versions by distributing these gestures in different versions, and again if we add the edition of trajectories inside each file we get another different version of the original and we may also distribute this intervention into more than one file to get multiple slightly different versions.

<sup>13</sup> The examples are available at: <http://www.schachter.com.ar/spacesound2017/examples.html>



## Gestural emphasizing and elaboration

We may also mix both procedures. Fig.4 shows one of the possible combinations between gestural emphasizing and elaboration:



*Fig. 4 a. b. c. Gestural emphasizing and elaboration*<sup>14</sup>

In this case our starting point is a different excerpt from the same piece. As we may see, here we are mixing both techniques: accents over the existing gestures plus new ones. One more time, the third example includes both dynamics and trajectories intervention.

## Stereophonic reduction of an original multichannel piece

When we straightforwardly compose in eight channels, if we want our piece to be distributed on CD, broadcasted on media or through streaming on the Internet, then we need to think about an alternative version in stereo which should be also considered as a valid version of the piece. More than that, our piece will be heard much more times on that stereo reduction than on the original concert octophonic version. In this case we need to think more or less like if we were doing a piano transcription of an orchestral piece. All the original dynamic variations should be kept, and the perception of texture should remain there. How can we achieve this goal?

First of all, to maintain an acceptable dynamic range we should work with as much headroom as possible. This is the point where we should notice the benefits of working in multiple channels with as much sound quality as possible. For instance if our eight channel original is in 48 KHz 24 Bits we will have as much as 144 dB of dynamic range, and this should allow us to use a very big headroom at the output mix bus without spoiling our original work. Let's say for instance 18 or 24 dB. After

<sup>14</sup> The examples are available at: <http://www.schachter.com.ar/spacesound2017/examples.html>

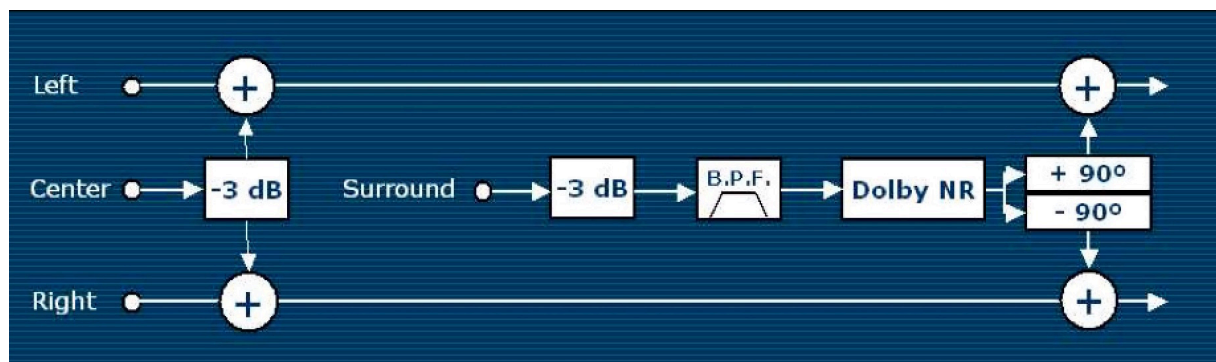
mixing and normalizing the output there should not be any lose of dynamic range. If we do not use headroom when mixing to stereo we will be forced to apply a limiter on the output bus and the result will be an overcompressed stereo file, far away from the original idea.

## The Surround Option - pros & cons

First of all we need to remark four essential differences between octophony and surround:

- Surround is an specific format thought for audio on the cinema.
- Surround is not discrete. As per Dolby Labs papers the surround channels are considered as a one and unique thing including at least a small degree of information supposed to be shared between channels.
- The Sound Gesture and the use of Trajectories are not main issues for Dolby Labs
- There are different channel categories in surround: the Front Central Channel is devoted to dialogues to keep the audience's eyes on the screen. The Ls and Rs channels are considered as the "effect" channels, and the main difference between Frontal and Rear is Dry vs. Wet, being Reverb their main effect. All these are motionless ideas compared to Gesture, Texture, Projection and Trajectories which are central to the Acousmatic way of thinking the musical discourse.

Dolby Labs developed what they call the "Surround Matrix encoding and decoding" which is shown in Fig. 5



*Fig. 5 Dolby Labs Surround Matrix*

According to this Matrix we can always get five channels out of two and viceversa. The Matrix adds L plus R with a 3 dB reduction to obtain the front Center. Then reduces another 3 dB and passes the signal through two Dolby filters (Band Pass and Dolby Noise Reduction) to get a Mono Surround channel. Finally this Surround channel is shifted 90 degrees forward and backward to create both Rear Channels called Ls and Rs

Thinking always in both the concert and the distribution formats, we should mention that Surround is edited on DVD instead of CD and there are multiple audio formats in Surround including both Lossless and Lossy<sup>15</sup>. Dominique Bassal (2002) writes about the possibility of placing four channels of uncompressed lossless audio in 48 KHz 20 bit or 96 KHz 16 bit inside a DVD-Video structure, which should be recognized by any standard DVD-player as a valid disc, this is a theoretical solution unfortunately not considered by any DVD authoring software so far and not recognized by any DVD-

<sup>15</sup> A much more detailed information about formats is available in the Appendix to this paper



player either. As a result of this, lossless is devoted to High definition Stereo which not considered as an option by the recording industry.

On recent years we saw the appearance of Blu-ray which keeps the same logical format as DVD inside a different physical format with much more capacity, and for Blu-ray there is a multichannel lossless option which is also not usually taken into account by the industry. To complete this situation, in some cases the DVD and Blu-ray players normally found on the market do not recognize lossless audio, recorded on DVDs and Blu-rays.

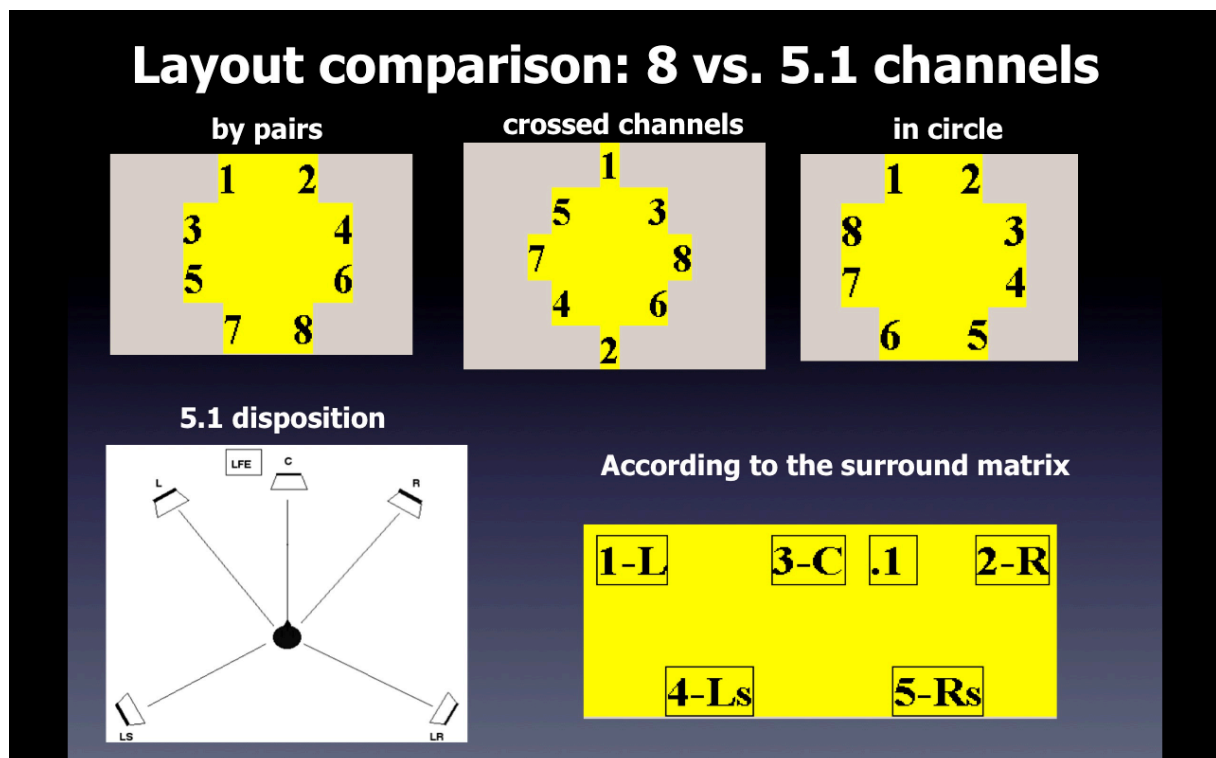
## The sweet point fact

Every multichannel system has a weakness in what is called the *sweet point* or the area in which the listener retains the spatial perception. This critical point is much wider in stereo than on a multichannel system and it is particularly weak on a standard surround in 5.1 channels. This goes worst due to the limitations of space at the normal consumers' houses, not only due to the size but also because the sound system placement is not such-a-main-thing-to-care-about for many people.

Here we need to return for a minute to *Ambisonics* just to remember that it has the ability to emulate any loudspeaker disposition starting from only four. But more than that, it provides an extended *sweet point* area which makes it very efficient and more related with the acousmatic universe than surround, but It did not stick in the massive market so it is not easy to find an Ambisonics decoder for home theater purpose and it remains instead as a valid alternative for the concert.

## Layout or channel arrangement in Octophony and 5.1 Surround

Here we can see some of the usual eight channel layouts compared with the 5.1 standard disposition



*Fig. 6 Octophony vs. Surround*

In eight channels we have many different alternatives for spatial placement. When the energy is distributed *by pairs* ... it is just like if it were thought for a number of four stereo pairs ... that resolve into eight when projected. The *crossed channel* distribution also is a paired one but focusing to the spatial opposition of the sonic materials. The *circle* layout may be clock or counterclockwise and of course may start in any of the eight loudspeakers, it is a typically non-paired disposition. The role of the channels may change during the sound projection and a paired distribution can change for instance to a circle one.

Instead of these a 5.1 surround sound distribution is fixed and thus gives us the problem of working with a much more static distribution and of course with less channels. At the end it is a limitation, not like it was when we only were able to think in stereo, but a limitation after all.

### **Dynamic range on acousmatic discourse in multichannel environments**

Same as what happened with the transition from analogue media to CD, but perhaps in a much deeper sense, any multichannel environment makes possible to think in Dynamic Range as a relevant attribute. Many of the new tools for analysis and sound processing, work in the same sense and confirm that the evolution of technology usually brings forth a constant evolution of the language of Electroacoustic Music. As the number of loudspeakers is increased, as far as we do not reduce the resolution in a higher proportion, we may think on the-use-of wider dynamic contrasts than stereo, considering that:

- we handle a larger and more satisfactory Signal to Noise Ratio
- we may elaborate the sonic discourse using intensity as a variable
- this-helps-to-get an Improved Textural Perception of the sound discourse from the listener

So the-real-challenge-should-be not to loose the essentials of a multichannel composition on the new standards, and this is not an easy task when we feel tempted to migrate our ideas to the surround sound formats.

About the plus and minus of the surround formats we may affirm that the global acceptance of the surround formats for massive distribution is a plus, and thanks to this, at least this multichannel disposition will be available anywhere, out of the concert venues. But on the other hand we get a minus: surround formats were originally thought for the cinema, not for music, and they allow many different sound file standards, some of them with a lossy resolution due to data compression, same as happens with most soundfile formats for the internet. One thing is clear, Surround formats were not conceived with the sound trajectories in mind, they devote a fixed central front placement for dialogues and the rear channels for what Dolby Labs call *sound effects* which as said before usually correspond to the reverb effect. The sound Gesture is also not a main concern for Dolby Labs. So in general we can say that Surround formats are originally less immersive than the usual multichannel layouts we use in acousmatic music.

Also, taking into account the essentially binaural nature of human hearing we can think any organization of loudspeakers as an extension of the two-channel stereo. For example an octophonic space will work as a double quartet of stereo images crossed at various points in the internal space delimited by the location of the loudspeakers. If we consider this as a fact then we could infer that any organization of channels with an odd number of loudspeakers may introduce a distracting element for our auditory perception.

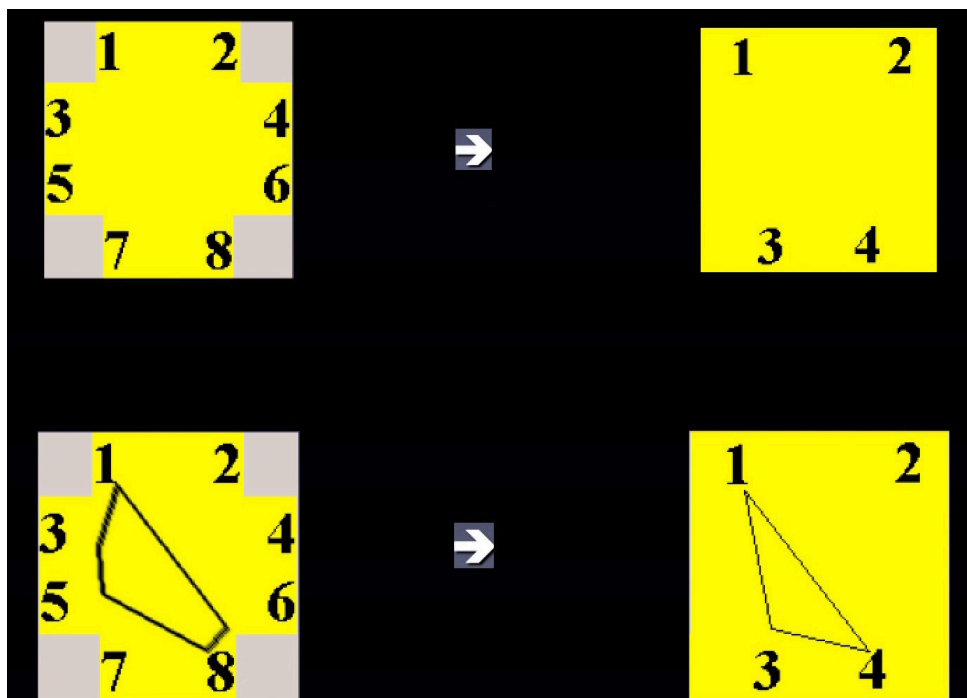
This may cause a perceptual unbalance and the sound coming from this specific loudspeaker could be

perceived as coming from inside the loudspeaker itself because it is not related to another specific loudspeaker, it plays alone. This *lack of relation* or *lack of play* makes the sound at the central front channel tend to be somehow motionless or at least less flexible for diffusion than the others. The front central channel plays an important role in the sound for the cinema, it is the owner of the voices and helps the audience to look at the screen, but this role is completely unnecessary in acousmatic music as our cinema for the ears does not need this kind of attention.

## Shrinking space from octophony to 5.1 surround

The eight channels *by pairs* distribution is for sure a good starting point if we want to shrink from octophony to 5.1. A good strategy may be as a first step to **shrink from eight to four** channels trying to maintain the original trajectories. It may allow us to define the left and right frontal channels as well as and the rear ones. We may begin by adding 1 plus 3 and 5 plus 7 on the left side, and 2 plus 4 and 6 plus 8 on the right side.

The amplitude levels should be edited keeping in mind that our goal that is to preserve gesture and trajectories and every time we sum two channels we should reduce 6 dB to the result to avoid saturation. Fig. 7 shows illustrates this shrinking strategy.



*Fig. 7 Shrinking space from Octophony to 5.1 Surround – Step 1*

Of course we may always use Ambisonics to emulate the original eight channel layout and reconstruct the original octophony out of a lesser number of channels.

The second step of this procedure is to create the central front channel and the sub-low channels. For this purpose we may follow the Dolby Labs Surround Matrix and add 1 plus 2 of the four channels, always reducing 6 dB, or we may alternatively create an independent mix for channel C if we think that there may be some elements on channels 3 and 4 that should be placed also on the front central location. As an alternative, we may discard C and use the 5.1 scheme to get a 4.1 output.

Finally, to get the sub-low “.1” channel we can mix channels 1 to four, less 12 dB to avoid saturation

and low pass filter the result, or eventually we may discard the sub-low channel, which does not mean to lose it at all, as all DVD players can do the job for us. In that case we'll obtain a 5.0 mix or a 4.0 mix if we discarded the front central channel.

After all this speculations, and just the way we did on the first step when we shranked to four channels, here we may also leave this on the hands of Ambisonics, give it the 8 channels original space AND ask for a 5 channel output with the Surround distribution, and of course always save all the independent discrete output files for further use.

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## Appendix – About Surround formats on media

One of the most interesting cases is the **SACD**, developed by Sony and Philips Electronics creators of the Compact Disc by the end of the 90's. It is a high-resolution format designed for high-resolution audio in Stereo and 5.1 Surround using the DSD or Direct Stream Digital format, that uses a sample rate of 2822.4 kHz on a standard DVD support. A 4,7 Gb DVD capacity can store two different versions of the same audio, one in Stereo and the other in 5.1 Surround of up to 100 minutes each. The SACD asks for a dedicated player with backward compatibility standard CD reading, but also it allows dual layering discs that may host standard PCM CD audio information on one layer, thus readable on standard CD players, or eventually on a DVD or Blu-ray player, but spite of this it has not great success, perhaps because the SACD standard defines the second layer and its CD or DVD compatibility as optional.

**DVD-Audio** is a digital format specifically designed for high quality audio on DVD support. It was not designed for video, so it is a different format than DVD-Video. It saw the light in 2000 so it had to fight against SACD but neither of both replaced the CD Audio. DVD-Audio accepts many different audio configurations starting from one single channel to 5.1 surround, using various sampling frequencies. It accepts different audio configurations on the same disc, as one 5.1 track at 96 kHz 24 bits together with a Stereo track in 192 kHz, 24 bits. It also accepts different audio quality inside a single track so that the frontal and rear channels may be at different sample rates and/or resolutions. On DVD-Audio sound is stored on in uncompressed Linear PCM format in the case of Stereo up to 192 kHz 24 bits, and in the case of 5.1 Surround up to 96 kHz 16 bits or 48 kHz 24 bits.

**DVD-Video** is designed to store digital video on DVD discs using the DVD-Video standards. It asks for a DVD player with an MPEG-2 decoder, it should accept digital audio at 96 kHz 24 bits Stereo but the usually found players do not recognize this format.

Audio on a DVD movie can be either PCM, DTS, MPEG-1 Audio Layer II (MP2), or Dolby Digital (AC-3) format. DTS audio is optional for all players, as the DTS format was not part of the initial standard and was added later; so, many old DVD players can't play DTS audio. Almost all DVD-Video releases in our days use Dolby Digital AC-3 audio which is a lossy format whose quality is comparable with MP3. The accepted audio formats on DVD Video are: PCM in 48 kHz or 96 kHz and 16 or 24 bit; AC3 in 48 kHz from 1 to 5.1 channels and up to 448 kBit per second (which is the standard); DTS in 48 kHz or 96 kHz from 2 to 6.1 channels at 768 kBit or 1536 kBit per second; MP2 in 48 kHz from 1 to 7.1 channels, and up to 912 kBit per second.

The DVD-Video standard accepts up to 8 different audio tracks per video thought for diverse audio formats and/or languages. The DVD video standard allows 48 kHz 16 bits in 8 channels but neither the software authoring applications nor the DVD players recognize it.

To end the list let's mention also the **HDCD** format which uses the standard CD support instead of DVD and is in fact a halfway or hybrid format owned by Microsoft, that offers a standard Redbook audio CD in 44.1 kHz 16 bits version together with an alternative extension of the dynamic range to 20 bits. It is compatible with the standard CD players that simply ignore the extra four bits, but for playing the extended version it is necessary a proprietary or dedicated player. This format does not host audio in surround and had very little success so that it is not easy to find HDCD players.