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**Showing the acousmatic sounds through
the mobile acousmonium AUDIOR**

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Abstract

According to François Bayle, acousmatic medial art takes the form of a work on the image-sound and the 'reading' of listening; in fact, not only the acousmatic listening in concert is aimed at adapting the 'internal space' of a work to a specific place, but it aims also at the exploration of a sound event, regardless of its origin and its meaning (Bayle, 2007). Thanks to different sound projection systems, the characteristics of different acoustic environments can be channeled towards a single public listening space. Nevertheless, there is a great variety of systems and concepts related to "show" acousmatic sounds. According to Ludger Brummer, while the ambisonic technique and the wavefield synthesis follow a scientific path that tries to create tools to arrive at a reproducible localization, the acousmonium employs a combination of space, pitch and sound density, able to reproduce effectively in a concert hall the internal space of a work. Both the acousmonium and the ambisonic techniques work with massive and parallel vibrations of membranes, but while with an ambisonic system the phase of the sound is controlled to create a point of localization, with the acousmonium it is possible to create sort of un-correlation between the sounds through the arrangement of the different speakers, in order to enrich the frequencies with phase convergence points for the ear (Brummer, 2006). This paper will show the characteristics of the AUDIOR acousmonium.

The acousmonium AUDIOR

Entirely designed and built in 2012 by Eraldo Bocca, the mobile acousmonium AUDIOR has been designed for the performance in concert of acousmatic repertoire. AUDIOR combines the peculiarities of immersive listening (obtained with full-range speakers around the audience) with those of an orchestra of speakers (obtained with a subdivision of the frequency ranges: Bass - Medium Bass - Medium - Medium High - High and Very High).

Besides, it has one analog console spatialization of 32 channels and two 16-channel digital console. Its basic double-rings architecture derives from the acousmonium MOTUS, conceived and designed by Jonathan Prager. Thanks to these features, AUDIOR offers the possibility of dynamically combining volume, space, density and timbre. The presence of many narrow-band loudspeakers (arranged in front of and around the public) guarantees the possibility of intervening on the timbre, while respecting a condition of immersive listening. All narrow-band speakers and part of the full-range speakers have been specially manufactured for this purpose: some of the speakers full-range are modular and can be assembled so that they can be adapted to different configurations. The speakers for the high

frequency are hyperbolic trumpets, which allow a great deal of pressure and linearity of issue. Like the two rings of full-range speakers, mid-low speakers and super tweeters are placed around the audience to allow immersive listening. The acousmonium AUDIOR currently consists of a total of 54 speakers (among full-range and narrow-band) and 44 amps. The availability of speakers of different dimensions, directivity, power and characteristics determines the possibility of constructing the most suitable sound spaces for the diffusion of acousmatic works, through changes in the layout, distance from the audience, height from the ground, and distance from the walls of the speakers, according to the physical spaces of the locations.



Fig. 01: The acousmonium AUDIOR at Teatro Espace, Turin (Italy), 2017

Enhancing the quality of listening

In the case of the AUDIOR acousmonium, the work of the performer on the timbre is supported by the adoption of both full-range and narrow-band speakers, placed symmetrically in front and around the audience. The narrow-band speakers reproduce only a part of the acoustic spectrum and can also be non-linear in the reproduction band. Besides, they have different types in order to play the best audio range which they are intended. In particular, the speakers for the mid-range are of type dipolar to modify the return of the stereo images, taking advantage of the issue reflected back from the walls of the concert hall and from the distance of the speakers from the walls. In this way they allow a further possibility of space-timbral exploration. The dipolar speakers placed in the front section offer the audience and the performer a quality of listening corroborated by the perception of a reflective rear space, which is added to the frontal emission extending the point emission of the speaker. Besides, they contribute in defining space-source as emergence of sounds, that demand the listener's attention and point towards a topological perception, through which the listener can localize the sources of the sounds (Lotis, 2014).



Fig. 02: AUDIOR dipolar speakers seen from behind. Conservatory of Milan (Italy), 2015

Next to the work on the amplitudes, is the work on the timbre and its nuances that represents an extremely important moment for the sound staging: it allows to extract a delicate profile, or to accentuate a pedal, but it requires, in order to be effective, quick access to the mixer's controls and a certain virtuosity (Dhomont, 2006). On the other hand, the space-source defines the intentional and conscious monologue of the environmental elements by specifying their location and emphasizing their characteristics (Vande Gorne, 2003).

Building the speakers

In addition to being informed by Eraldo Bocca's forty-year experience in the construction of acoustic loudspeakers and environmental acoustics, the guidelines followed in the construction of the Acousmonium AUDIOR loudspeakers have been defined according to three factors: the first was the listening to the MOTUS Acousmonium in concert in the year 2011 (in the frame of Festival 5 Giornate, Milan); the second was the installation of the Acousmonium SATOR in the year in 2012 (Auditorium of the Centro San Fedele, Milan); the third was the good advice of Annette Vande Gorne. The choice to build acoustic loudspeakers of different sizes and powers, able to work in environments of different sizes and to obtain good performance in even rooms with bad acoustics, led to the construction of diffusers in the configuration D'Appolito, dipolar and array. The D'Appolito configuration allows a better dispersion of the sound. The dipolar construction minimizes the lateral reflections, also taking advantage of the rear emissivity to enrich the sound emission and drastically reduce the distortions of the speakers. The Bessell arrays speaker configuration have a projection of the sound with a cylindrical wave, avoiding in part the reflections of the floor and ceiling. Another important choice was to divide the audio band between different speakers (Bass - Medium Bass - Medium - Medium High - High and Very High).

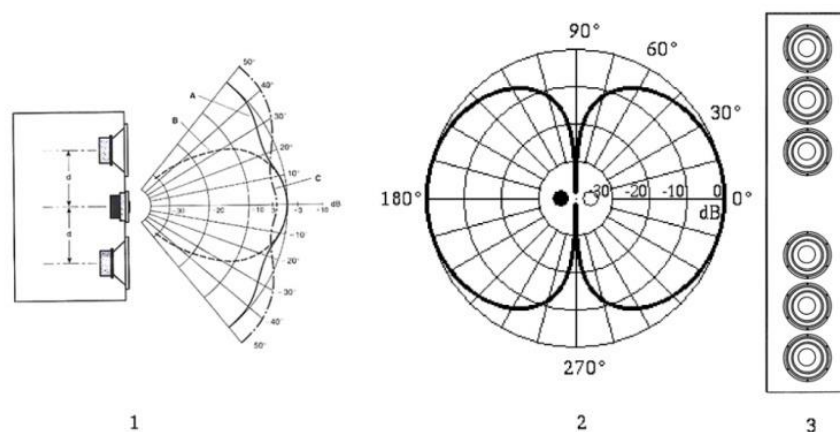


Fig. 03: 1. D'Appolito speaker configuration 2. Dipole 3. Bessel array

This allows the interpreter to obtain timbral variations by simply acting on the faders of the spatialization console. A more practical choice was to adopt only passive loudspeakers, in order to minimize the distribution of the power supply, usually only two points: one at the console and one at the front. Moreover, all the connections are made through cables and connection boxes, built with industrial connectors to make installation quicker and safer.

Concerts

Since 2012 the activities related to the mobile AUDIOR acousmonium took place in Italy and in Switzerland. The AUDIOR acousmonium has so far enabled the realization of about forty concerts with the performance of works by a hundred composers from around the world, dozens of first performances, seven monographic concerts (dedicated to Bernard Parmegiani, Trevor Wishart, Brunhild and Luc Ferrari, Jean-Claude Risset, Erik Mikael Karlsson, Marc Favre, Angelo Paccagnini), four sessions of dance and acousmatic music, a study meeting dedicated to Angelo Paccagnini and chaired by Laura Zattra (2017), the concert cycles 'Chitarra e altre corde', 'Vox Humana', 'Fuoco Aria Terra Acqua - La Musica degli Elementi', 'Tsunami e Licheni'. Finally, we remember AUDIOR's participation in three festivals in Italy: the *Festival 5 Giornate* in Milan (Editions 2014, 2017 and 2018), the *Festival Contemporanea - Acusmatica* in Udine (XX edition, 2017) and the *Festival Musica e suoni* in Sarzana (XVII edition, 2018). With the AUDIOR acousmonium, concerts were held both in theaters and in places of historical and artistic interest, such as the 19th-century Hall of the Visconti-Sforza Castle of Galliate (2014), the church of San Cristoforo in Lodi (2015), Palazzo Roderio di Sarzana (2018) and the Sala della Balla of the Museum of Musical Instruments of the Castello Sforzesco in Milan (2017). Many of these occasions have seen accompanying the experience of acousmatic listening with video art works, with dance, with the screening of cinematographic works, not in the form of mere complementarity, but in search of elements of concordance, or conflict, following in this an idea that expressed Bernard Fort:

'The strength of acousmatic works in theater or dance proves that, if they are not mere atmospheres or sound settings, a musical language is possible while the eye is working, and precisely confronts personal mental images with 'visual' images proposed by a staging. (The motorist, alone in his car, saw inside the various scenes of his day, populated with all these faces recently met even though the vigilance of his eyes does not give up for a single second the road and its dangers). The visual offered to the public can, in a certain way, reinforce the

poetics of a work if a clear dialectic is established between the mental images and the work of the eye. But this dialectic is not easy to put in place, because the mental images are multiple. The composer himself has forged a large number that he hopes to show his audience ... and nothing guarantees that they correspond to that of listeners ! Moreover, as we have already said, the mental images that everyone makes during acousmatic listening are very personal and find their source in the history of each individual. It is precisely in a desire to reframe with the poetic project of the composer that can study the visual image to be proposed during the concert. Either this one will try to reinforce the first objective, or, on the contrary, it will play on the rejections, the complementarities, the shocks of sense generators of interpretation' (Fort, 2007).

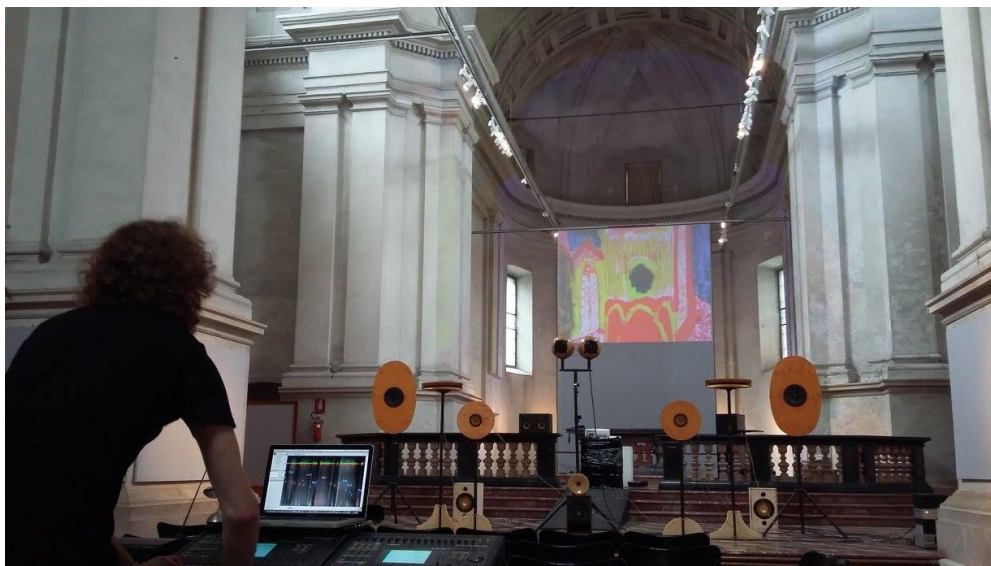


Fig. 04: Rehearsals on the acousmonium AUDIOR at San Cristoforo church, Lodi (Italy), 2015

Interplay among sounds, images and gestures

The acousmatic works applied for theater, dance, cinema, video are considered part of the *acousmatic arts* together with concrete or acousmatic music, radio creations and radio plays (Dufour, 2001). As part of the concerts with the acousmonium AUDIOR, performances of acousmatic music and dance are proposed. In this frame electronic scenography may acquire importance, since body gestures and sounds can intersect with images projected on the scene, in a metamorphic dynamism which sometimes comes to subvert the hierarchy between the visual, sound and body elements. In fact, the images projected on the acousmonium light wood speakers cause their reflecting surfaces to return the light in a perspective fragmented by the distance - in depth and in width - of the pairs of speakers between them. Moreover, acousmatic music and dance share the same preoccupation: to free from a discursive and conventional logic the raw material of their art: sound, movement. While gestural and visual dimensions interplay with immersive listening, the body of the viewer is immersed in a network of vibrating forces with which it resonates in the context of a process of surfacing sound/light figures, visible and invisible architectures, slits that cross the public space, to unfold a logic of manifestation of a hidden dimension of things (Pitozzi, 2012).

The projection on the acousmonium of images made by the visual artist X-tra Sour (Pete

Doolittle), Belio (Elio Bozzola) and the videoartist Diana Danelli constituted a mode of interaction between acousmatic music and images that was proposed in various occasions with different works, in some cases with the participation of the dancers Marcella Fanzaga and Ambra G. Bergamasco.

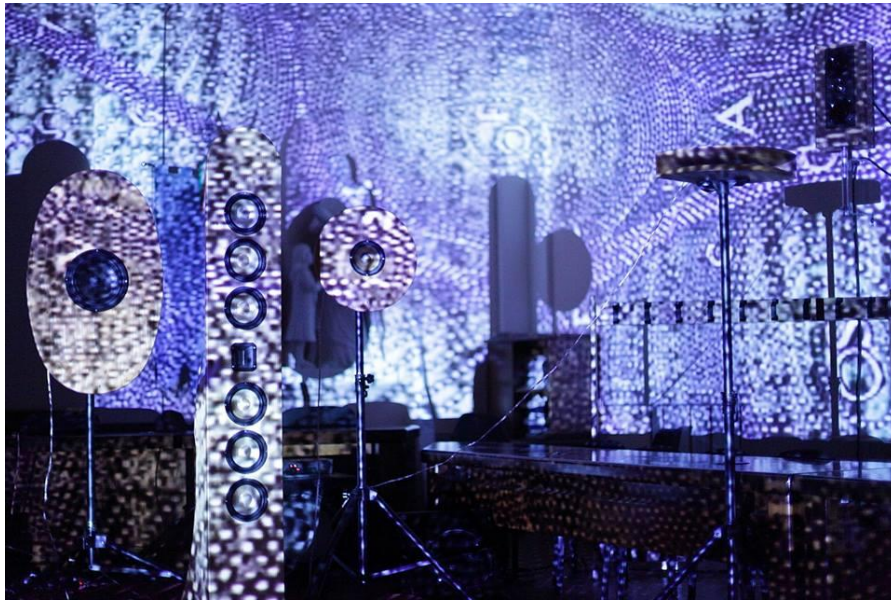


Fig. 05: Videoprojection on the AUDIOR front speakers. Castle of Galliate, (Italy), 2014.

Workshops and masterclasses

Modern and contemporary musical aesthetics, and in particular those related to electronic music, have explored modes of immersive listening in which the approach to sound material is no longer exclusively temporal and linear but rather spatial and sculptural. The sound mass becomes the space, the habitat within which the listener is hosted and welcomed. With this awareness, the AUDIOR acousmonium sound spatialization workshops aim at a theoretical and practical training in the field of spatialization techniques of recorded music on support. The preparation includes, in addition to the exercises to the acousmonium, also a work of analysis that takes into account the formal aspects and the salient characteristics of the composition in terms of dynamics, timbre and stereo spatiality. The laboratory also provides the teaching of electroacoustic elements, in order to allow understanding the construction techniques adopted to implement the AUDIOR acousmonium. On one side, the realization of the AUDIOR acousmonium as an orchestra formed by speakers of different size and quality may evoke in the listener the idea of a role similar to that of traditional instruments. On the other side, the work of spatialization will have to become aware of the individual qualities of the high-speakers and their geographic arrangement, so that the projection of a certain sound spectrum can take place without any prejudice.



Fig. 06: Acousmonium concert at the end of the workshop in Conservatory of Como (Italy), 2015

Scores for spatialized interpretation

The image below shows a diffusion score in which the notation of sound movements in space is expressed in alphanumeric characters. It indicates the position of the speakers to be activated by the interpreter at the spatialization console. The alphanumeric indications are arranged from left to right, in the sense of the time sliding line, within a time window whose extension can be defined as desired. The indications concerning the movements in space (in blue) are distinguished from the indications concerning the timbre (in red): this information, often overlapped, is added to those provided by the waveform (above the title) and to those of the spectrogram (recognizable below). In the following image, realized with Acousmograph (INA - GRM), the intent was to prepare the execution of four works by Angelo Paccagnini, realized in the Phonology Studio of the RAI of Milan, active from 1955 to 1983 on the idea of Luciano Berio and Bruno Maderna, for experiments both of concrete music and of electronic music, following the example of the centers of Paris and Cologne.

If the first objective of this type of notation is to set the interpretative lines of a piece of music in accordance with the strategy defined by author of the score, the second objective, no less important, is to create scores readable by others.

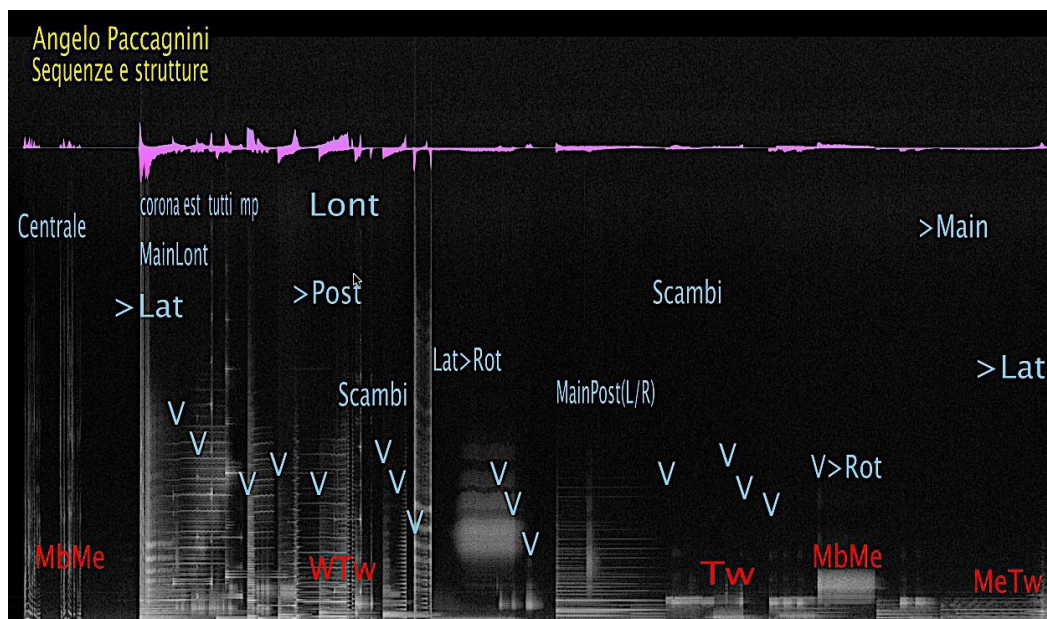


Fig. 07: Angelo Paccagnini, Sequenze e strutture (1961), spatialisation score, the beginning.

For this purpose, it is necessary to represent in a shareable form (and that of alphanumeric coding is) the commands corresponding to the names of the speakers moment after moment called to spread the sound. For this reason it is necessary that the criterion adopted in the geographical distribution of the speakers in the concert hall be kept in mind also in the way of organizing the spatialization console. Moreover, the appearance of a diffusion score reflects its functions: in this case it is a 'polyphony' of alphanumeric commands that, translated by the interpreter at the console, activate different processes that affect both the timbral qualities and the movements of the sound in space. A combination of the gestures of the two hands, such as those indicated in the score, makes it possible to control both the translations of sound masses, the emission of individual sources and to mutate the general qualities of the timbre at all times. In the example, after adjusting the volumes (mp) of external crown of the speakers, the interpreter should make an exchange between different speakers (in correspondence with the signs V) while defining the color quality of timbre through using medium (Me) speakers and middle-bass and tweeters (Mb, Tw) side emission. Since 2013, an educational activity (workshop and masterclass) has been held for students of electronic music courses in the conservatories (Como, Turin and Milan), in music schools and in cultural centres.

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