EGOSOUND, AN EGOCENTRIC, INTERACTIVE AND REAL-TIME APPROACH OF SOUND SPACE.

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ABSTRACT

Developed in the context of virtual environments linked to artistic creation, **Egosound** was conceived to visualize multiphonic sound space in an egocentric way. *Ambisonic* algorithms and a graphic editor for trajectories are implemented. An example of artistic project with Egosound is exposed. Parts of the software engine of **Egosound** are now available for download as external objects for Pure Data and Max/Msp graphical programming environments.

1. INTRODUCTION

The concept of « sound space », in the context of electroacoustic music, is often considered as something referring to a « spatial layout », a way to organize sounds in the stereophonic listening environment. However, this geometric representation of the « sound space » tends to exclude the temporal domain, which forges the musical space at several levels and scales of our perception [1] [2].

Using interfaces (with or without contact) in the musical context enables a greater control on temporality and its multi-scales variations, making it possible to modify in real time characteristics of the sound spaces. Thus, sound spaces become sensitive [3].

2. WHAT IS EGOSOUND ?

Egosound is a standalone application developed using the Max/MSP/Jitter environment, to be used on a multi-loudspeaker sound system.

Developed in the institutional context of research of *Maison des Sciences de l'Homme Paris-Nord*, concerning the relationships between art and industry specially about the virtual environments and artistic creation, **Egosound** is a work in progress, allowing us to explore, through various propositions in the experimental artistic creation domain, the interactive relationships between seeing and hearing.

With **Egosound**, our goal is to propose to experiment sound spaces in an interactive way. Here, sound space is reduced to a number of sound objects, moving in the multi-loudspeaker listening environment, according to user-defined trajectories. This sound space is visually represented in a 3D video environment (Open GL) in order to provide an egocentric representation of this space (as the user would see). Moreover, the user is able to (virtually) wander through this space, using the mouse as the navigation interface. A subtlety of the French language translates the adjective *egocentric* by *égocentré*, that should not be confused with the other adjective *égocentrique* that has to do with narcissism [4].

Due to the increasingly high number of sound spatialization techniques, we have decided to focus on the *Ambisonic* decoding algorithms in order to provide an adaptive sound environment, depending on the movements of both the sound objects and the user [5] [6].
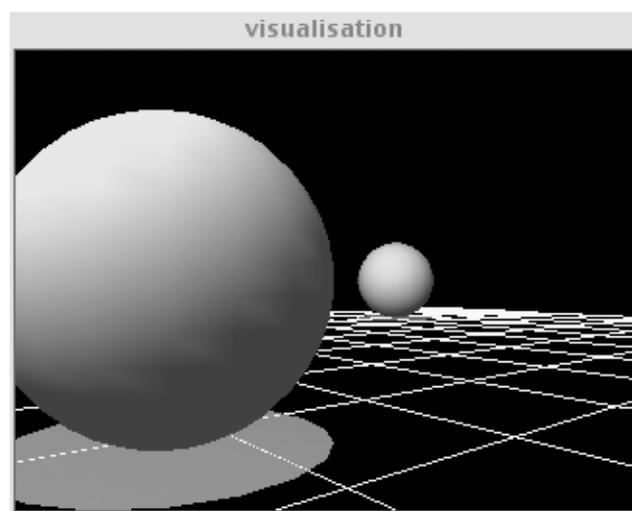

Figure 1 : *Visualisation interface of* Egosound

The sonic projection of the sound space is linked with the visual representation, so the user can visually "follow what he hears", which leads the visual representation to become an instrument for the listening process. For now, sound objects are represented visually by coloured spheres and the user can edit transfer functions linking sonic morphologies with visual attributes (size, colour saturation). Egosound can potentially handle as many sources as desired, though this is restricted by the computer's characteristics. However, using more than four sound sources should make it hard to distinguish individual localizations and movements. That could be a quality in a musical composition, for an empiric experimentation with trajectories, we have limited its number to four.

In order to lower computational cost, we have decided (as a first step) not to include effects such as Doppler effect or reverberation. Though these effects increase the accuracy of the localization and movement perception, a generic panning tool seemed sufficient, especially since the visualisation of the virtual source is considered as a tool for hearing, which is the main interest of Egosound. Moreover, for aesthetics reasons, reverberation or pitch variation may be unwanted by the composer.

3. TRAJECTORIES

Composing sound space means composing with perception, with primitive, antepredicative sensations. More, for years, musical composition tends to integrate spatialization as a real inscribable dimension of music. From this point of view, the localization of fixed sound sources is not sufficient, that's why we have developed a trajectory interface which contains elementary geometrical tools: broken line, hand made line, triangle, rectangle, ellipse, spiral and a random generator. This interface allows to draw and to go all over trajectory. The movement speed can be checked and the trajectory may be recorded. Then, this tool can be used for both composition and live electronic music performance. External inspectors can drive the trajectory parameters. For instance, the pitch of an instrument might control the movement speed of a sound source on its trajectory. With a gesture, the user can shift all the sound sources he's controlling with a perfect realisation of his intention.
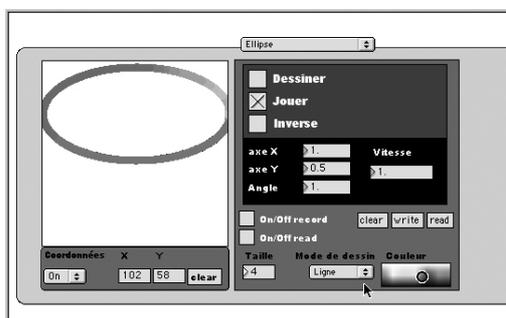

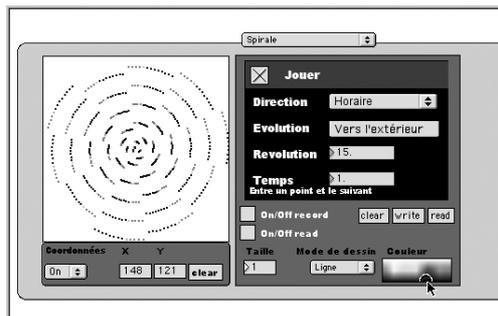Figure 2 : *An exemple of trajectory: the ellipse.*

Figure 3 : *Creating a trajectory out of a spiral.*

4. ARTISTIC CREATION

Egosound will be shown with a multimedia installation offering to the visitor an "interactive chair" in front of a monitoring screen, surrounded by eight active loudspeakers. The visitor will sit in the chair and, by inclining his chest and pivoting with the chair, will navigate in visual and virtual space only by hearing and visualising the sound object. The authors are composing short interactive musical works, in order to offer attractive interactive sound objects. Named " La terre ne se meut pas", this installation is, in a certain way, homage to the philosopher Edmund Husserl's works on phenomenology of perception [7]. This installation will be shown at the H2PTM'03 in Saint-Denis, September 2003 [8] (Figures 4 et 5).

The parameters of mapping are the radial and the angular speeds, given by the movements of the user on the chair. Two ultrasound sensors designed by Artem [9] provide the data: the first sensor is fixed in front of the user, and calculates the distance with the user's chest. This distance is increasing/decreasing as the user tilts forward/backward. The second sensor is located on the axis of the chair, and calculates a distance which can be interpreted as an angle by means of a trigonometric calculus. We have chosen the ultrasound sensors because of their invisibility and accuracy.
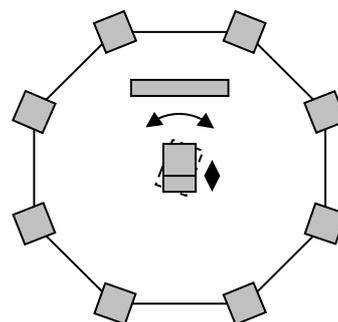

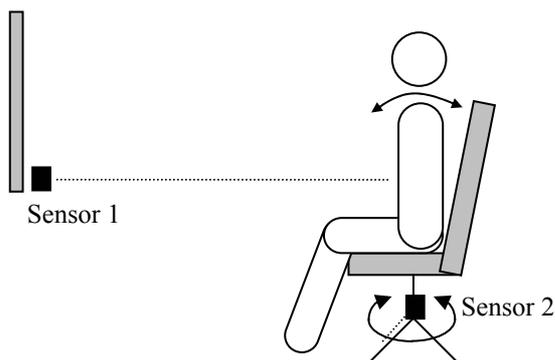Figure 4 : *Plan of "La terre ne se meut pas", an interactive installation with Egosound*

Figure 5 : *The "interactive" chair.*

In other circumstances, a joystick, a joy pad, a basic mouse and even a human "egocentric" performer may be a controller.

5. SOFTWARE DEVELOPMENT

Egosound *beta* version software is downloadable, so are the spatialization and trajectory tools [10]. The *trajectory* object is a controller object for MAX , and the *ambipan~* object is an audio processing object for MAX/MSP and Pure Data, re-coded in *C* language by programmer Rémi Mignot, under instructions; *ambipan~* has been optimised, and is now extended to any multiphonic situation, from stereophonic (2 channels) to hexadecaphonic (16 channels) setup. In this new version, the coordinates of the sources can be signal-driven, which leaves the door open to many experiments on spatial modulation of sounds.

The next step concerning these developments is to experiment with 3D audio spatialization. The 3D audio engine has already been realised by Rémi Mignot, and we are working on developing an intuitive 3D trajectory tool.
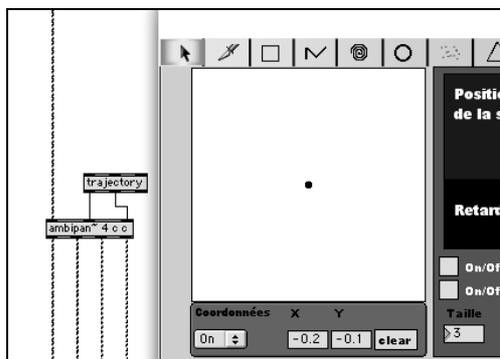

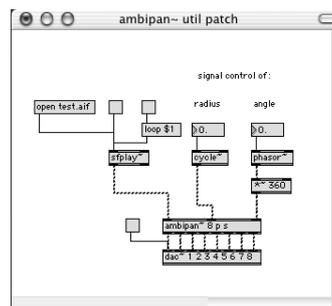Figure 6 : *"trajectory"*

for MAX

Figure 7 : *"ambipan~": an example within MAX/MSP.*

Anne Sedes, uses the objects *trajectory* and *ambipan~*, for electronic and interactive compositions for choreograph Laurence Marthouret and drummer Miquel Bernat, as well as Jean-Baptiste Thiébaut for improvisation music and Benoît Courribet for electronic and interactive music mapped with 3D open GL image. Spanish composer José Manuel Lopez Lopez should use those two tools in collaboration with our team for sound spatialization of his operatic work "La Noche y la Palabre", that will be created in may 2004 in Seville, Granada and Madrid. Many musicians should be interested by the process.

This application may be extended for video game domain and for post-production sound mixing for cinema and multimedia. Contacts have been established, and companies working in these domains seem to be interested by this kind of process, in spite of the constraints and uses of the profession.

6. CONCLUSION

As a work in progress, **Egosound** was created in a mixed domain, between scientific research and artistic creation, where artistic experimentations may feed industrial applications.

After that first experiment, we may view a more convenient software product or toolkit. Such a software may be used for spatialization and many other mappings with sound parameters. Maybe we can imagine plug-in, for mixing with 5.1 standard. The free downloadable objects *trajectory* and *ambipan~* constitute a first way to offer a concrete integration of the potential of the **Egosound** experience, may find a place in the electronic composers software toolkit and maybe raise up an interest from the multimedia industry.

7. REFERENCES

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