Multispectral Imaging: Past, Present and Future

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In general, the quality of an image is determined by sharpness, tone reproduction characteristics, color reproduction, graininess, texture, gross, distortion and so on. We consider here the color reproduction characteristics of the object. Color reproduction of the object is dependent on many factors such as spectral characteristics of taking and viewing illuminants and spectral characteristics of imaging systems. Therefore it is important to measure the reflectance spectra of the object, which are specific character of the object for designing of the imaging devices. In 1988, we have developed a new spectrophotometer[1] for measuring the spectral reflectance of the gastric mucous membrane cooperated with Olympus Optical co. ltd.

Many spectra of gastric mucous membrane were measured by a developed Endoscopic spectrophotometer. Measured spectral reflectance of membrane has been analyzed by the principal component analysis and the results indicated that the reflectance spectra could be adequately described using only three principal components. We showed that the reflectance spectra of skin could be also described by three principal components[2]. Based on these experimental results, we showed that the reflectance spectra of all pixels in gastric mucous membrane and skin could be calculated from the R, G, B signals taken by Electronic Endoscopes and CCD camera. Then it became possible to do computer simulation for improvement of color reproduction in various kinds of imaging systems, for example optimization of spectral transmittance of separation filter and estimation of color reproduction in different illuminant and viewing conditions. Figure 1 shows the simulated of color reproduction of polyp image under 18 kinds of illuminants.

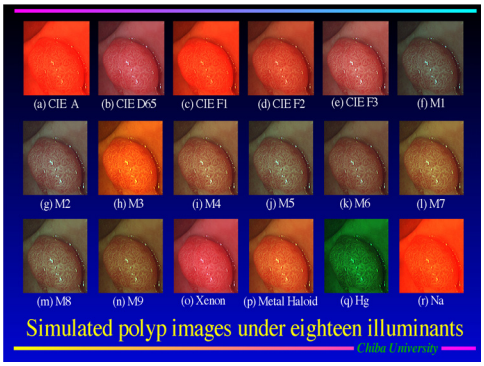

Figure 1: Simulated of color reproduction of polyp image under 18 kinds of illuminants.

On the other hand, color management has been required for device independent color reproduction and color transformation between different imaging systems for the last decade. Therefore, the importance of recording, reproduction and theory of reflectance spectra of the object instead of colorimetric theory based on the tri-stimulus value was recognized in recent year by many scientists. In our laboratories, we have developed multiband camera[3,4] to record the reflectance spectra of art paints based on the principal component analysis and Wiener estimation method in 1997 cooperated with Mitsubishi Electric co. and Mitsubishi Microcomputer Software co.. The camera is consisted of single chip CCD with rotating color wheel comprising five filters. This camera was significantly applied to record digital archives and fundamental research on spectral imaging.

We have also developed gonio-spectral imaging systems[5] for recording the spectral and shape information of three-dimensional object simultaneously supported by IPA(Information Promotion Agency, Japan). Figure 2 shows schematic diagram of developed goniospectral imaging systems and Figure 3 shows three dimensional image with shape and reflectance spectral of the object.

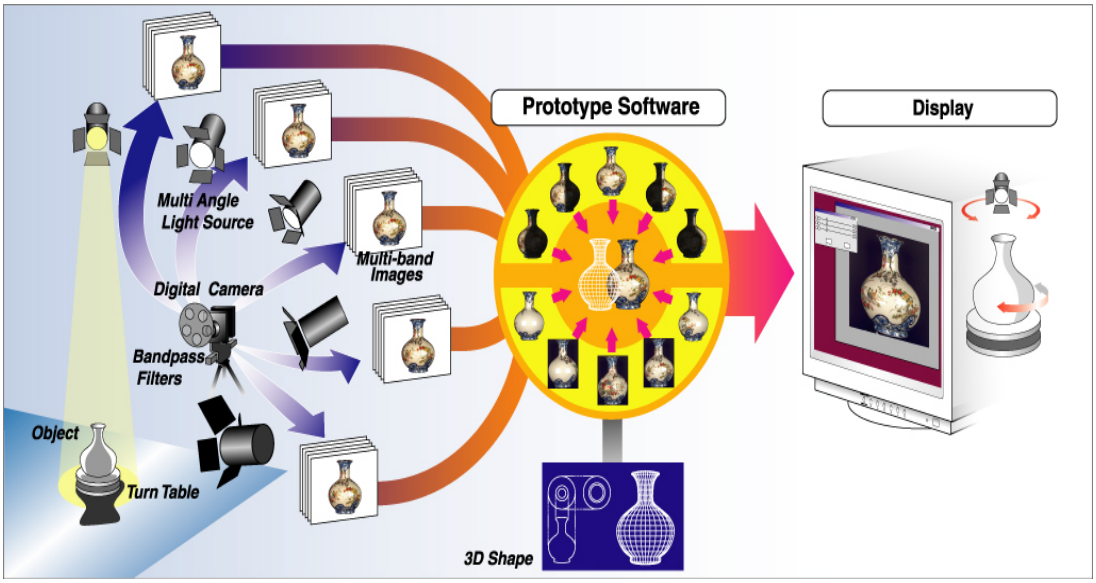

Figure 2: Developed Goniospectral imaging systems

In 1999, I organized the first international conference on multispctral imaging in Chiba University. From this year, we had the International Conference on Multispectral Imaging (MSI) every year as (2nd MSI 2000, Chiba University, Japan), (3rd MSI, 2001 University of Joensuu, Finland), (4th MSI 2002, Tokyo, Japan), (5th MSI 2003, Rochester, USA), (6th MSI 2004, Aachen, Germany), (7th MSI 2005, Granada, Spain),and (8th MSI 2006 is planning to be held in San Jose, USA).

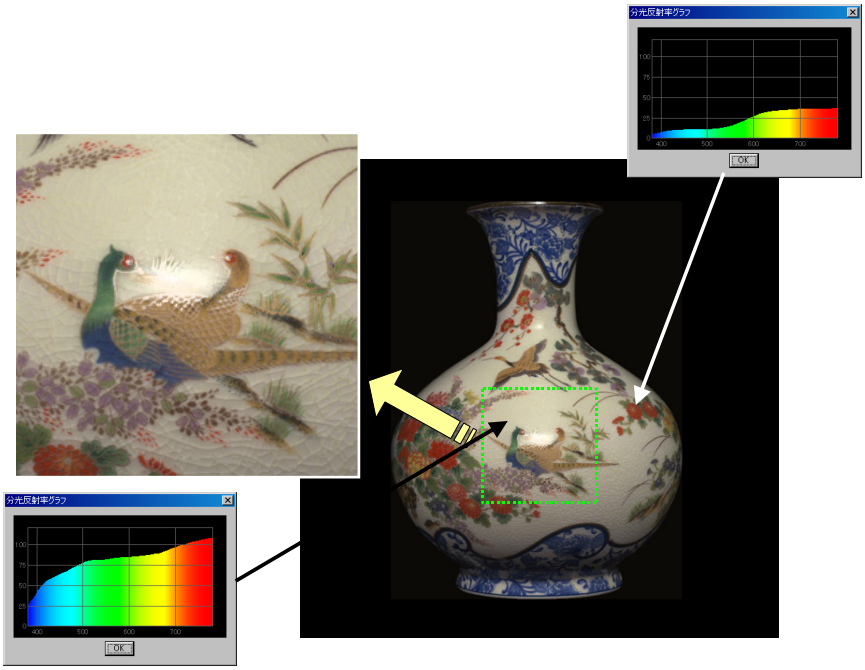

Figure 3: Three dimensional object with shape and spectral information.

I believe that the spectral imaging has many capabilities and applications to science, technologies and industries. I hope that many young scientists are involved the research of multispectral imaging.

References

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