Implementation of real-time room auralization using a surrounding 157 loudspeaker array

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Abstract

Numerous auralization systems have been developed for room acoustic simulations. Many of these systems use binaural rendering. This report presents the implementation of a real-time room acoustic auralization system using an array of 157 loudspeakers. The room acoustic model combines an iterative image-source model and feedback delay networks to create the early reflections and late reverberation. Higher-order Ambisonics (HOA) is used to generate spatial room impulse responses. A distributed network system is then used to generate the auralization output.

1 Introduction

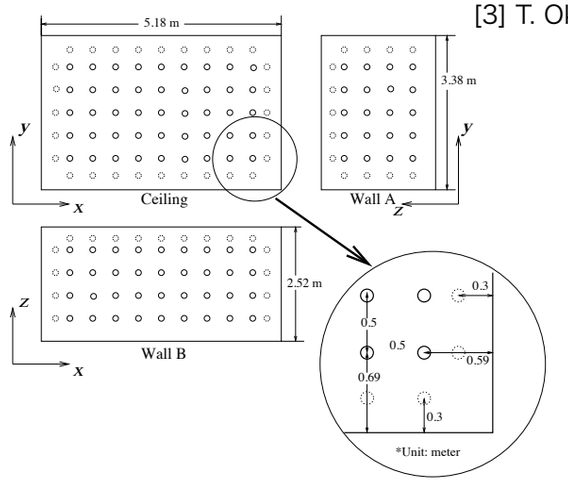
- Auralization [1] has become a useful tool for the acoustic design of 3D architectural environments [1] M. Kleiner *et. al* 1993
- Most conventional techniques are computationally intensive and are therefore poorly suited to real-time applications
- M. Noisternig *et. al* have recently proposed a real-time system for auralization based on beam-tracing and binaural rendering [2].

[2] M. Noisternig *et. al* 2008

This poster presents the implementation of this auralization system on a surrounding 157 loudspeaker array, using a cluster of 5 PCs and the open source software EVERTims, VirChor and Pure Data.

2 Surrounding 157 loudspeaker array [3]

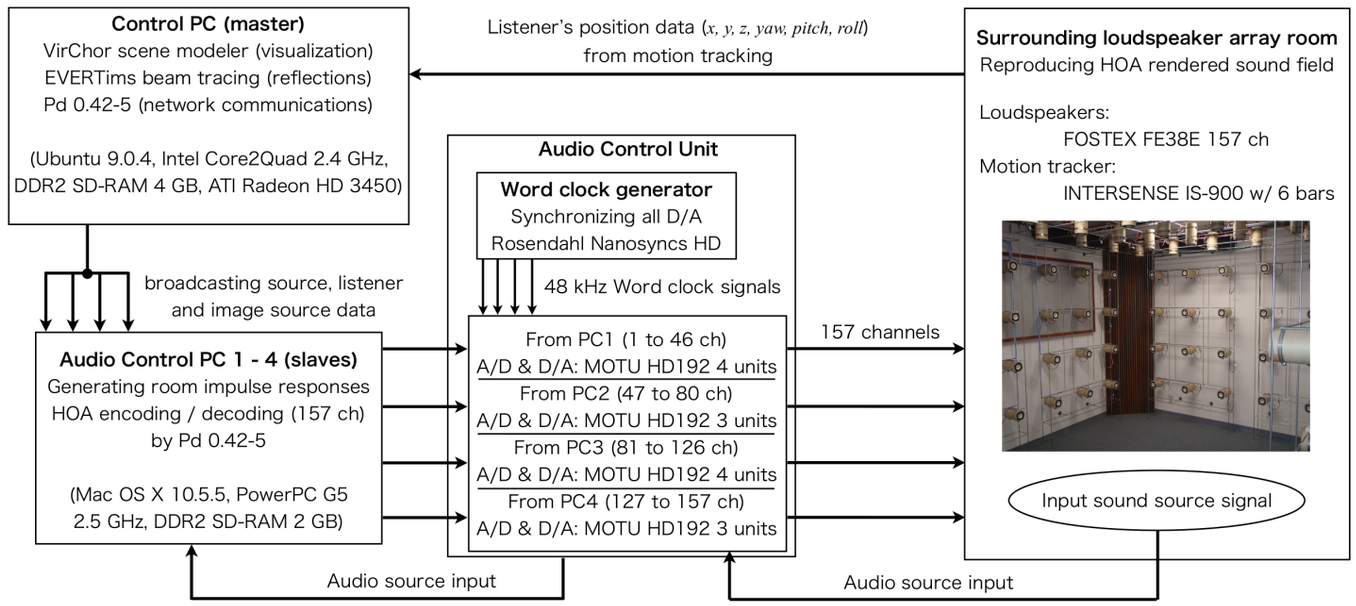
[3] T. Okamoto *et. al* 2007



Room dimensions and arrangement of loudspeakers

The measured mid-frequency reverberation time RT30 of the reproduction room is on the order of 0.2 s.

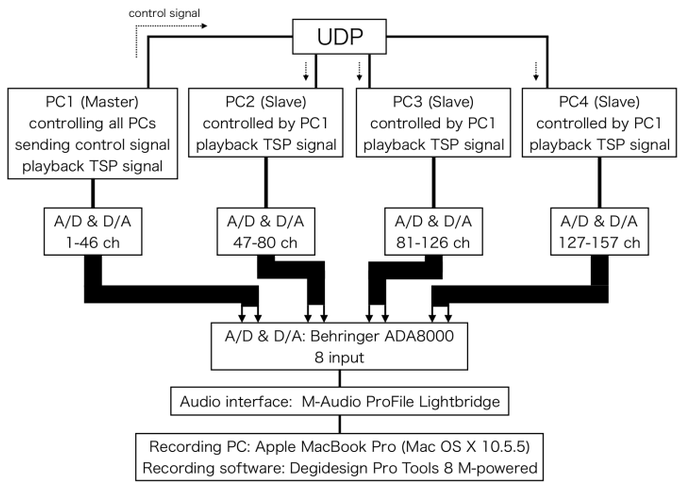
3 Real-time room auralization system using the loudspeaker array



1. Master PC calculates the impulse responses at the listener position applying beam tracing for early reflections (EVERTims) [5] [4] J. B. Allen *et. al* 1979 [5] S. Laine *et. al* 2009
2. Client PCs calculate late reverberation by Feedback Delay Networks [6] and the 157 loudspeaker driving signals based on Higher Order Ambisonics rendering [7] [6] J-M. Jot *et. al* 1991 [7] M. Poletti *et. al* 2005

4 Latency performance evaluation

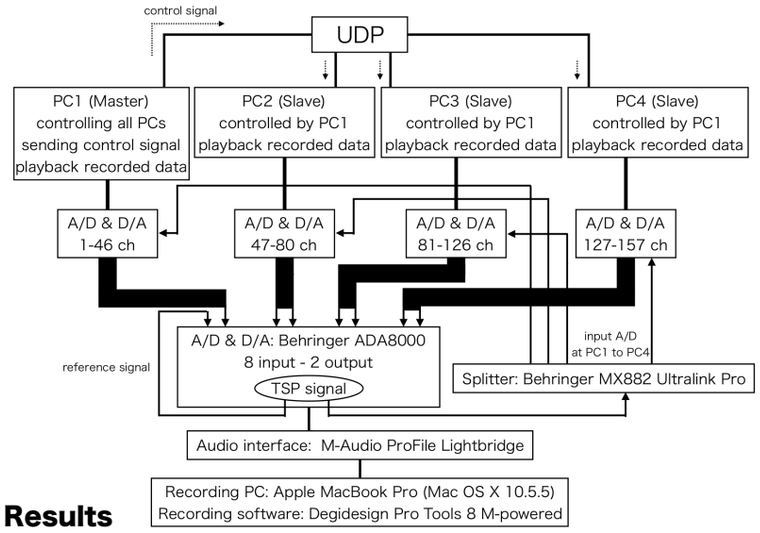
4.1 File playback synchronicity



Results

1. All output signals of one PC are fully synchronized (sample accurate)
2. Output signals between different PCs are not fully synchronized with an average latency of 7.9 ms.

4.2 Audio streaming synchronicity with splitter



Results

1. **All output signals were completely synchronous !**
2. The overall I/O system latency is constant 20 ms.
3. To further reduce the I/O latency real-time kernels and better CPU parallelization have to be applied

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