nosis technique based on holographic approach, is introduced to find the position of faults effectively. The modified version of beamforming that models the moving periodic impulsive noise as a scan function is introduced.

**3pSP14. Software-centered implementation of 128-channel loudspeaker array with stock PC and its application.** Hiroshi Mizoguchi, Takafumi Nakamura, Hiroshi Takemura (Tokyo Univ. of Sci., 2641 Noda, Chiba 278-8510, Japan), and Satoshi Kagami (DHRC, AIST, Japan)

A huge speaker array system of 128 loudspeakers was constructed and experimented. It was implemented as "software-centered" style, utilizing stock loudspeakers and a PC. No dedicated hardware nor DSP was utilized. Spot forming, instead of beam forming, could be realized by 32 by 4 square layout of the array. Spot means small area of higher sound pressure level. Number of the spot was not limited to one. In the experiment, within 3 m by 3 m area, four spots of different sounds could be simultaneously formed. This spot forming was confirmed by actually measuring spatial distribution of sound pressure level. The effect of the spot was also confirmed auditorily. Since the system was software centered, it was dynamic. By simply changing software parameters, the location of the spot can be easily moved even while the system is running. This movability of the spot was intended to be the basis for visual steering. To realize the system, a simultaneous 128-channel 14-bit DA converter PCI board was developed. The 44.1-KHz sampling rate was achieved by a 2.4-GHz Intel Xeon based PC utilizing the DA board and a real-time OS, named ART-Linux. Approximately 23-$\mu$s loop could be realized by the software. It was the world's fastest software loop.

**3pSP15. Complex envelope implementation for fast and efficient acoustic holography.** Choon-Su Park and Yang-Hann Kim (Ctr. for Noise and Vib. Control, Dept. of Mech. Eng., KAIST, Daejeon 350-701, Republic of Korea)

Acoustic holography allows us to predict the spatial pressure distribution on any surface of interest. To implement this method, we normally use Fourier transform in time and space domain. It is noteworthy that the data size is so huge that it takes a long time to calculate pressure field. Moreover, the reconstructed pressure field is frequently too complex to observe the characteristics of pressure field. One possible candidate is the complex envelope. The complex envelope in time domain is well known and widely used in various fields. We have attempted to extend this method in the space domain, so that we can have a rather compact sound pressure picture that provides the information we need, for example where sound sources are. This belongs to what we call the analysis problem of acoustic holography. We might want to draw some parts in detail but other parts in a rather coarse way. The complex envelope in space certainly meets this objective. First we start with the simplest case. We devise a monopole complex envelope. Then we extend it to finite size source case. Various holography examples are reprocessed according to what we propose and demonstrate how this method is practically fast and how it provides a better picture for analyzing the sound field.

**3pSP16. The acoustic information extraction of the indoor impulse response by multiresolution analysis.** Wakako Tanaka, Yong Tang, Toru Itakura, and Hideo Shibayama (3-7-5 Toyosu Koutou-ku, Tokyo, 135-8548, Japan, m105072@sic.shibaura-it.ac.jp)

The impulse response is divided into approximation and detail components by the multiresolution analysis. The correlations between the early sound and reflected sounds are estimated respectively for the impulse response and the approximate signal. The approximate signal was calculated as a function of level of the multiresolution analysis. The correlation coefficient of these correlations is over 0.7 under level three. We evaluate the differences of these correlations from the listening test.

**3pSP17. Detection for the early reflection in the impulse response by the correlation function.** Toru Itakura, Yong Tang, Wakako Tanaka, and Hideo Shibayama (Shibaura Inst. of Technol., Toyosu 3-7-5, Koutoku-ku, Tokyo 135-0061, Japan, m106009@sic.shibaura-it.ac.jp)

Detecting an early reflection sound contained in the impulse response measured in a room, we calculated the correlation factor between the early reflection and the impulse response. Calculating the correlation factor every sampling period, we make the correlation function. For the function, we set a threshold level. We detected the absolute correlation value larger than the threshold level. And, we set the zero value for subthreshold level. Following this algorithm, we generate a new signal with the high correlation factor for the early reflection. We compared the signal with the impulse response by using listening test.

**3pSP18. A design of virtual sound field simulator based on acoustic ray tracing and wall impedance.** Kiichiro Yamada, Yuki Denda, Masato Nakayama (Grad. School of Sci. and Eng., Ritsumeikan Univ., 1-1-1 Noji Higashi, Kusatsu, Shiga 525-8577, Japan, rs047023@se.ritsumei.ac.jp), and Takanobu Nishiura (Ritsumeikan Univ., Kusatsu, Shiga 525-8577, Japan)

The sound propagation analysis using an architectural scale model is an effective approach for architectural acoustic design of a concert hall, and so on. However, the scale model must be reconstructed together, changing the basic plan of the architectural design. To cope with this problem, an architectural sound field has been virtually designed on the computer by the sound field simulator in recent years. The acoustic ray tracing is one of the simulators based on geometric acoustics. It is an efficient solution from the viewpoints of simulation cost and time. However, it cannot simulate the wall materials, because it employs the delta function as the wall impedance. To overcome this problem, in this paper, we try to design the virtual sound field simulator based on acoustic ray tracing and wall impedance acquired by real measurements. We first measured the reflection characteristics of the wall with impulse response to acquire the wall impedance. Then, we designed the virtual sound field simulator by convoluting the acoustic rays with measured wall impedances. As a result of subjective evaluation experiments, the proposed simulator could realize a more realistic sound field than the conventional acoustic ray tracing. [Work supported by MEXT of Japan.]



**3pSP19. A fundamental investigation of the small microphone array system and its applications.** Akira Nawa, Yoku Watanabe, and Hareo Hamada (Tokyo Denki Univ., 2-1200 Muzai-gakuendai, Inzai, Choba prefecture 270-1382, Japan)

A purpose of this research is to construct a 3-D sound recording and reproduction system that has a high presence by performing a spatially controlled sound field synthesis technique. For this purpose, it will be required to examine and choose the most suitable sound recording system, since a conventional sound recording system samples only original signal itself, and does not include enough spatial information. In other words, it will be required to examine the system to record the information of the three-dimensional spaces, such as the direction and the distance, and to transform the configuration to become effective to the reproduction system. This paper will deal with a basic examination to construct the microphone array placed in proximity and the recording system, which is able to control the directivities in the three-dimensional spaces, using algorithm based on LMS by FIR filter networks from signals to each microphone.