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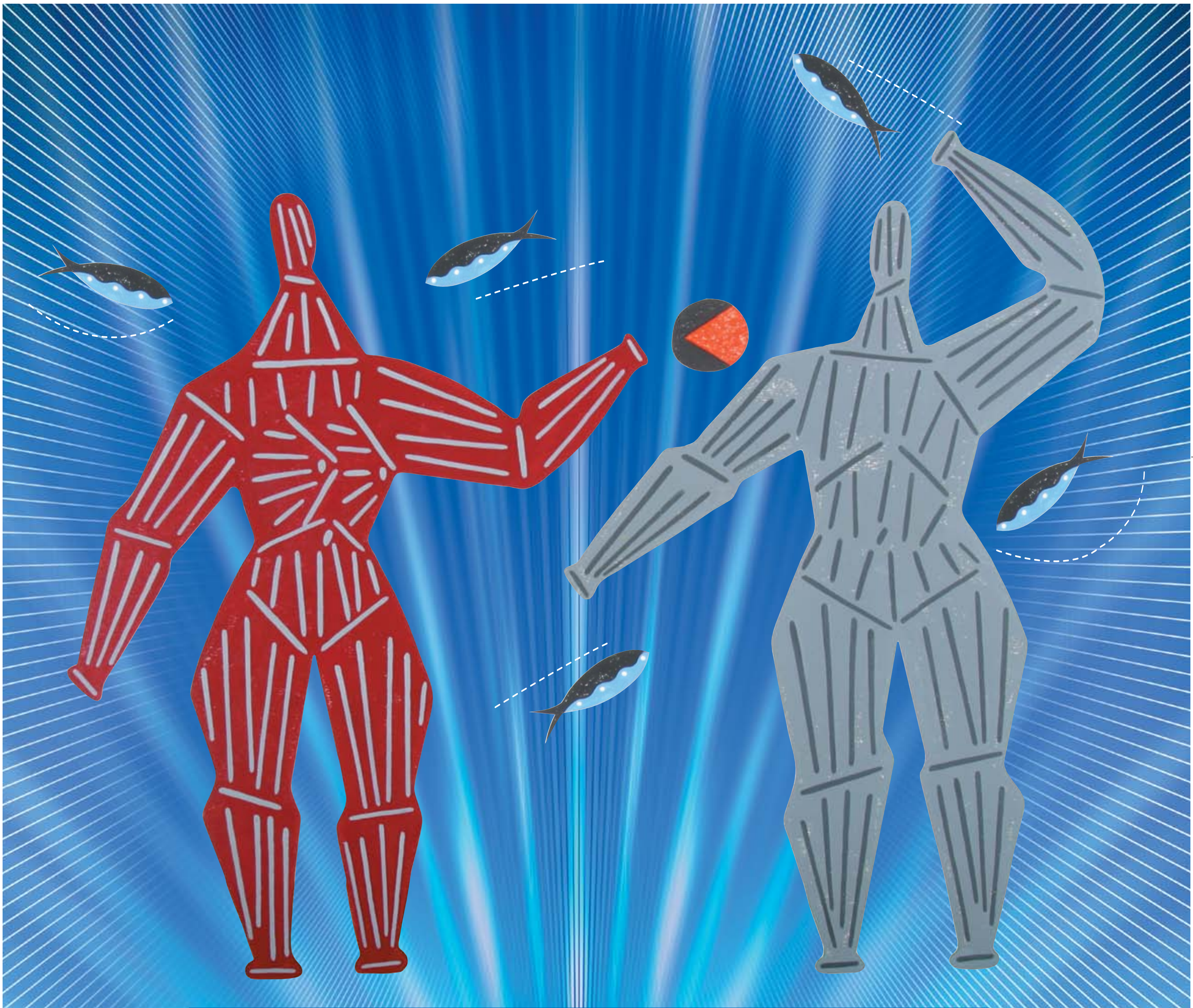

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Toward Higher-Definition Video Service

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Joined the CRL (currently the NICT) in April 1989 to engage in research on mobile satellite communications using the Engineering Test Satellite V (ETSV) at CRL Kashima Space Research Center (currently NICT Kashima Space Research Center). Later, temporarily transferred to National Institution of Multimedia Education (NIME) to engage in design of an intercollegiate satellite communication network, the SCS (Space Collaboration System). After returning to the CRL, engaged in design of R&D gigabit network (JGN) and development of applications using super-high-definition video. Received Eng. D. degree.

On May 31, the inaugural meeting of the "Digital Cinema Technology Forum" (Chairman: Tomonori Aoyama, Professor, University of Tokyo; Secretariat: Support Center for Advanced Telecommunications Technology Research) took place. Approximately 70 people participated, drawn from the Ministry of Internal Affairs and Communications, the NICT, the NPO Digital Cinema Consortium of Japan (DCCJ), and various companies dealing in film and video technologies.

The objectives of the council are as follows:

- In view of the rapid advance of information-communication networks, to establish technology focusing on ultra-high-capacity digital cinema as primary content for network distribution
- To carry out experiments to establish distribution, quality-evaluation, and security technologies for 4K Digital Cinema standards (see Figure 1) by combining the strengths of all parties dealing in production, distribution, and exhibition
- To promote international expansion and to contribute to international standardization in collaboration with the relevant organizations in Europe and the US

Inaugural Meeting
(courtesy of DCCJ)

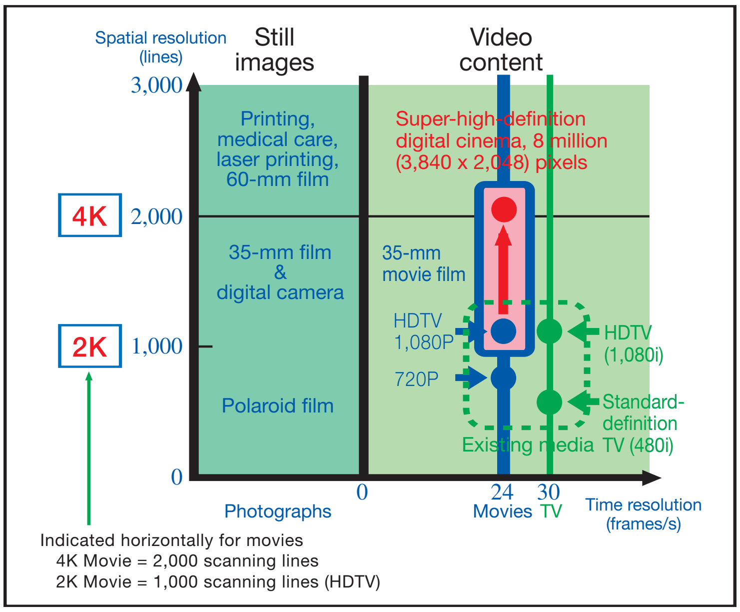


Figure 1: Video Format (courtesy of Tomonori Aoyama, DCCJ)

Since the start of monochrome broadcasting, television has passed a number of major milestones, from color to satellite to high-definition and digital broadcasting. Similarly, the movie industry has witnessed a number of major turning points: silent movies gave way to those with recorded sound, then color film emerged, followed by three-dimensional images and digitization (with high-definition 2K Digital Cinema). Progress is now underway in the development of new technologies for higher-definition video service, which may well mark a new breakthrough for the industry.

Aiming at the creation of a true virtual space using super-high-definition video, the NICT has conducted joint research in super-high-definition virtual reality communications technology in collaboration with

Victor Company of Japan. As a result of these efforts, we have developed a display device (the projector shown in Figure 2) and a camera (shown in Figure 3) that provide four times the resolution of HDTV (3,840 horizontal x 2,048 vertical, for 8 million pixels), as detailed in our press releases of June 5, 2001 and April 15, 2003. In addition, other domestic research institutions are currently developing a number of cutting-edge 4K Digital Cinema and super-high-definition (on the order of 4,000 lines) video systems.

Figure 2: Super-high-definition Video Projector (3,840 x 2,048 pixels)

Figure 3: Super-high-definition (8 million pixels) CMOS Video Camera

The DCCJ has been conducting worldwide demonstration and evaluation experiments on 4K Digital Cinema. The DCI (Digital Cinema Initiative, formed by the seven major Hollywood studios), the de facto authority establishing global standards in this field is considering the formulation of specifications focusing on 4K Digital Cinema. They are scheduled to finalize a new set of digital cinema standards by the end of this year at the latest. The main specifications will most likely be as follows:

- Format 4,096 (H) x 2,160 (V) pixels
- Color space XYZ 12 bits
- Frame rate 24 frames/s
- Compression system JPEG2000

To promote the widespread adoption of 4K Digital Cinema as a member of the Digital Cinema Technology Forum, the NICT plans to develop a prototype system for shooting, playing, and distributing films in conformity with the new specifications, and will perform transmission and evaluation experiments using JGN II, NICT's R&D test bed network.

Akasaka Natural Vision Research Center, NICT

R&D in Natural Vision (next-generation video display and transmission system)

Hiroyuki Fukuda

Akasaka Natural Vision Research Center, Collaborative Research Management Division

1987: Joined Olympus Corporation. Participated in the development of image-processing technologies and products such as digital cameras and code scanners.

2002: Temporarily transferred to Akasaka Natural Vision Research Center, TAO.

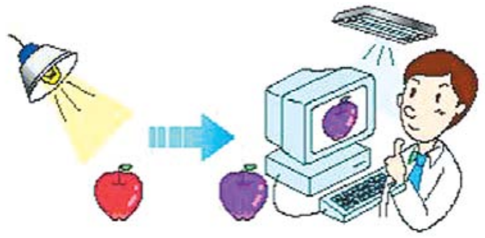
Currently engaged in R&D in multispectral-input technologies and applications.

1. Introduction

Thanks to the widespread accessibility of video devices in recent years, you can now easily preserve your memories at home with a videotape recorder or digital camera. However, when later viewing a recorded event, you may feel that the impression conveyed by the images is not what you had expected.

To address this problem, we are pursuing R&D in "Natural Vision," a video system that uses spectral information obtained by resolving light from the subject by wavelength, instead of the traditional reliance on a combination of three primary colors. To date we have studied video-input technology for obtaining spectra and have investigated technologies for distributing, displaying, saving, and analyzing this spectral information. At the same time, we have been working to develop practical applications for these technologies.

(a) Video reproduction to convey a sense of immediate presence



(b) Video reproduction to convey a dynamic sense of depth, as with an approaching object.

Figure 1: Concept of Faithful Reproduction

2. Overview of Natural Vision

Natural Vision is intended to reproduce colors faithfully based on the concept represented in Figure 1. As shown in (a), it is necessary to obtain color information as seen by the human eye. However, conventional cameras cannot distinguish among certain colors that people find readily distinguishable, as these video input devices are not analogous to the human eye. We are therefore working to create a mechanism that will accurately reproduce subject colors using video input that is based on spectral information. In addition, to reproduce colors in lighting environments that differ from those of shooting locations—as in the case of (b)—we are also working to develop a mechanism of color reproduction that can take into account the different light spectra of various environments.

Figure 2: Six-band HDTV Camera

Figure 3: Six-primary-color DLP Projector

3. Current Status of R&D

Basic technology

In terms of video collection technology, conventional cameras simply "take" videos. Despite structural similarities with traditional cameras, the camera we have designed is based on the concept of spectral measurement, on a pixel-by-pixel basis, of light reflected off of the subject. We are currently using a rotating filter-slot 16-band multispectrum camera and a six-band HDTV multispectrum video camera (Figure 2). These cameras enable the collection of spectral information from received image signals. We are using these devices to identify issues to be addressed—such as color reproducibility and image quality—as well as to formulate design guidelines for the development of cameras for various applications (medical care, catalog printing, digital archiving of art, etc.).

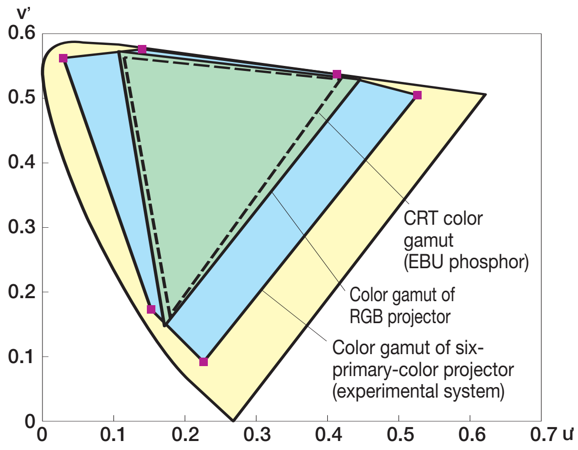


Figure 4: Expansion of Color Gamut Using Six-primary-color Display

This graph shows how the color gamut is expanded with a six-primary-color display. The horseshoe-shaped figure represents the range of colors visible to the human eye, and the polygons inside the figure represent the color ranges that can be displayed by the respective monitors or projectors. The larger the polygon, the more vivid the colors the monitor can display.

In terms of display technology, we used multi-primary color devices to develop a six-primary-color DLP projector (Figure 3). We achieved faithful color reproduction and demonstrated the effectiveness of using multiple primary colors to expand the range of color reproduction (Figure 4).

Demonstration experiments and application development

Based on the demand for and potential effectiveness of Natural Vision, we selected several promising application areas as candidates for demonstration experiments and application development. We are now conducting experiments and development in a number of these areas. For example:

- **Medical imaging**

On the medical front, we are conducting demonstration experiments using a multispectrum microscopic camera system and a multispectrum dermatological camera we developed for this purpose. The application of this microscopic camera system to pathology will enable standardization of sample staining assessment through digital determination of objective stain results, regardless of differences in staining methods among hospitals. By further enhancing this methodology, it may become possible to provide technological diagnostic support through quantification of pigment amounts. For applications in dermatology, we are conducting joint R&D with various medical institutions in the quantification of medical conditions using the multispectrum dermatological camera. We are optimistic about the range of practical applications.

Although all of the above-mentioned applications are based on still-image systems, we are also working on the development of medical uses for a video camera. For example, we are considering the application of such a system to emergency medical facilities, in which video could be transmitted to specialists at remote locations; the specialists would then issue instructions.

- **Digital archiving**

There is a growing demand for multispectrum cameras for use in video storage of items of cultural heritage. Storing video of the highest quality is essential in these cases, to provide sufficient information for researchers of the future, when technological advances will have rendered it possible to repair or analyze a number of historical objects. For example, the National Library of Mexico is focusing their efforts on the preservation of ancient pictographic documents that are invaluable in the study of Pre-Aztec history. The Library and NICT have already started cooperative multispectrum filming of these documents. We believe that there are a great number of such valuable objects both in Japan and throughout the world, so naturally we hope to contribute to the creation of similar archives in the future.

4. Conclusion

Since this project is intended to provide a bridge to practical use of Natural Vision, we would like to increase the extent of research cooperation with other organizations and to strengthen our efforts in the development of applications based on research results. We have conducted many demonstrations, since the difference between Natural Vision and video can only be fully comprehended if you see it for yourself. We will thus continue to encourage more people to experience this technology firsthand.

JGN Receives Award for Contribution to Industry-Academic-Government Collaboration (Minister of Internal Affairs and Communications Award)

The JGN (R&D gigabit network) won an award from the Minister of Internal Affairs and Communications at the 3rd Conference for Industry-Academic-Government Collaboration held at the Kyoto International Conference Hall on June 19 and 20, 2004. This award was given in recognition of the application of JGN by over 600 industrial, academic, and governmental institutions, and in honor of its contribution to leading-edge R&D and industrialization, the revitalization of local communities and the development of human resources. On this occasion JGN was the only winner of the Minister of Internal Affairs and Communications Award.

On the day of the awards ceremony, Mr. Tadao Saito, Professor Emeritus, University of Tokyo, delivered a speech entitled “Achievements of the R&D Gigabit Network (JGN)” in his role as project leader. He received a certificate and plaque from Masahiro Tabata, Vice-Minister for Internal Affairs and Communications.

At the NICT exhibition booth, we installed display panels to show an overview and the benefits of JGN and JGN II, and installed a monitor to display examples of R&D projects using JGN.

Awards Ceremony (Minister of Internal Affairs and Communications Award)

*Correction We apologize for a typographical error made on page 1 of the June issue: RESEACH should have been RESEARCH.

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