

Concept and Technology of Natural Vision System

Nagaaki Ohyama^{1,2}, Masahiro Yamaguchi^{1,3} and Hideaki Haneishi^{1,4}

¹Akasaka Natural Vision Research Center

National Institute of Information and Communication Technology (Japan)

²Frontier Collaborative Research Center, Tokyo Institute of Technology (Japan)

³Imaging Science and Engineering Laboratory, Tokyo Institute of Technology (Japan)

⁴Department of Information and Image Sciences, Chiba University (Japan)

Abstract

Natural Vision (NV) system has been developed since 1999 as a Japan's national project managed under TAO (Telecommunication and Advancement Organization of Japan), which was reorganized into NICT (National Institute of Information and Communication Center) from April, 2004. As NV can reproduce images with exactly the same color when we see with our naked eyes and also simulate how objects look under different illumination when objects are recorded by a multi-spectral camera, NV is expected to contribute a lot to EC, telemedicine, digital museum, etc. These applications are usually using color images and require an accurate color reproduction. However, the conventional system hardly reproduces exact color, because attention has been mainly paid on showing color images more beautifully rather than accurately. In other words, we may say that NV physically measures the color of objects, while the conventional one provides only colored images. In order to meet these requirements a national R and D project named NV has started in 1999 and has successfully shown its effectiveness.

NV is an advanced color imaging system consisting of image capture, processing, archive, transmission, display and recognition, and deals with N ($N > 2$) primary colors depending upon application requirements. As N increases, the accuracy of the color reproduction becomes higher on one hand, but the system becomes more complicated on the other hand. The low grade of the image acquisition device is the calibrated RGB based system such as a digital camera

and the high level device is the multi-channel camera, which enables us to estimate the object reflectance function with information about the illumination light. And once we know the spectral reflectance function of the objects, we can change the illumination through a computer processing and show them on the well calibrated displays.

Display device also has several grades. The low grade is the conventional three color display with calibration. As is well known, three primary colors of a conventional display form a color triangle and colors within the triangle could be reproduced accurately by using NV technology. Colors outside the triangle, however, cannot be reproduced by the conventional display, unless we use more saturated primary colors with enough brightness. In order to expand the color gamut, 4 primary color LCD display and 6 primary color projector are experimentally developed in the NV project. The expanded gamut as well as the accurate reproduction of the images is highly appreciated especially in the computer graphics.

The history of the broadcast tells us that it began with monochrome, color and HD (High Definition) and that it recently moved into digital broadcast. This technological revolution suggests that NV could be a next generation key technology in both broadcast and internet fields. In this point of view NV format and technologies have to be well popularized in the market and accepted as international standards. Since NV has potential possibilities to be applied to and contribute a lot to many applications, much more efforts on basic research and development should be made. Researchers are very welcome to share the NV concepts.