A System for Analyzing Color Information with the Multi-spectral Image and its Application

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ABSTRACT

With the development of multi-spectral cameras, it has become easier to take a multi-spectral image of ordinary scene. This means that the information from a multi-spectral camera would be a strong tool to obtain and analyze the color information of various environments. However, it is complicated to extract color information from raw spectral distribution data in a multi-spectral image since a precise color calibration and the calculations of colorimetric values such as chromaticity coordinates are required.

We have constructed a system which can analyze color data from spectral data taken by a multi-spectral camera. First, ununiform intensities and the shape of spectral distributions in an image due to the sensitivity of each sensor in a camera were calibrated based on a uniform reference light through integrating sphere. Then the CIE1931 XYZ were calculated using the obtained precise spectral distributions and the color-matching function. It is also possible to transfer to the other chromaticity values such as the CIELAB and LMS cone responses. With this system, we can analyze color statistics (e.g. average color and color distribution) of an image, and also can convert the multi-spectral image to a RGB image

As an example of application, we compared those color information and spectral distribution to analyze and simulate the color appearance of normal color vision, dichromat and anomalous trichromat. We took multi-spectral images of traffic signals with new LED and old type lamps. The CIE1931 xy chromaticity coordinates of red, green and yellow traffic lamps were calculated from the multi-spectral images. We also simulated the different degrees of color deficiency by shifting L or M cone spectral sensitivity based on a model proposed by Yaguchi et al. (ICVS2013) and reproduced the simulated RGB images of color deficiencies. We examined simulated chromaticity coordinates of old and new traffic signals. The results show that the simulated chromaticity coordinates of dichromat and anomalous trichromat are different from normal color vision for both old and new traffic signal in the case of red and blue signals. In the case of yellow, however, the simulated chromaticity coordinates of dichromat and anomalous trichromat is very different from normal color vision for the new traffic signal, while there is no difference for the old one. With those simulated images it is easy to see the difference of the normal color vision and color deficiencies. This type of analysis with this system would be important for color vision research and color universal design. It is suggested that our system contributes to study and analyze various environments using multi-spectral images and their data.