Addresses

2004 STRL Open House

Seeing and Hearing to Integrate:

Concerning Accuracy and Signal/Noise

Shinsuke SHIMOJYO,
Professor,
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Upon seeing the images of Super Hi-Vision at this STRL open house, I was impressed by not only the fullness of the screen and the clear edge, but also by the image clarity in the depth direction. Today, I will talk about the accuracy and resolution of human perception. To the question of whether or not higher spatial and temporal resolution is better, I consider the response to be "Yes." However, this issue is not as simple as it sounds. This is because our brain is an organ that integrates, supplements insufficient information, and sometimes adapts itself to learn under certain conditions.

There is a phenomenon called "Parks' camel," which occurs when an observer views a moving two-dimensional object through a vertical slit. The brain perceives the object in two-dimensions by re-constructing the object's shape, even though there is not much two-dimensional information entering the retina. This phenomenon cannot be clearly seen using a display. This is due to its inadequate temporal resolution. This fact indicates that the resolution must be higher. Conversely however, it also means that the resolution does not have to be increased, since the brain interpolates for the lack of information.

Another example is a case where a single flash is accompanied by two sounds. Observers typically perceive the single flash as double flashes. This is an example of how visual and auditory sensations complement each other in the brain. The synchronization of visual and auditory sensations also becomes an important factor in this case, while nearly all human perception phenomena can adapt with prompt calibration through the effect of experience.

What draws our interest in a wider field of view, like in the case of the Super Hi-Vision system, is the status of peripheral vision. The fact is that peripheral vision is not as unique as central vision. However, peripheral vision becomes extremely important in a situation where a person perceives his or her body in motion.

The development of a higher definition display system will definitely increase our perception experience. I believe that a higher quality audio-visual space can be constructed through further investigation of how human perceptions respond to such factors.

Light and Sound:

For a Comfortable Information Environment

Kenichi IGA,
Executive Director of the Japan Society for the Promotion of Science/President of IEICE

I started to study lasers in 1962, and I soon became dissatisfied with the structure of early semiconductor lasers. The semiconductor laser of that time was formed by cleaving semiconductor crystals with a knife. In 1977, I invented a vertical cavity surface emitting laser (VCSEL) of which the cavity was vertical to the substrate and could be manufactured in such a way that was similar to the fabrication of integrated circuits (IC's). The laser generally obeys a scaling law, which allows us to obtain a smaller threshold current by reducing the size of the laser. In principle, the surface emitting laser can be very small and hence realize a threshold of 10 micro-amperes or less. Its single-mode property is employed in high-speed communications such as Gigabit Ethernet, in optical interconnections between digital systems, and in image processing devices such as color printers. The world market for transceiver modules using VCSEL's is forecast to exceed 1.1 trillion yen in 2011.

The string of the double bass that I am going to play now is considered to vibrate with many harmonics, but in reality it is a solitary wave called a Helmholtz wave. Due to this property, the bow can catch and slide a string, and the string can vibrate, even though the bow is moving in one direction. My hypothesis is that a good sound can be generated through a single-mode Helmholtz wave. This is put into practice by the "Noda Method" proposed by Ichiro Noda. The common concept of lasers and string instruments is that the wave is resonant in cavity and the energy is transferred from the source to the air by impedance transformation. Light and sound emission can be performed efficiently only when there is an impedance converter such as a laser cavity, or the body of the strings. I was impressed by this similarity of the physics of single-mode vibration.

I believe that what is important for the future of Japan is to introduce an aspect of sensibility also into the field of electronics, information, and communications. I talked today about the fact that image and sound are inseparable, and should be considered in parallel, since they play an extremely important role in constructing a comfortable information environment. One of the missions of NHK is to provide its customers with a quality intellectual environment and comfort. It is my wish to see the broadcasting advance as a consensually founded comfortable information environment.

Ultrahigh-Definition Television System with 4000 Scanning Lines

Super Hi-Vision

Fumio OKANO,
Director of Three-Dimensional Audio-Visual Systems, NHK Science and Technical Research Laboratories

Digital satellite broadcasting, which started in 2000, and digital terrestrial broadcasting, which started in December 2003, have made Hi-Vision (HDTV) programming available for the enjoyment of viewers at home. In addition, small video devices, such as mobile receivers, have appeared in various situations in everyday life. While these devices will provide lots of information for business and home life, to enrich our lives, it is also anticipated that comfort and emotional fulfillment will rise as the convenience of such services increases.

A desirable form of future media is one in which we can immerse ourselves in a space surrounded by video and sound, with the perception of being at the displayed site or of actually having a displayed object there with us. To realize such an audio-visual system, technology for wide-view, large-display video that far exceeds the capacity of current HDTV is considered the most promising way to go. To explore the potential of such an audio visual system, we constructed an ultrahigh-definition video system with 4,000 scanning lines, which has a number of pixels that is 16 times higher than that of the current HDTV system. Combining this system with technological advances in multi-channel surround sound systems will enable us to pioneer a new field of audio-visual systems.

While the advances in research on the ultrahigh-definition system will require drastic improvements in technologies of various fields, we will especially make an effort in the following areas.

- Imaging / display / sound technologies.
- Visual and auditory psychological effects.
- Other element technologies.

If we regard video systems as a means to utilize human perception to the fullest extent, we can say that a wider-view larger display simply reflects a human desire. Our research using the ultrahigh-definition video system will hopefully point the way to a future broadcasting system with limitless possibilities.

We are also cooperating with the Japan Association for the 2005 World Exposition for the upcoming exposition in Aichi, Japan, where we will present an exhibit using this video system.

Organic Electroluminescence Displays

Shizuo TOKITO,
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Digital terrestrial broadcasting can be received not only at home, but also in a mobile environment, making it possible to view anytime and anywhere. Now if a paper-thin, lightweight flexible display could be rolled up, it could be easily carried around by pedestrians; even an A4-size display would be convenient to carry. We recognized that organic electroluminescent (EL) material would be a promising candidate for making such a flexible display, and have been trying to improve the flexibility of devices using it as their active media.

Our ongoing research features a polymer material that can be incorporated in a flexible display and that emits highly efficient light. We are also studying the optimization of the display's structure. As an emitting material, we developed polymer that emits light through phosphorescence, and we anticipated that it would have even higher efficiencies than polymers that emit light through fluorescence. In fact, these phosphorescent polymers currently have the highest luminous efficiency in the world. We fabricated a prototype 3.6-inch flexible color organic EL display by depositing a white organic EL layer using this phosphorescent polymer and color filters over a plastic film substrate, through which moving pictures could be displayed.

As for the TFT driver required for high-quality picture displays, we obtained an organic TFT with a high mobility equivalent to that of amorphous silicon. Another development is the successful fabrication of a prototype organic TFT-driven organic EL panel, which had been difficult to fabricate until now. For this, we applied our newly developed gate insulator to the organic TFT device. The TFT was used to actively drive a 4×4 panel for the first time in the world. These accomplishments are steadily making a bendable active drive organic EL display more of a possibility.

Future work will involve further improvements to the luminous efficiency and lifetime of the organic EL display, together with the fabrication of a prototype active-drive organic EL display based on plastic film.