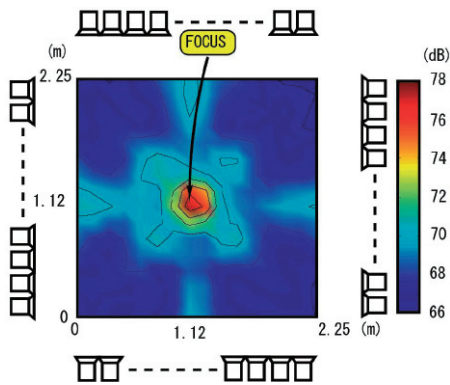


# Focusing on multiple sounds using super-distributed microphones and speakers

**Satoshi Kagami** Humanoid Interaction Team Leader , Digital Human Research Center

## Listen and recognize a sound, then emit it to wherever intended

Our environment always includes a vast number of flowing sounds. We human beings listen unconsciously to what we think we need. Robots, however, would be incapable of picking up only the information they need out of the sounds captured by a microphone. In addition, no technology has yet been established to provide a sound to a specific place at home or in the office. In light of these facts, we are researching, using numerous microphones and speakers, a means to allow us to provide sound only to those places that need it, or to catch sounds that exist only in the place we specify.



**Figure:** 128ch Diagram showing actual measurement of the sound field with one sound focus using speaker arrays

## Super-distributed microphones and speakers, and sound focusing

Super-distributed microphones and speakers are sound devices comprising several hundred microphones and speakers, each of which is aligned in an array form (positioned in a regular disposition). Inside the array, we can capture sound that is focused on any arbitrary point, or otherwise capture sound out of that position, both of which can be accomplished by adjusting the phase of the wavelength or the amplitude of the sound waves emitted from each sound device. At that focal point, we can differentiate and separate the sounds that come not only from one sound source, but also from multiple sound sources. A system that is set up in this way consists only of inexpensive sound devices and a PC, which are then controlled by software with a real-time based OS so that no problem obstructs its use for various environments.

Sounds pass through air at about 340 m/s. Therefore, with many sound devices placed in that air, the time every sound reaches each device varies depending on the distance from the focus. Knowing and using this fact, it is possible to select one sound and intensify it specifically by setting a sound focus at one location and adding the time



**Photo:** 128ch Microphone arrays allow five people to each listen to a different sound

difference of each sound coming from that point to compensate.

## What can we do with super-distributed microphones and speakers?

A set of super-distributed microphones can capture and recognize one sound from all the different sounds that are audible from various directions. Therefore, it can be used as a robot ear, for example. Development of a system that can record the minutes of a meeting automatically is now underway. Using super-distributed speakers, the sound can be heard only at its focus position. Therefore, such a system could be used to listen to, for example, only the right-guided voice at the right exhibit in a museum, or to change the voice alternately for a group of adults and for a group of children. Another example is that it might be possible that only some groups in a living room could hear and appreciate television or the movie while no others in the room would be able to do so, or be bothered with doing so. With these examples of applications in mind, a room-sized prototype system is under development.

## Industry forum on five senses

# Toward horizontal unity among studies of the five senses

**Yasuhiro Nishida** Assistant Director, Osaka Science & Technology Center

Osaka Science & Technology Center has made the “Industrial Forum on Five Senses” take off in 2004 after it had spent longer than a year on the runway.

Five senses technology (technologies related to any of the five senses such as sensors or information on sensation) as well as systems and products made using such technologies are steadily improving to create a “high-quality, safe, secured, and healthy society.” On the other hand, the important necessity is not the achievement of superficial convenience, but firmly based technologies, systems, and

products to recognize and address the differences of each individual of every generation in every activity. From that vantage, it seems to be a requirement that five senses technologies apply to improvement of human life and society from a social scientific perspective: we should seek a new paradigm for these technologies’ development.

Based on the background described above, the forum has been established to allow a new industry (Five Senses Industry) to start and extend to seek a high level of amenity, and perform the following practical activities to assist people to: