

Watch the Pitfalls in Medical Application of Multispectral Color Imaging

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1. Introduction

Recently, a large potential risk of erroneous diagnoses caused by inaccurately reproduced colors has been left behind with the rapidly spread of digital imaging in medicine. Important questions are why medical practitioners who must be most nervous about erroneous diagnosis do not seem to mind inaccurate color reproduction, and why specialists of medical imaging seem to have little interest in multispectral imaging technology.

Our recent experience of collaborative studies with researchers from various medical sub-fields and from the color-engineering field has revealed the very answer. That is, most of them have rational but over-simplified color conceptions based on their medical knowledge, which could trap many of them into thought pitfalls. Furthermore, this situation contains other pitfalls forcing some specialists of color science unduly underestimate the infinite potential of multispectral imaging in medicine.

In this paper, these pitfalls are pointed out and the way to eliminate them is proposed to promote further research activities in this area.

2. Pitfalls in the Medical Territory

‘The three primary colors can reproduce every color because we have only three kinds of cone cells.’ --> In reality, because spectral sensitivity characteristic curves of three kinds of cone cells overlap with each other RGB values calculated by color matching functions for some light wavelengths become negative numbers and they actually cannot be displayed.

‘Because spectral sensitivity characteristic curves of cone cells spread over a wide range of light wavelengths, improvement of color accuracy will have only a small effect.’ --> Human visual recognition of vital information must be highly developed by means of real-time combined analysis of various kinds of signals. Therefore, reproduction of accurate color reflectance may have a serious effect.

‘Complete color reproduction is impossible because no display equipment is free from physical limitations.’ --> Because we have only three kinds of cone cells, colorimetric color reproduction using three primary colors may reproduce a considerable range of visible colors very precisely.

‘It is not realistic to replace present infrastructures based on the RGB color system.’ --> If estimation of

spectral reflectance based on three principal components will succeed in making a sufficiently good approximation, color data acquired by present imaging devices that have three channels may be also used for estimation of spectral reflectance. Further, present display devices that have three channels may well reproduce tristimulus values of the original spectral reflectance, if they are properly calibrated.

3. Pitfalls in the Engineering Territory

‘There does not seem to be any serious requests for color accuracy from most of medical professionals, therefore need for accurate color representation is considered to be little.’ --> For example, there is a huge demand for recording precise images of skin lesions, but most dermatologists fall into the aforementioned pitfalls and fail to pursue any technological solution.

‘Quality required for medical imaging is so high that any technology would not satisfy medical professionals.’ --> Very high quality is not required in all cases. Required quality depends greatly on medical findings that should be detected in each case and that quality has a large variation among the key findings of each case. In general, small numbers of diseases have high frequencies and there are a large number of rare diseases. Therefore, an imaging technology should be selectively applied to cases that have high frequencies and the quality of diagnostic imaging required for them may be achieved by the technology.

4. Conclusion

To promote substantial studies in this area and to eventually benefit many people who are suffering from painful diseases, we should have plain and clear evidence that plugs the abovementioned pitfalls.

One of key products to show the evidence to medical practitioners is a computer program that simulates a hypothesis mentioned in the explanations of the forth pitfall in the medical territory. Anyone interested in this software is invited to join its development project.

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