HARPEX DEMONSTRATION

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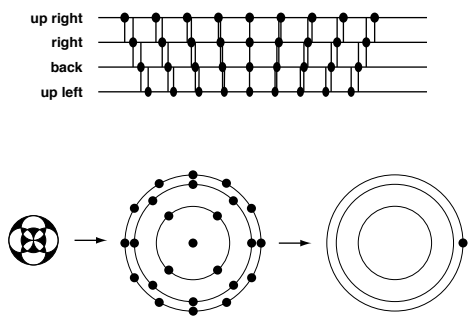

Figure 1: Four simultaneous sources, one isolated output channel

ABSTRACT

The focus of the demonstration is to examine properties of the HARPEX method, a new method for decoding first-order B-format signals which is proposed in a separate paper submitted to the symposium [1]. The demo will follow the philosophy that the function of a system can best be learned by studying its failures.

The demo uses the hemispherical loudspeaker array which is installed at the Espace de Projection at IRCAM for the duration of the symposium. Different sequences of synthesized test signals are used to examine the various limitations of the method. A few soundfield recordings will demonstrate how these test results correspond to real-world performance.

1. OVERLAPPING SOURCES

HARPEX is a non-linear method, and responds differently to different superpositions of sounds. A synthesized signal consisting of only one or two sound sources will in practice be perfectly separated and localized by the method, even in the case of full spectral and temporal overlap, and is therefore not an interesting test signal. The superposition behavior is demonstrated by progressively adding sound upon sound with a high degree of spectral overlap, from different directions, until defects become apparent. These defects will be brought to the fore by silencing all but one of the output channels.

The source material will be a single voice continually repeating different words from different directions. This demo will test the system's ability to separate and localize sound sources in a complex auditory scene. A reference signal, where each sound source is routed to its corresponding loudspeaker, will test the listeners' ability to separate and localize sources in the same auditory scene. The purpose is to demonstrate to which extent shortcomings in the decoding system are masked by limitations in our auditory system.

2. REVERBERATION

An auditory scene with strong reflections will vastly multiply the number of sound source images. A synthesized sound scene with a synthetic room model is used to demonstrate the performance of the decoder with different levels of reflectivity. A drum loop is used as a sound source. Using Richard Furse's vspace software [2], this drum loop is projected into a virtual space with the same dimensions as the Espace de Projection. Both channels of the original stereo recording are projected from the same point in space, but with different directivity patterns. The point of emission corresponds to the location of one of the loudspeakers in the array. As the reflectivity of the walls and ceiling in the virtual space is increased, the reverberation time also increases and defects in the decoding method may become apparent. To make the defects clear, the decoded signal will be played back while muting different subsets of loudspeakers.

3. TRANSIENTS

Dispersion, pre-echo and softening of transients are related and common problems with many signal processing operations that take take place in the frequency domain. Castagnets are known to be particularly challenging in that regard. A double MS recording of castagnets [3] (recorded by Magdalena Plewa, courtesy of Shoeps GmbH) is matrixed into B-format and decoded to the 12 loudspeakers in the horizontal plane.

4. OTHER EXAMPLES

A few sound samples, recorded with tetrahedral microphones, will be played. These will demonstrate more subjective qualities of the sound, like clarity, space, distance and envelopment, as well as the natural combination of effects like polyphony and reverberation.

- "VoiCE in the round" (excerpt) [4]: The vocal ensemble VoiCE, comprising three female singers, sings "Nunc Gaudeant Materna" by Hildegard of Bingen. The singers are inside a chapel, arranged in a triangle with the microphone at the center. Recorded by Paul Hodges. Microphone: Core Sound TetraMic.

- "Duruflé - Requiem" (excerpt) [5]: Organ and choir. Performed by the Cherwell Singers in the chapel of Exeter College, Oxford. Recorded by Paul Hodges. Microphone: Core Sound TetraMic.
- "Headshaft - At Dodge Street" (excerpt) [6]: Fusion. Performed by Benny Benson, drums; Justin Piper, guitar; Jeremy Parker, organ. Audience sounds can be heard. Recorded by Hugh Pyle. Microphone: Core Sound TetraMic.
- "Voix Mystère Bulgaire" (excerpt) [7]: Bulgarian female choir. Courtesy of SoundField ltd. Microphone: A SoundField microphone system.
- "Finnish Folk Music" (excerpt) [7]: Guitar, violin and voices. Courtesy of SoundField ltd. Microphone: A SoundField microphone system.
- "Aeroplane" [7]: The sound of an aeroplane passing overhead combined the rumble of a distant highway. Courtesy of SoundField ltd. Microphone: A SoundField microphone system.
- "Motorbike" (excerpt) [7]: The sound of a motorbike passing quickly by the microphone. Courtesy of SoundField ltd. Microphone: A SoundField microphone system.

5. ACKNOWLEDGMENTS

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6. REFERENCES

[1] S. Berge and N. Barrett, "High Angular Resolution Planewave Expansion," in *Proceedings of the 2010 Ambisonics Symposium*, 2010.

[2] Furse, R., "Vspace introduction," http://www.muse.demon.co.uk/vspace/vspace.html.

[3] Shoeps GmbH, "Surround plug-in for rtas mac, vst windows/mac double ms tool," http://www.schoeps.de/en/products/dms_plugin/overview.

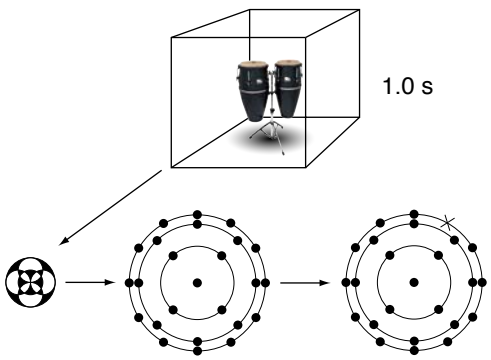

Figure 2: Virtual room acoustics, channel with direct sound muted

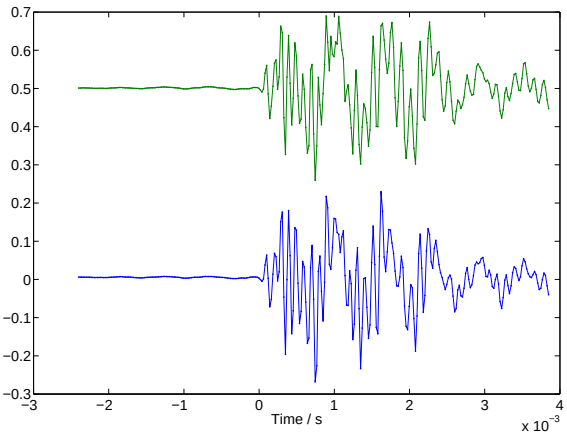

Figure 3: Waveform of a castagnet attack. Bottom: W channel (scaled sum of front and back capsules in a double MS setup). Top: The highest-amplitude decoded channel of 12. f_s = 48 kHz. Each point corresponds to a single sample.

[4] Hodges, P., "Voice in the round," http://www.ambisonia.com/Members/pwhodges/ambisonicfile.2007-10-15.6303718085.

[5] ——, "Duruflé - requiem," http://www.ambisonia.com/Members/pwhodges/ambisonicfile.2009-03-24.9080229180.

[6] Pyle, H., "Headshaft - at dodge street," http://www.ambisonia.com/Members/hughpyle/ambisonicfile.2008-02-07.5324814796.

[7] SoundField ltd., "B-format audio," http://www.soundfield.com/downloads/b-format.php.