

Macrogroove

A Sound 3D-sculpture Interactive Player

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Figure 1: *Next Industrial Revolution*, a sculpture from Gilles Azzaro [1].

ABSTRACT

Macrogroove is an interactive and playful multimedia system that allows the user to play a sound coded in the form of a 3D-sonagram. The user is invited to manually move a laser sheet over this “pseudo-relief”, in order to playback the original sound in real time.

KEYWORDS

Sound, 3D-printing, 3D-sculpture, interactive player.

1 INTRODUCTION

Sculpting a sound in 3D is a long-standing dream of the French artist Gilles Azzaro [1]. While sound is a 1D-signal, which can thus be represented as a 2D-curve, its time-frequency representation, for example in the form of a *sonagram*, provides a 3D-model: one dimension for time, another one for frequency, and the last one for amplitude. This well-known 3D-representation of a sound signal is particularly suitable for 3D-printing. Thanks to some modifications,

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Gilles Azzaro knows how to transform this 3D-representation of a sound into a real artwork (see Figure 1).

2 3D-SONAGRAM READING

Another of Gilles Azzaro’s dreams is to read such a 3D-sonagram i.e., design a system able to turn the 3D-sonagram back into a sound. This would mimic the behavior of a diamond stylus reading the microscopic variations encoded in a vinyl disc, or *microgroove*. In the sought macroscopic version, a sensor moving along the time axis would analyze in real-time cross-sections of the relief, or *macrogroove*. Each section corresponds to an instantaneous spectrum of the signal (see Figure 2), therefore it seems possible to read a 3D-sonagram and playback a sound by inverting the time-frequency transform. However, many technical obstacles make this idea difficult to achieve. This is why Gilles Azzaro called on the REVA team at IRIT in Toulouse, who has expertise in both multimedia and 3D-reconstruction by artificial vision.

3 SIGNAL CODING

The first obstacle comes from the fact that the spectrum is not easily invertible. Indeed, the Fourier transform of a real signal (sound) is a complex spectrum. However, a 3D-representation can only encode part of this signal, for instance the amplitude. The phase is thus lost, which results in distortions in the reconstructed sound, as can be observed using the *Phono Paper* [2] app, which

