

Focusing on multiple sounds using super-distributed microphones and speakers

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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.

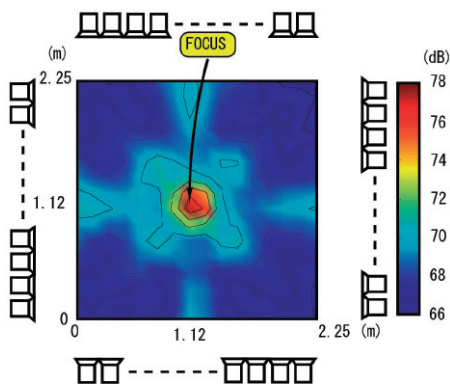


Figure: 128ch Diagram showing actual measurement of the sound field with one sound focus using speaker arrays

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:

Organic device in ubiquitous information society

Kiyoshi Yase Deputy Director, Photonics Research Institute

As information society is becoming more advanced, more needs are demanded for ubiquitous information household appliances, which allow users to access information at any time from any place. Among others, organic devices, as represented by organic electroluminescent (EL) devices and the thin film transistors (TFT) are expected to apply more for soft and flexible information electronic devices such as electronic newspapers. Organic materials have “light and soft” characteristics in contrast to non-organic materials. The organic EL display has been already commercialized and used for cell phones and displays for digital cameras.

Development of organic EL devices that capture outside light efficiently

Our research group is working on development of “photo-responsive organic EL devices” by putting a layer of a photoelectric transducer (organic photo conductor (OPC)) into an organic EL device. Emitting light to that device, photo carriers are produced at the OPC layer. The carriers are then injected into the organic EL layer, thereby improving its intensity.

Figure 1 illustrates that light radiation. Emitting near-infrared light (780 nm) to a device with 3–6 V applied, only the emitted portion radiates green light (in the switching

mode: left side of Fig. 1). Applying 6 V or more to the device, the entire device radiates green light and the radiation intensity increases at the place where the near infrared light is irradiated (in the amplification mode: right side of Fig. 1). In the future, we anticipate developing a “lighting apparatus responding to brightness” by having a higher sensitivity around the visible range of the OPC layer so that it can recognize the environmental brightness. Consequently, it will be irradiated with low intensity in a dark place and with high intensity by absorbing light in clear weather outside, for example.

Development of n-type organic TFT of high performance by applying spin-coating method

In addition, organic TFT is now receiving attention for use in RF-ID tag or organic EL, which is driven by organic TFT circuit. Particularly, the development of organic semiconductors that are soluble in solvents is becoming more popular recently because, if done successfully, it would allow production of organic TFTs with a large area at low cost by the associated printing law.

Our research group newly developed the C60 derivatives(C60MC12). Using an alkyl chain, which can become soluble in the solvent, we can produce a highly crystallized thin film

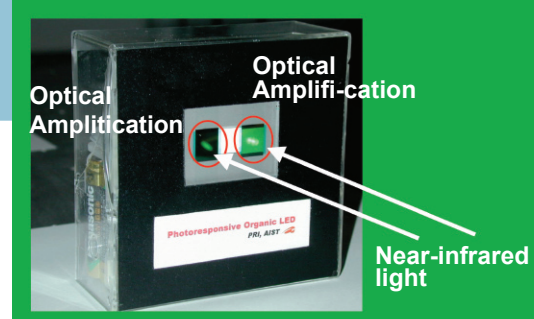


Figure 1: Photo of light-responsive organic EL device when illuminated

using the spin-coating method. Figure 2 shows characteristics of the C60MC12-TFT. The electron mobility is $0.09 \text{ cm}^2/\text{Vs}$, which shows the best value of all the n-type organic TFTs produced by the spin-coating method.

Based on this success, we accomplished the same level of electron mobility as of p-type semiconductors (polythiophene) that were made using the spin-coating method, which means that both p-type and n-type of organic semiconductors became available. As a consequence, not only has that circuit designing become more flexible, but organic devices can also now be produced even on a soft and flexible base like plastic, which is allowed by the new printing law. It is expected that the actual use of in the real world would be accelerated by the use of this new technology.

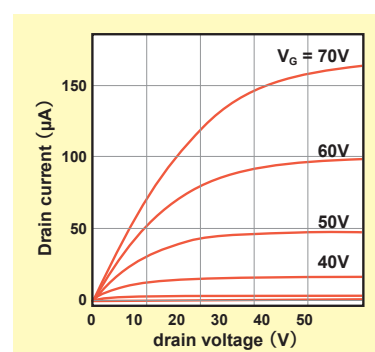


Figure 2: Characteristics of C60MC12-TFT produced by spreading method

- Create a personal network and a research community across fields of technical aspects or social life aspects with respect to the five senses;
- Exchange information regarding five senses technology and its needs;
- Plan and promote various research and development projects regarding five senses technology;
- Establish a vision for the five senses industry;
- Investigate and advise on aspects of five senses technology and industry to work on a new promotion policy or to plan a new base creation.

Up to the end of December 2004, we have opened the forum five times with 800 participants in all. In addition, we have forum members of nearly 250 people from over 200 companies who have joined at present, meaning that cooperative activities made by industry and by academic and government organizations are steadily and passionately moving forward to support “Five Senses Industry” in its establishment and growth.

