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Promising Applications of Multispectral Imaging in Laboratory Medicine

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Introduction

Multispectral imaging, which can capture, record and reproduce spectral reflectance of objects, is a new and hot imaging technology in the color engineering field. Through research collaboration between engineering and laboratory medicine, two models emerge as promising approaches; spectral color pictures, which include spectral reflectance information for each pixel, and absolute appearance pictures, which provide a highly accurate reproduction of real objects and are never affected by devices or illumination conditions.

Spectral Color Pictures

If spectral reflectance of a lesion is recorded, new morphological diagnostic methods more powerful than human visual perception alone will be developed. For example, a specific range of wavelengths can be adaptively enhanced to reveal previously undetectable medical findings.

As concerns skin and mucosa, a current digital camera with three color channels will be used for estimating spectral reflectance (Fig. 1) , with which the amount of melanin, hemoglobin and oxyhemoglobin, will be analyzed.

Absolute Appearance Pictures

Although factors affecting appearance other than color are left behind, a spectral color picture will be an ideal solution for color reproduction because its color appearance under any illumination is calculated (Fig. 2).

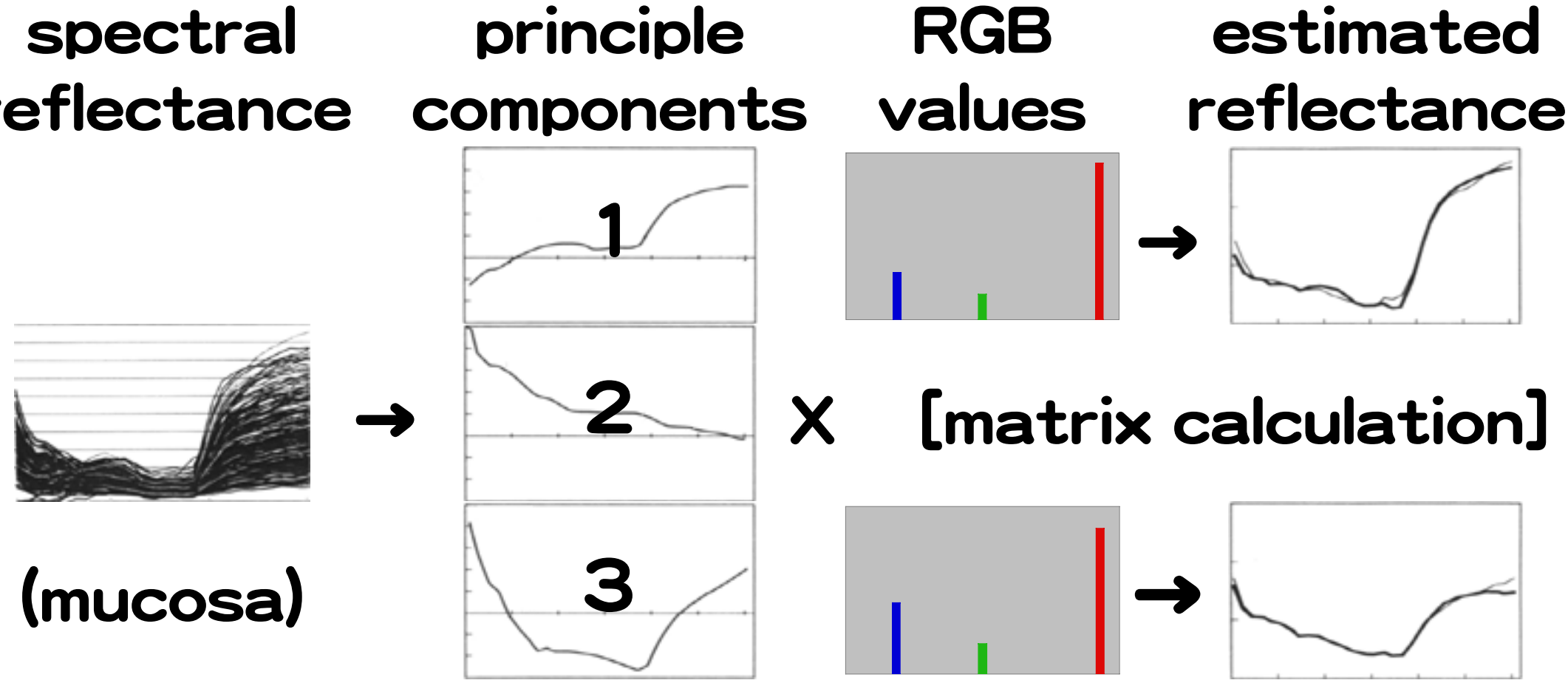
As concerns skin and mucosa, a spectral color picture can be taken using a three-band digital camera as mentioned before, and its color appearance can be reproduced using a current three-band display thanks to the characteristics of three kinds of human cone cells (Fig. 3).

How to Approach Them

Because spectral color pictures are completely new in medicine, demand for them will initially be very low. Most applications will require a lot of further investigation forcing a large investment but will provide significant improvements in diagnostic ability in limited clinical situations.

Inconsistency of color appearance caused by devices and illumination becomes common in medical imaging. Therefore, absolute appearance pictures will provide practical and general improvements in medicine at relatively low cost.

Figure 1 Estimation of Spectral Reflectance



【source】 Yoichi Miyake : Analysis and Evaluation in Digital Color Imaging, University of Tokyo Press, 2000.

Figure 2 Calculation of Color Appearance under Different Illumination

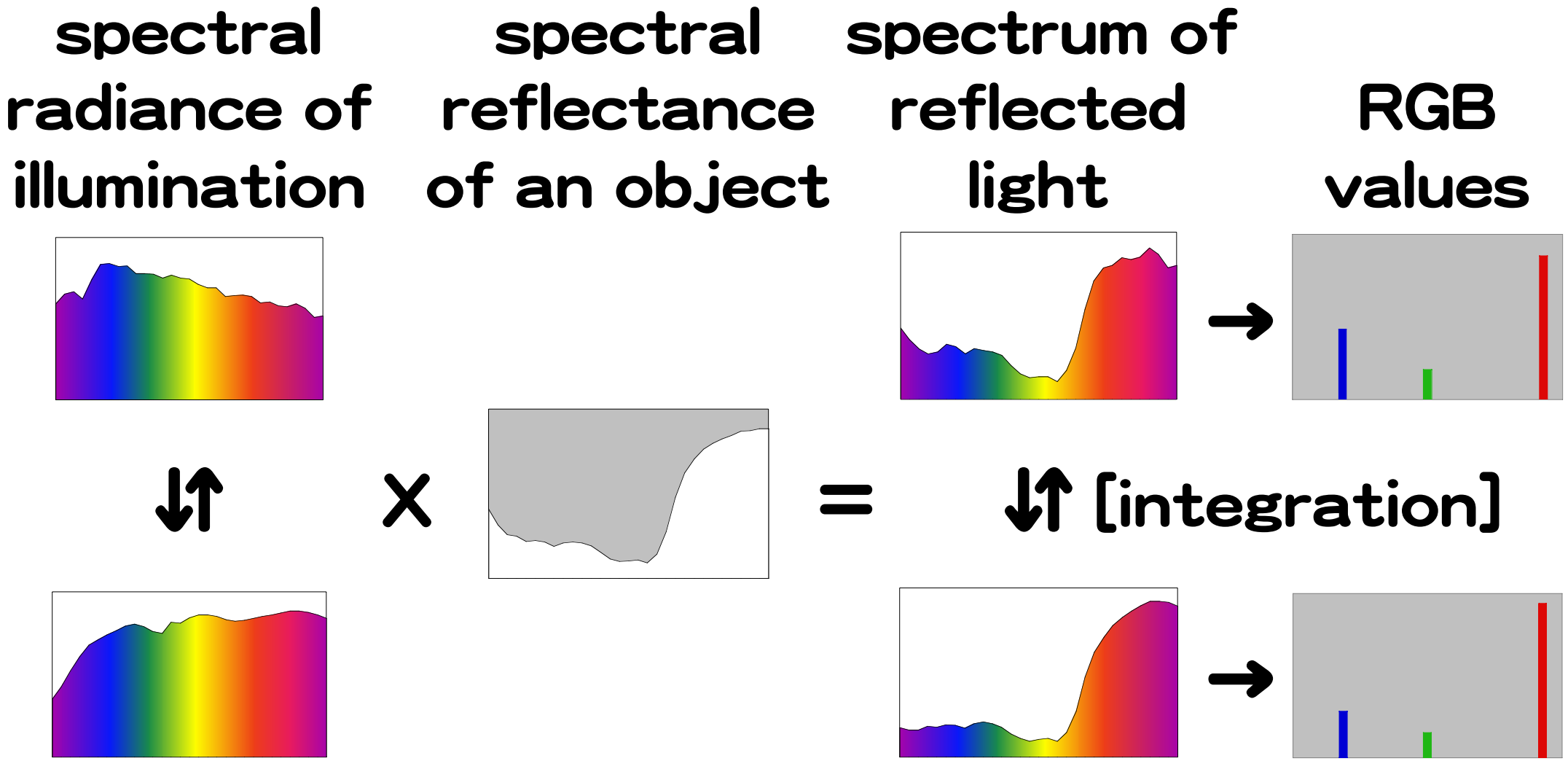
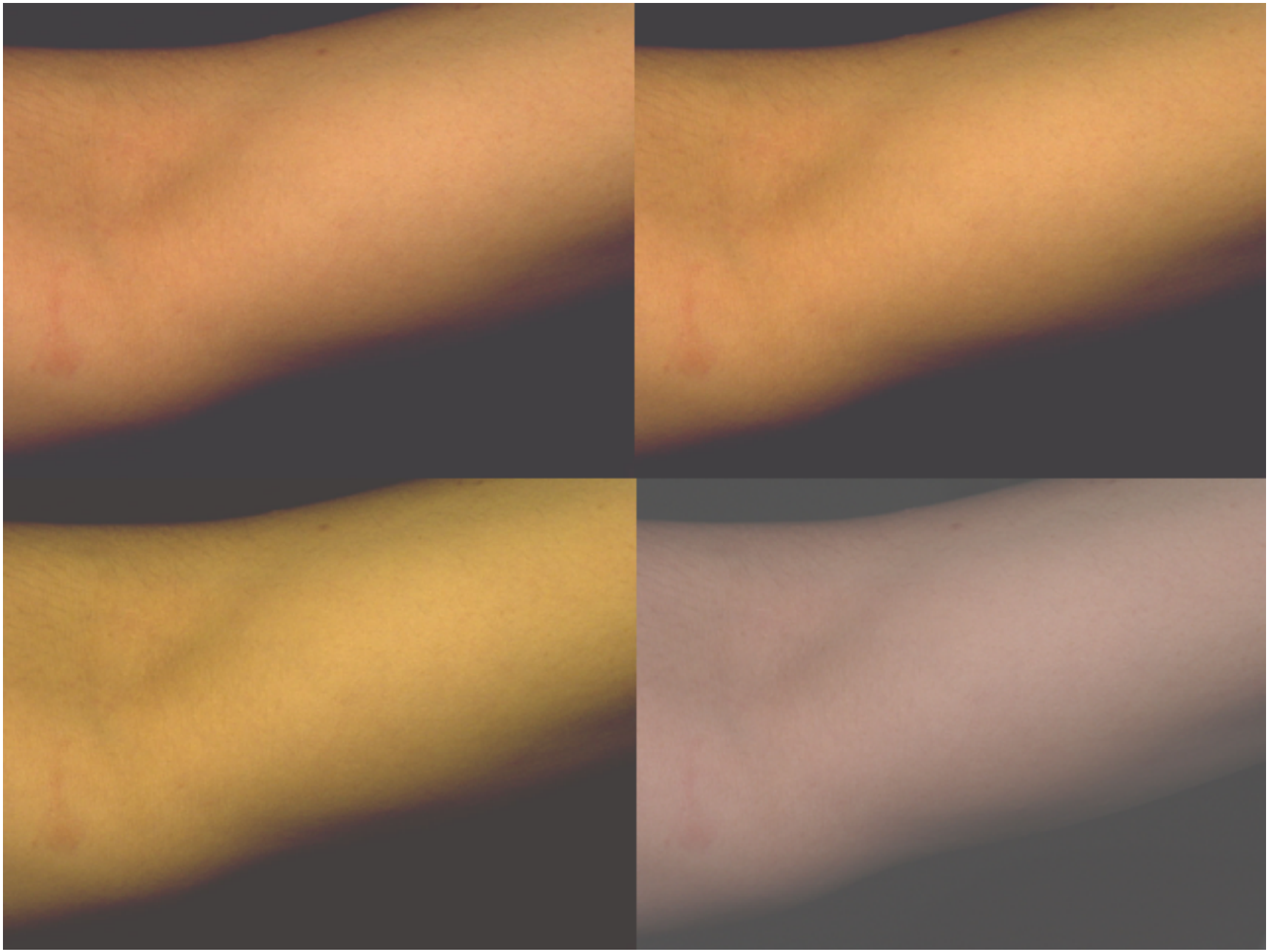


Figure 3 Simulated Color Appearance



A flash photography of a cubital fossa with an erythematous wheal on it was taken using a digital camera. The lower right picture shows color reproduced by an ordinary color processing method installed in the camera. The lower left, upper right and upper left pictures show color appearance when the arm is illuminated by a classical fluorescent lamp, a neutral white fluorescent lamp and day light each, which were calculated using spectral reflectance estimated from RGB values of the picture. Needless to say, neither these printed colors are exact ones nor the photographed real arm is available here, but you will see large differences among them.