Construction of 80-channel mobile sound recording system

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ABSTRACT

Sound field sharing system based on the boundary surface control scheme is currently under development. As a sound information acquisition device, eighty-channel microphone array is adopted. The sound signals have to be simultaneously recorded through this array for appropriate reproduction. This paper introduces the battery powered recording system for this array. The system is constructed by ten eight-channel field recorders and these are connected to assure the sampling synchronization.

1. INTRODUCTION

The development of sound field sharing system is currently in progress. The proposed system is intended to provide an extremely high degree of presence of sound field at plural distant places. Theoretical background of sound field information acquisition and reproduction strategy is the boundary surface control proposed by Ise[1].

Figure 1 indicates the schematic diagram of whole system. All the data for sound field sharing is planned to be exchanged through the internet.

The authors are in charge of constructing the sound field database which includes the impulse responses and any types of contents such as music play or the natural sound and so on. For this purpose, eighty-channel microphone array is adopted for the standard data acquisition device. This microphone array is constructed as a shape of C80 fullerene structure and miniature-microphones are located at each nodes.

The sound field reproduction system is constructed as a “Sound Cask” which consists of ninety-six loudspeakers. The performance and details of this cask is reported as a separate paper[2]. This paper introduces the basic performance of microphone array and the construction of simultaneous recording system which can be driven by portable butteries.

2. PERFORMANCE OF C80 FULLERENE MICROPHONE ARRAY

At each modal point of C80 fullerene structure constructed by an aluminum frame, the miniature condenser microphone (DPA 4060) is embedded. Detail of microphone arrangement is shown in Fig. 2.

In an anechoic chamber, the sound source is located at 2 m distance and the impulse response to each microphone was measured by using turn-table rotating with five degree step. The directional characteristic of each microphone was then calculated for the dominant frequency range. Results of # 31 microphone is shown in Fig. 3. This #31 microphone is usually located in front in our recordings.

Since the center of rotation of the measurement was coincident with the center of the array and not with the #31 microphone’s location, fluctuation up to 1.5 dB could be resulted. Considering such fluctuation, the directivity of the microphone can be regarded as omni-directional for the low and mid frequencies up to 2kHz. For higher frequencies, 4kHz and 8kHz, around 10 dB reduction can be observed for the incident from back direction.

Figure 4 shows the frequency characteristics of the response. The results for the rotated cases at every 30 degree step are also plotted. Almost flat response during 100 Hz to 5kHz and slightly boosted response at around 10kHz are observed.

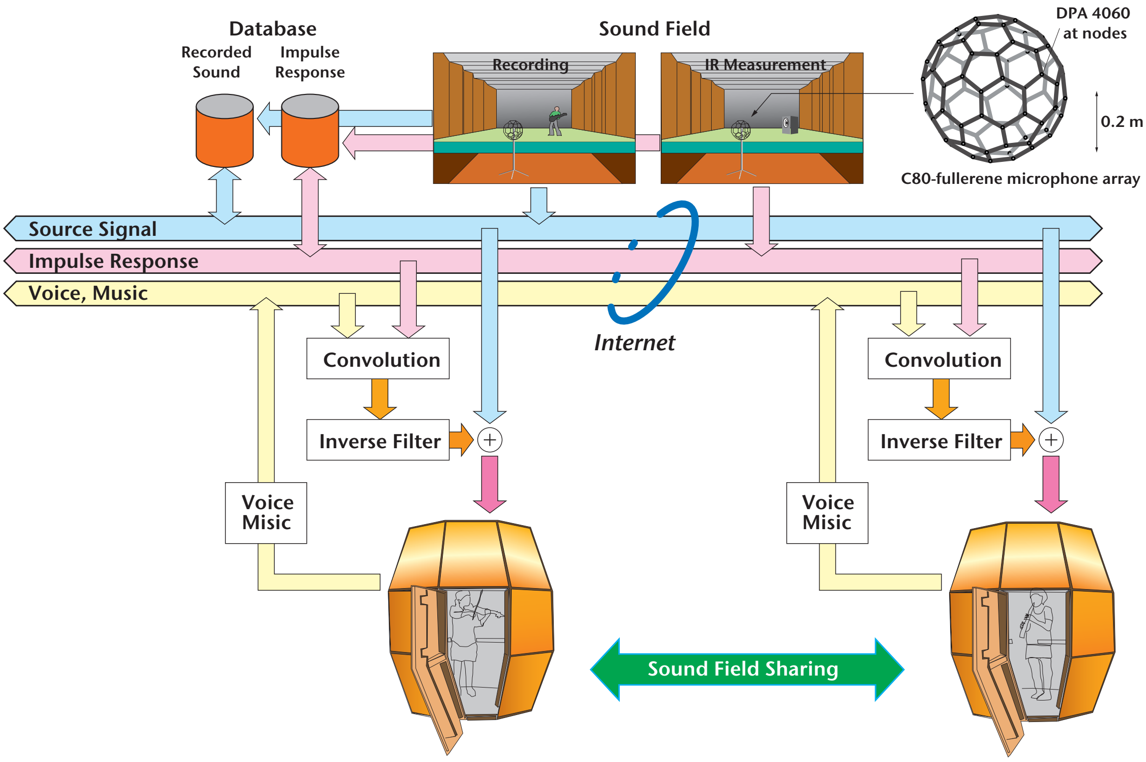

Fig. 1: Sound field sharing system with boundary surface control (BoSC) microphone and speaker array. The recorded signals by the C80 fullerene microphone array is re-produced in the 'Sound Cask' which consists of 96 channel loudspeakers after appropriate signal processing such as inverse filtering.

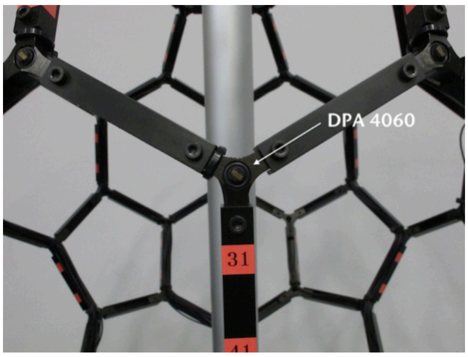

Fig. 2: Miniture microphone (DPA 4060) mounted at nodes of C80 fullerene structure. The #31 microphone is usually located in front.

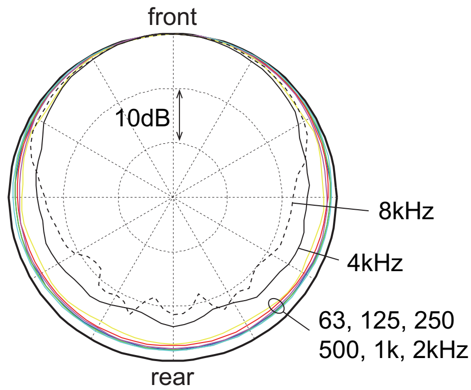

Fig. 3: Directivity of #31 microphone in the array. The results from 63 Hz to 8 kHz at every octave band are shown.

Additionally, the desired directional characteristics can be assigned by designing the appropriate filters for each output of microphones. For example, the trial of realizing uni-directional characteristics is shown in reference [3].

To assure the uniform sensitivity for all microphones, specific signal from sound calibrator (B&K Type 4231 with specially made jig for microphone fitting) is recorded at every recording project.

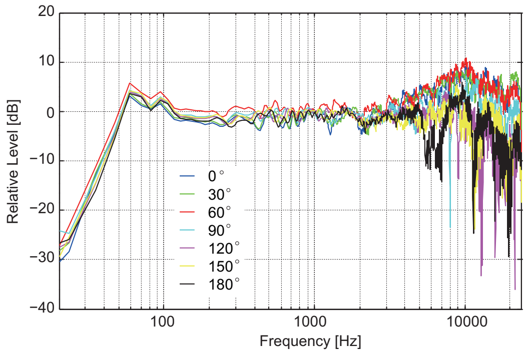

Fig. 4: Frequency response of #31 microphone. The rotated results for every 30 degrees are also plotted.

Fig. 5: Sound recording system based on PC and DAW (Nuendo). Ten eight-channels microphone amplifier (YAMAHA MLA-8) and four MOTU 24io are used.

3. RECORDING SYSTEM

First, the recording system based on PC was constructed. The system consisted with sound-card (MOTU 24io $\times$ 4) and Digital Audio Workstation (DAW) such as Nuendo and Pro Tools. Example is shown in Fig. 5. Stable recording could be realized, however, the stable AC power suppy was always needed.

For convenience of outdoor recording, for example, the buttery powered system is then constructed. The system uses ten filed recorders which can simultaneously record eight-channels. The TASCAM HS-P82 is adopted in our case. The constructed system is shown in Fig. 6. This recorder can supply eight channel phantom power for microphones.

In Fig. 6, there are eleven recorders. Additional one

Fig. 6: Sound recording system based on TASCAM HS-P82. The additional one (bottom-right) recorder is used for additional recording and test signal reproduction such as swept-sine.

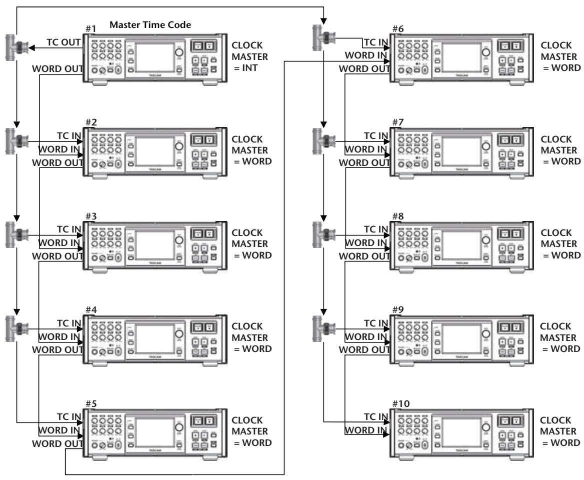

Fig. 7: Connection method of recorder for Time Code and Word Clock synchronization.Time code is distributed from the first machine to all others directly and the word clock was distributed by cascade connection.

is usually used for the sound output device such as swept-sine signal for impulse response measurement, or for the recording of additional microphones. The weight of one-rack in Fig. 6 is around 25 kg excluding batteries.

Signals are recorded in Compact Flash card and since the file format is FAT32, the maximum size of one continuous recording file is limited to 2GB. The recorded data can be transferred to PC via USB.

Fig. 8: Examples of outdoor recording. Top: recording in university campus, Bottom: recording in pine grove.

The connection diagram for SMPTE time cord and word clock synchronization is shown in Fig. 7. Time code is distributed from the 'parent' machine to all 'children' directly and the word clock was distributed by cascade connection.

The sampling frequency of 48 kHz and 24 bit resolution are used in our recordings. Roughly speaking, three hours recording can be carried out by the batteries.

Examples of outdoor recordings are shown in Fig. 8. The upper photo shows the recording of voice of cicada in the university campus. The lower photo was taken at the measurement of reverberation in a huge pine grove. In the case of impulse response measurement in outdoor, the loudspeaker must be driven by the powered amplifier. In such case, the portable AC buttery is additionally introduced.

4. CONCLUDING REMARKS

The proposed system can extend the chance of numerous-channel simultaneous recording even though there are no AC power supply is expected. In addition such severe condition, we often use this system in indoor recording such as concert hall due to its portability and simplicity of the system.

Subjective test for the comparison of the recorded sound quality between PC-based system and the proposed portable system is one of the topic in our ongoing research project.

5. REFERENCES

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