

Binaural tools for 3D audio production at home

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Abstract - We present two innovative software tools for editing and rendering immersive audio that allow taking the post-production process outside professional studios. The Binaural Home Studio allows to post-produce either 3D or binaural audio while offering special 3D effect functionalities. The contents produced can be listened and therefore tested with head-tracking headphones throughout the Binaural Player. The binaural output produced by the player is interactive, in the sense that adapts to head movements using a head-tracking headphone which gives to both content creators and end-users more realism and sense of presence.

Index Terms – Binaural audio, 3D audio, ambisonics, VR, immersive audio

INTRODUCTION

Communication has changed dramatically since the uptake of digital content and Internet. A huge amount of information is available at any time and anywhere, in all kinds of formats, with several levels of reality and sense of presence and with different interaction capabilities.

Technology advances have moved fast and still do towards more realistic and natural ways of communicating, thus improving the user experience which in turn translates into more efficiency and effectiveness.

3D and binaural audio are examples of current information formats that are trendy nowadays. In particular, binaural audio has rapidly gained popularity in recent years for providing truly spatial audio soundtracks to VR experiences. Different tools to produce 3D and binaural audio have appeared in the market in the last year. Most of them are only for binaural rendering and do not allow for a high quality ambisonic-based delivery. High-quality 3D and binaural audio contents are still produced in professional studios using a variety of sophisticated, arduous and many times non-interoperable tools. This leaves creative artists with no appropriate means to easily adopt the new formats.

In this paper, we present two innovative software tools for the post-production and the smart rendering of 3D/binaural audio: the Binaural Home Studio (BHS) and the Binaural Player (BP) respectively, both of them built upon Eurecat's ambisonic-based 3D audio technology. BHS and BP are being developed under the EU project

BINCI [1] and are part of a more extensive set of composer-oriented hardware and software immersive audio tools that will be ported to the market under the brand name Sfëar®. In the case of the tools described in this document, BHS and BP allow producing 3D audio outside professional audio studios. In addition to help artists' post-production process, BP allows end-users to enjoy an enhanced binaural audio that augments the user's sense of presence in a virtual scene [2].

THE 3D/BINAURAL AUDIO TOOLS

BHS and BP present several unique characteristics:

- **Portable:** The output can be rendered either in 3D or in binaural (to be listened through headphones), making it possible to post-produce 3D audio in a professional studio and then continue working at home using the binaural output of the player to test results.
- **Integrated:** Any kind of audio input (stereo, 5.1, 7.1, etc.), including ambisonics from 1st to 5th order [3] can be edited with BHS, thus allowing to work with all permitted formats using one single tool.
- **Flexible:** Ambisonic audio input can be sent to BHS from ambisonic microphones via the Digital Audio Workstation (DAW).
- **Universal:** BHS produces audio in the intermediate 3D audio format Sfëar and BP takes this output to produce binaural audio. BP can be extended to decode Sfëar format in order to render the audio in any display environment: 3D, stereo, 5.1, 7.1, 13.1, etc. or binaural. This is made possible because the encoding of the sound scene does not depend on the layout used for the reproduction.
- **Interactive:** BHS and BP are to be used with head-tracking headphones adding realism to the experience. As opposed to current binaural recordings where the audio sources seem to move with the movements of the head, head tracking is used to keep re-positioning the audio sources as if they were fixed in the space [4].

The role of BHS and BP in the 3D audio production workflow is depicted in Figure 1.

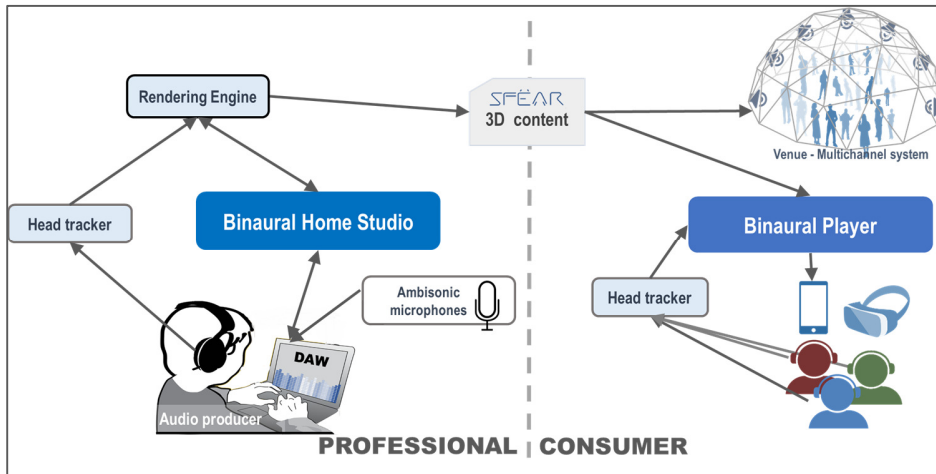


FIGURE 1. SFĚAR® 3D AUDIO PRODUCTION WORKFLOW

I. The Binaural Home Studio (BHS)

BHS provides a set of tools to create, mix and monitor 3D audio content for professional audio producers and artists in general. It has been designed to fully comply with the existing workflow of its users and therefore it has been developed as a set of plugins compatible with main existing Digital Audio Workstations. To maintain such compatibility, BHS plugins do not include any audio process; they simply provide an interface to control parameters in a remote audio processing server, the rendering engine, using remote communication protocols.

BHS plugins (Figure 2) provide a number of audio editing functionalities for producing audio special effects. They include:

- **Panning:** Allows “moving” virtual audio sources in the 3D audio scene by defining its position and width.
- **Clustering:** Makes possible to treat any compound of virtual audio sources as a single distributed multichannel source.
- **Modulation:** Enables modulation of the parameters of any panner or cluster.
- **3D effect plugins:** Provides an extensible set of plugins including, among others, reverberation, distance and 3D Spectral filter effects. The first two are key for achieving the feeling of three-dimensional space around the listener’s head. Reverberation is achieved by calculating the effect of the room acoustics on the source’s signal, which highly depends on its position within the room. Distance plugin allows moving the sound source further or closer to the listening point, by changing not only the source’s volume but also the ratio between direct sound and reverberant sound. The Spectral Splitter splits the signal into a set of spectral bands and offers to pan

them individually, thus enabling a creative arrangement of the frequency components of the source scene throughout space.

BHS comprises also a visualizer (Figure 3) that provides visual feedback of the whole spatial audio scene to the user. It can also display 360° video for syncing purposes and allows to position sources by dragging them with the mouse.

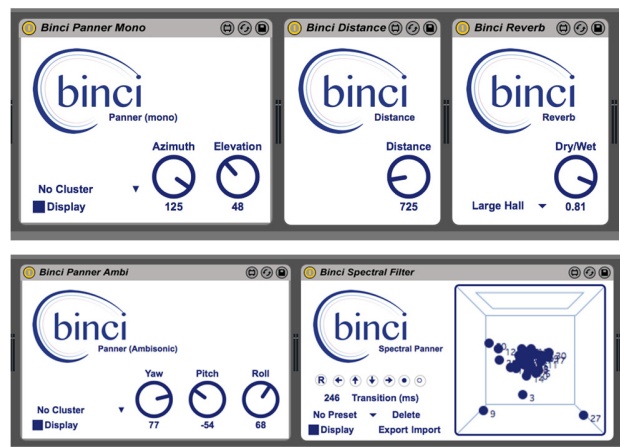


FIGURE 2. BHS PLUGINS INTERFACES.

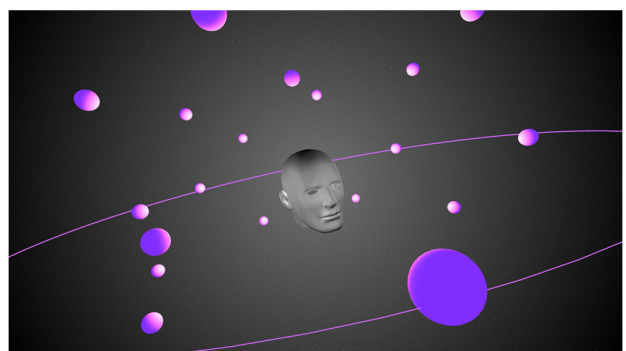


FIGURE 3. BINAURAL HOME STUDIO VISUALIZER.

II. The Binaural Player (BP)

The Binaural Player allows users to experience interactive binaural audio with head-tracking-equipped headphones. Input of the BP are files in Sfear format produced by the rendering engine connected to BHS. As it is meant to be an interactive binaural player, its output is always live stereo binaural allowing the user to rotate his head inside the scene while listening. These movements are tracked by the head-tracking device and sent over Bluetooth to the playback device, and are further interpreted by the BP.

This feature is quite important to give a real immersive sensation, especially in VR environments where users can freely move around in virtual sound spaces.

CONCLUSIONS

Two powerful tools for 3D and binaural audio have been presented. Both will make it easier for creative artists to adopt the new audio immersive technologies and their set of new effects, bringing extra value and creative possibilities to their productions. At present, these tools are being used by a limited number of producers for the creation of artistic projects inside the BINCI project in order to test the tools in real production environments. Moreover, two experimental audioguides will be produced with BHS by BINCI partner Antenna International and will be demonstrated (by using BP) with real users in two relevant cultural sites: Fundació Joan Miró in Barcelona and the Alte Pinakothek in München.

BHS is being extended to include new features and to interact with other Sfear® audio tools.

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