Sound Reproduction with a Strong Sensation of Reality

-Aiming at realistic sound image reproduction-

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STRL has been studying sound reproduction technologies that convey a strong sensation of reality and their coding schemes, with the aim of creating a future broadcasting system that will be capable of presenting the sensation of actually being at the recording site.

Currently, a 5.1 channel surround stereo system is implemented in digital satellite broadcasting. Although this allows for the reconstruction of sound with a sensation of reality higher than that of any conventional service, it is still a difficult challenge to reproduce certain sounds. For example, it is difficult to create a sound that a listener perceives as popping up from a synchronized 3D video image, or to reconstruct the sound heard from a particular seat in a concert hall. As one of its schemes to reproduce audio with a higher sensation of reality, STRL has constructed a prototype system that combines a loudspeaker array capable of reconstructing sound at a point in front of the loudspeakers, and a virtual reality audio system (VRAS), which can reproduce a natural-sounding sound field space (because it simulates sounds reflected from every direction).

It is known that the physical characteristic changes shown in Table 1 serve as a key to humans judging the perceived distance of a sound source. The arrayed loudspeakers use the reverberation component characteristic to reconstruct a sound's perceived distance, through the production of a sound focus point in space. Figure 1 shows the loudspeaker array system. When the wavefront radiated from multiple loudspeakers reaches a particular point in space, the sound energy that first reaches the area (direct sound) near the focal point rapidly increases, in comparison with the energy level of the following reverberations (indirect sound). The reverberations generated from reflections off walls or the floor are not correlated with the number of loudspeakers, resulting in no significant energy increase near the focal point. This leads to a relatively small reverberation and the reconstruction of a sound that can be perceived to be at a location in front of the loudspeakers.

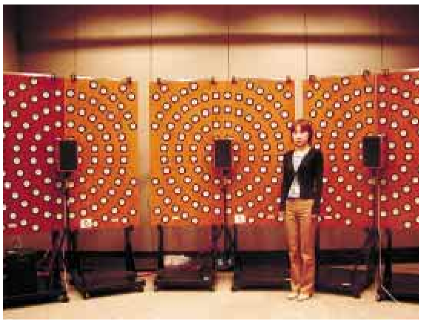

Figure 1: Loudspeaker array

Table1: Changes in distance perception and physical characteristics of sound

Physical characteristic / Perceived distance of sound	Nearby source	Distant source
Loudness of sound	Loud	Soft
Frequency characteristic	Small attenuation at a high range	Large attenuation at a high range
Binaural difference	Large difference	Small difference
Reverberation	Small	Large

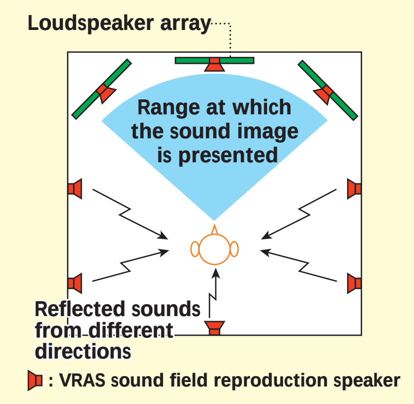

Figure 2: Audio replay system conveying a strong sensation of reality

At the same time, VRAS can construct a natural-sounding sound field space that simulates sitting in any part of the recording site location specified by the listener. It does this by reproducing the reflected sounds directionally, i.e., at the designated point based on the actual shape of the hall, and by producing convoluted sound source signals without peal. This system's real-time processing capability, which allows it to adapt to changes in the desired location, has made it possible to reconstruct sounds that track interactive operations.

As Figure 2 shows, the combination of loudspeaker array and VRAS can now create a natural sound environment that gives a listener the sensation of actually being at the recording site, including the perception of a sound source's distance. We are going to continue this research with the aim of creating broadcast media that can deliver this strong sensation of reality.