Extending Space in Varèse's *Interpolations*

Extending Stereo Space

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Abstract

This brief paper presents the process followed in spatializing Varèse's electronic *Interpolations* for *Déserts*. It first presents some ethical considerations, a brief history of the interpolations, and finally, a spatialization strategy that tries to remain faithful to the original. This text was written to accompany sound examples of the process.

1. Introduction

The electronic *interpolations* for *Déserts*, were developed in two stages, first in 1954, at Schaeffer's Studio D'Essai in Paris, and later in 1961, in the Columbia-Princeton Electronic Music Studio (CPEMC) in New York. Varèse arrived in Paris with sounds he had recorded in factories in New York and with the first interpolation completed and the second incomplete. He first worked with Ann McMillan in New York, with Pierre Henry in the Studio D'Essai, and Bülent Arel in the CPEMC.

According to Risset, Varèse wanted to make a new version, but due to several complications, he only re-worked the Paris versions. It is unclear what was the nature of this re-working of the tape in 1961. After Varèse's death, Ussachevsky proposed to make a new version of the interpolations, but "Louise Varèse was not sure that Varèse would have approved of it" and he did not make this version.[1]

2. Ethical and Aesthetical Considerations

There is an ethical issue to consider when approaching the spatialization of a historical work recorded on magnetic tape: Do we have the right to spatialize the work of a composer who is

1 J. Risset. The Liberation of Sound, Art-Science and the Digital Domain: Contacts with Edgard Varèse. *Contemporary Music Review*, 23(2):27–54, 2004.

no longer present?

Sound diffusion is regarded both as a compositional and performance practice. As a performance practice it is generally understood as the projection of sounds in a space[2]. This practice is generally conceived as a "live" practice, where sound projection of a mono or stereo source is achieved manually with a mixer and a set of speakers. Some composers[3] have suggested the use of a computer to diffuse sound as computers provide us with the possibility of controlling sound diffusion with more precision than manual control.

We know from his writings that Varèse had thought of sound in space beyond the possibilities that the technology of his time allowed for. Varèse was constantly demanding from technology, what technology couldn't yet provide. It is clear from Varèse's writing that sound projection and spatial concerns were a central metaphor in his work:

> ... a sense of sound-projection in space by means of the emission of sound in any part or in many parts of the hall, as may be required by the score.[4]
>
> I shall add a fourth [dimension of music], sound projection - that feeling that sound is leaving us with no hope of being reflected back, a feeling akin to that aroused by beams of light sent forth by a powerful searchlight - for the ear as for the eye, that sense of projection, of a journey into space.[5]

Furthetmore, Varèse later said "for the first time I heard my music projected into space"[6] referring to the premiere of *Poéme Electronique* at the Phillips Pavillion, in which "three layers of sound material [were projected] through 350 loudspeakers".[7]

Considering on one hand that *sound diffusion* as a performance practice allows a person to distribute a stereo or mono piece into a larger number of speakers, and on the other, that Varèse clearly had the desire of projecting his music into space, multichannel versions of his work are valid and desirable.

3. Procedure to extend the stereo space

Like a lot of early electronic music, the interpolations were realized in two channels or stereo. The technique was so unusual at the time, that in order to achieve the stereo radio transmission, two radio stations were used. In the interpolations, sounds do not move in space by dynamically

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2 Some ideas can be found in L. Austin. Sound diffusion in composition and performance: An interview with denis smalley. *Computer Music Journal*, 24(2):10–21, 2000. and J. Harrison. Sound, space, sculpture: some thoughts on the what,how and why of sound diffusion. *Organised Sound*, 3(02):117–127, 1998.

3 For example in B. Truax. Composition and diffusion: space in sound in space. *Organised Sound*, 3(2):141–146, 1998.

4 E. Varèse and C. Wen-chung. The Liberation of Sound. *Perspectives of New Music*, 5(1):11–19, 1966.

5 O. Mattis. Varèse's Multimedia Conception of "Déserts". *The Musical Quarterly*, 76(4):557–583, 1992.

6 Ibid.

7 V. Lombardo, A. Valle, J. Fitch, K. Tazelaar, S. Weinzierl, and W. Borczyk. A Virtual-Reality Reconstruction of *Poéme Electronique* based on Philological Research. *Computer Music Journal*, 33(2):24–47, 2009.

changing the relative aplitudes of the mono channels. Sounds placed in one of the channels are however also placed in the other at a lower amplitude so that they are perceived as coming from a source closer to the center. It is in any case, extremely clear from the tape that Varèse produced two differentiated continuities of sound intended to be perceived in synchrony, yet independently.

In order to respect this original realization, my approach looked to find a way of extending the original stereo version, therefore obtaining a technique that could be extended to other stereo pieces. As a result, extending the stereo version to, for example, an 8-channel version, each of the original stereo channels is assigned to 4 of the 8 resulting channels as shown in Figure 1. In this way, the original intention of having two streams on both sides of the listener is retained, but an element of depth is added. The question then was how to distribute each mono channel to their corresponding four channels.

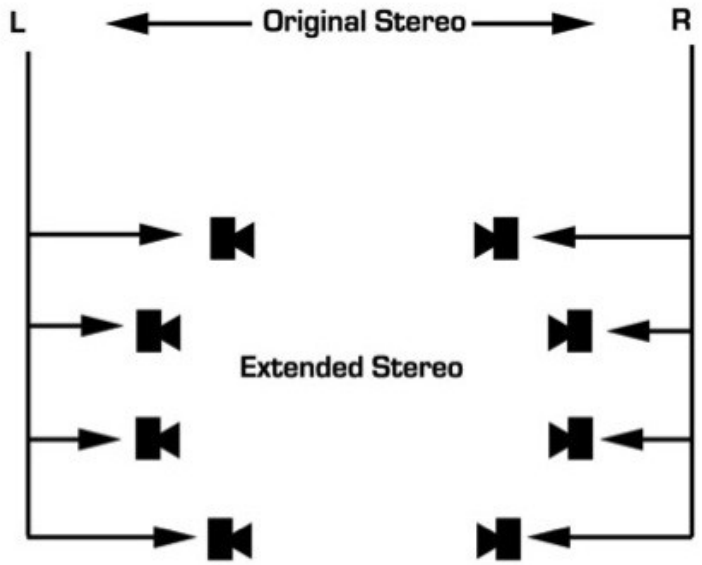

Figure 1. Extended Stereo Space

The aim of the procedure is to obtain individual elements from each of the continuous mono channels that can then be placed individually in its corresponding four channels. This process, shown in Figure 2, is achieved in three steps:

STEP 1: Temporally split the mono sound to generate individual mono clips or shorter segments of sound. In order to achieve this, I listened carefully and identified points in the sound continuity, where a cut could be made. In this way, two sequential sound events, were cut to obtain independent elements.

STEP 2: Cut the spectrum of these clips into spectral bands. Some events are clearly separated in time, however, many sound events might have energy in the lower or higher ends of the spectrum, or this energy might shift over time. By splitting the sound into spectral bands, we can position different spectral energies in different places in the room.

STEP 3: Assign a spatial position to each resulting band[8]. Once all of these elements are obtained, it is possible to place them in a position in space and specify a trajectory of movement.

A further and optional step includes the manipulation of this extended stereo space. As shown in Figure 3, the 8 channels can be contracted, rotated, reflected or any combination of these operations. This step can be controlled in real time in the concert hall in order to retain the performance actions that live sound diffusion brings to tape playback in combination with the precision of computer control.

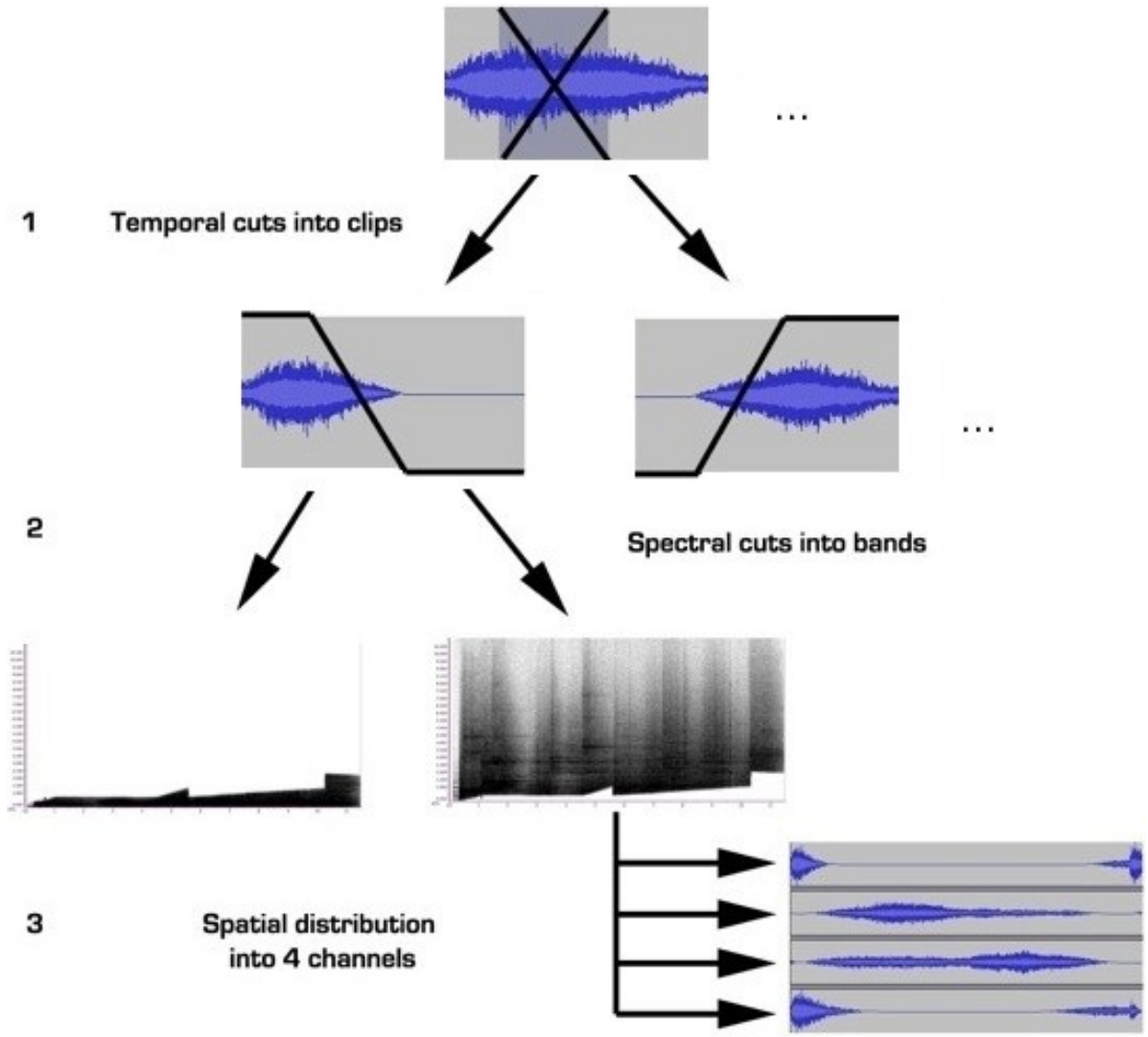

Figure 2. Procedure to spatialize a single channel into four channels. Each temporally and spectrally cut clip produces four channels and all of them are later added together.

8. This procedure used linear amplitude envelopes to generate the temporal and spectral separation, because when mixing these clips additively, we obtain the original sound back. The filters used are based on the FFT-transform and spatialization is achieved through a cosine transfer function.

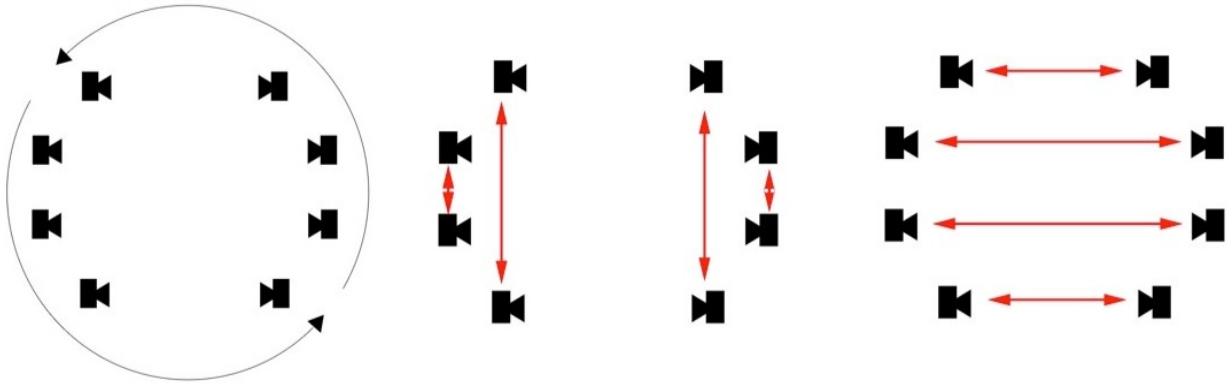

Figure 3. Further steps in the manipulation of the extended stereo space. (3a) Rotation, (3b) contraction to original stereo, and (3c) reflection exchanging left and right channels.

4. List of tracks

It is impossible in the stereo setting of a CD, to replicate the feeling of being inside a space with an array of speakers. Whenever possible, I would recommend downloading the 8 channel version from my/PNM website and listening to it in an 8 channel system, or ideally making your own multichannel version. However, the following tracks attempt to do two things: to demonstrate the process of spatializing a historical work, and to provide us with examples that allow us to listen to some of the benefits and qualities of having a larger spatial field with differentiated sound material projected in each speaker. To achieve this, what was originally mono material has been placed in the stereo field for demonstration purposes and therefore the experience of being in an 8 channel field is not replicated.

Example Excerpt from the fisrt Interpolation

Track 1: This excerpt from the 1st interpolation will serve as an example of how the stereo space can be extended. It is first played in its original version followed by the left and right channels alone.

Track 2: The excerpt we are trying to spatialize can be divided into two sections. The first, more rhythmic section, consists of several individual elements, while the second, presents more continuous material. These classifications are characteristic of the material of the first interpolation. We now listen to these two sections.

Extending the First Section of the Right Channel

Track 3: The material in this section is fragmented, so we cut the sound continuity into smaller sound elements or clips, after careful listening. After listening to these small elements, we then divide them into two spectral layers, which we hear in succesion.

Track 4: Each of the two spectral layers of each of the clips is then given a position and trajectory in space. We now listen to the whole in a stereo distribution of the four channels.

Extending the Second Section of the Right Channel.

Track 5: The material of this section is continuous in nature, so we treat it as one long clip. However, spectral energy is constantly shifting and we therefore divide it into four spectral layers.

Track 6: The first excerpt of this track presnts the four spectral layers in a stereo distribution from left to right, from low to high frequency. This is not particularly impressive in stereo, but very effective in an 8 channel setup. The second part of the track presents these same layers with a spatial trajectory also in a stereo distribution.

Extending the Left Channel.

Track 7: Following the same procedure used for extending the Right Channel, this track exemplifies the clip segmentation on the Left channel.

Track 8: As in the previous tracks we listen to the clips divided into 2 and 4 spectral layers depending on the material.

Track 9: this track presents a stereo distribution of the clips and layers, after their defining their placement and trajectory in space.

Stereo Versions

It is important to keep in mind that the material obtained from the left channel would be spread over the four speakers that are on the left of the listener. Therefore the sound movements in space that we hear in the stereo distributions presented here are not intended to reflect the way sound would be perceived in space, but only to demonstrate the mobility that can be obtained from a mono source.

Track 10: This track presents a mix of the stereo distribution of both channels of this example excerpt.

Track 11: This track presents the complete 1st interpolation as a mix of stereo distributions.