Sound localization in multiple regions: theory and applications

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proofed room is compared with the reconstructed wave front within this system. The experiment shows that the reconstructed secondary wave front is very similar to the primary wave front in lower frequency.

4pEAf5. Three-Dimensional FDTD Method for Analysing of the acoustic characteristics of Compact Acoustic Reproduction Systems. Yuichiro Koga (Kansai University, Kobe-Nishiku-Gakuenhigasimati5-1-512, 651-2102 Kobe, Japan, koga0814@joho.densi.kansai-u.ac.jp)

We propose a method for analysing of the acoustic characteristics of compact acoustic reproduction systems with Three-Dimensional FDTD method. We reproduce actual structure of compact acoustic reproduction systems and take the frequency characteristic of sound pressure level at a point with Three-Dimensional FDTD method. To compare the frequency characteristic of sound pressure level of actual measurement of compact acoustic reproduction systems to measurement of the proposed method, we show availability of the proposed method for analysing of the acoustic characteristics of compact acoustic reproduction systems. The proposed method could explain actual phenomena on compact acoustic reproduction systems well.

4pEAf6. Sound localization in multiple regions: theory and applications. Yang-Hann Kim (Center for Noise and Vibration Control, Korea Advanced Institute of Science and Technology, 4114, Department of Mechanical Engineering, Guseong-dong, Yuseong-gu, 305-701 Daejon, Republic of Korea, yanghannkim@kaist.ac.kr), Ji-Ho Chang (Center for Noise and Vibration Control, Korea Advanced Institute of Science and Technology, Dep. of Mechanical Engineering, Guseong-dong, Yuseong-gu, 305-701 Daejon, Republic of Korea, chang.jiho@gmail.com), Jin-Young Park (Center for Noise and Vibration Control, Korea Advanced Institute of Science and Technology, Dep. of Mechanical Engineering, Guseong-dong, Yuseong-gu, 305-701 Daejon, Republic of Korea, jypark1979@kaist.ac.kr)

It is often required to have several listening zones, which allows us to have different sounds that we select. For example, in a room, someone wants to listen sound from TV set, and other wants to listen music. In a car, a driver might wants to hear the information coming from his/her navigator system, and the passenger at the back side wants have a quiet zone so that he/she can sleep. To accomplish this kind of acoustic zones, we need to generate multiple sound zones by using multiple speakers. The performance has to be evaluated in accordance with how well one can listen the sound that is expected to have. We proposed to maximize the acoustic contrast between the zones that are defined. The basic concept associated with this approach was proposed by Choi and Kim [J. Acoust. Soc. Am., Vol.111(4), 1695-1700, Apr. 2002.], but this paper extend this fundamental idea to multiple zone cases. Theoretical formulation which shows what we have proposed is well addressed and several practical cases, including car audio system will be demonstrated. [This work was supported by the Korea Science and Engineering Foundation (KOSEF) through the National Research Lab. Program funded by the Ministry of Science and Technology (M10500000112-05J0000-11210)]

4pEAf7. Sound focused personal audio system design: Performance improvement in acoustic contrast control by spatial weighting for obtaining spatially averaged acoustic potential energy. Jin-Young Park (Center for Noise and Vibration Control, Korea Advanced Institute of Science and Technology, Dep. of Mechanical Engineering, Guseong-dong, Yuseong-gu, 305-701 Daejon, Republic of Korea, jypark1979@kaist.ac.kr), Ji-Ho Chang (Center for Noise and Vibration Control, Korea Advanced Institute of Science and Technology, Dep. of Mechanical Engineering, Guseong-dong, Yuseong-gu, 305-701 Daejon, Republic of Korea, chang.jiho@gmail.com), Chan-Hui Lee (Center for Noise and Vibration Control, Korea Advanced Institute of Science and Technology, Dep. of Mechanical Engineering, Guseong-dong, Yuseong-gu, 305-701 Daejon, Republic of Korea, Chance99@kaist.ac.kr), Yang-Hann Kim (Center for Noise and Vibration Control, Korea Advanced Institute of Science and Technology, 4114, Department of Mechanical Engineering, Guseong-dong, Yuseong-gu, 305-701 Daejon, Republic of Korea, yanghannkim@kaist.ac.kr)

In acoustic contrast control [J.-W. Choi and Y.-H. Kim, J. Acoust. Soc. Am. 111. 1695 (2002)], spatially averaged acoustic potential energy is used as a representative spatial parameter because acoustic contrast control aims to maximize spatially averaged acoustic potential energy ratio between acoustically bright and dark zone. Therefore, spatial averaging process should be concerned carefully because control performance is sensitive to how to determine bright and dark zone. We have already got successful result in feasibility study for personal audio system with over 20dB difference between bright (frontal) and dark (side) zone [C.-H. Lee et al., J. Acoust. Soc. Am. 111, 3053 (2007)], without any spatial weighting in spatial averaging of acoustic potential energy. Recently, we're trying to improve the control performance by giving spatial weighting in spatial averaging process because how to give spatial weighting has to do with the improvement of control performance to satisfy the original purpose of personal audio system more closely. In this paper, it will be covered the investigation for how to give spatial weighting in averaging process and shown experimental evaluations for a sound focused personal audio system. [Supported by the Korea Science and Engineering Foundation (KOSEF) through the National Research Lab. Program funded by the Ministry of Science and Technology (M10500000112-05J0000-11210)]

4pEAf8. 3D sound field rendering under non-idealized loudspeaker arrangements. Alois Sontacchi (Institute of Electronic Music and Acoustics, Inffeldgasse 10 / 3, 8010 Graz, Austria, sontacchi@iem.at), Franz Zotter (Institute of Electronic Music and Acoustics, Inffeldgasse 10 / 3, 8010 Graz, Austria, zotter@iem.at), Robert Höldrich (Institute of Electronic Music and Acoustics, Inffeldgasse 10 / 3, 8010 Graz, Austria, hoeldrich@iem.at)

The approach to realise periphonic sound field reproduction based on spherical harmonics (multi-pole theory) has already been well-known as Ambisonics and Higher Order Ambisonics, respectively. By the aid of an N-dimensional orthogonal set of vectors any arbitrary source free sound field can be described. Reproduction is realized by projection of the encoded sound field on a regular loudspeaker distribution over a spherical surface. The used set of vectors exhibits a defined hierarchic with interesting symmetries. In the original scheme sound sources represented by plane waves (sources in far distance) can be encoded independent of the decoding process on the regular loudspeaker layout. Usually, in practice - in contrast to theory, 3D loudspeaker layouts are requested for the upper hemisphere. This restriction is caused by the physical configuration. First of all that demand bounds the reproduction of sound sources to the upper area. Furthermore caused by these facts idealized regular layouts considering the 3 dimensions are impossible. Within this contribution we will show how the symmetries of the spherical harmonics can be used to obtain optimized decoding rules and to overcome insufficient irregular loudspeaker arrangements.

4pEAf9. Measurements of head-related transfer function in sagittal and frontal coordinates. Takashi Nakado (Nagoya University, Furo-cho, Chikusa-ku, 4648603 Nagoya, Japan, nakado@sp.m.is.nagoya-u.ac.jp), Takanori Nishino (Nagoya University, Furo-cho, Chikusa-ku, 4648603 Nagoya, Japan, nishino@media.nagoya-u.ac.jp), Kazuya Takeda (Nagoya University, Furo-cho, Chikusa-ku, 4648603 Nagoya, Japan, kazuya.takeda@nagoya-u.jp)

3D sounds can be generated by using a head-related transfer function (HRTF), which is defined as the acoustic transfer function between a sound source and the entrance to the ear canal. Since HRTF depends on a subject and the sound source direction, many HRTF measurements were conducted. In most case, HRTFs were measured in horizontal coordinates. However, HRTF measurements in other coordinates are also useful. In previous researches, HRTFs measured in sagittal coordinates were used to investigate the relation between spectral cues and vertical angle perception. Although HRTF measurement in frontal coordinates is rarely conducted, there is an advantage to measure HRTFs densely in the front and rear where sound localizations are very sensitive. Therefore, we measured HRTFs for about