Abstract of Doctoral Thesis

Title：Reproduction of Three Dimensional Sound Field with High Sound Quality by Polyhedron Parametric Loudspeaker

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Recently, technologies for reproducing a 3-D sound field are required for providing highly realistic sensations in simulation of crisis situation and amusement. Various methods have been conventionally proposed for achieving 3-D sound field by multiple channel surround systems and binaural reproduction systems with the head-related transfer function. These techniques can easily provide the audible realistic sensation for user. However, these systems often take up a lot of space due to the arrangement of multiple loudspeakers. Moreover, they require the user to obtain the correct head-related transfer function by specific equipment.

For overcoming these problems, a system for reproducing 3-D sound fields have been proposed by using a multiple parametric loudspeaker called acoustic planetarium. The parametric loudspeaker, which uses an ultrasound wave, can transmit acoustic sound to a particular area, referred to as an audio spot. Furthermore, it can design sound images on walls, ceilings, and floors by reflecting an emitted sound. Therefore, acoustic planetarium can easily present incoming sound from various directions. However, it has a lower sound quality. In addition, it is difficult to provide a moving sound image because emission direction of the parametric loudspeaker stays constant.

In this paper, we therefore propose the new modulation method for improving the sound quality. Furthermore, we propose a criterion for measuring a demodulation level for estimating the suitable demodulation distance. In addition, we also develop curved-type and polyhedron parametric loudspeakers for steering the emission direction without moving the emitter. We carried out evaluation experiments to confirm the effectiveness of the proposed methods. The results confirmed that the proposed modulation method could improve sound quality of parametric loudspeakers, and estimate the suitable demodulation distance. Moreover, we confirmed that the moving sound image could be designed by using developed curved-type parametric

loudspeaker.