Standardization of Multispectral Image Formats

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ABSTRACT

Increasing use of multispectral images has also raised a question about need of standard multispectral image format. At the moment, a technical committee of the CIE Division 8, TC8-07 of Multispectral Imaging, is working in order to define a general data format for storing multispectral images. This paper describes the standardization work done so far and the current state of the standardization process. Image formats and test software considered during the process are also presented. The standardization process is still at its early stage, so the future work is discussed at the end of this paper.

1. INTRODUCTION

Multispectral images are used in various applications. For example, remote sensing, astronomy, medical imaging, computer graphics and high-quality color printing take the advantage of multispectral imaging. Despite the similar research interests, data exchange between multispectral image researchers is not very common. One big reason for that might be problems with data compatibility, because almost all research groups have their own format for storing multispectral data. At the moment, a technical committee of the CIE Division 8, TC8-07 of Multispectral Imaging, is working in order to define a general data format for storing multispectral images. TC8-07 members have collected up characteristics of multispectral image formats and other image formats that could be suitable for storing multispectral images. There has also been some discussion about the general requirements of multispectral image standard and a couple of implementations for testing different image formats have been presented by TC members.

2. CONSIDERED IMAGE FORMATS

Various multispectral image formats have already been developed for different purposes, and also existing image formats have been or are planned to be modified in order to store multispectral image data. For different applications, different metadata for interpreting the multispectral values are needed. Metadata can, for example, include information about geographical location, color matching functions or properties of measuring equipment.

The following image formats have been brought under committee observation by TC8-07 members. MUSP and Natural Vision formats are initially designed for storing multispectral images. HDF5 is a file format for storing practically any kind of scientific data. JPEG2000 and TIFF are meant originally for storing “traditional” digital images, but with some modifications they could also be used for storing multispectral images. GeoTIFF is a TIFF extension that enables storing geographic information.

MUSP Multispectral Image File Format[1] is a multispectral image format developed by Color AIXperts GmbH, Aachen, Germany. It is in use in industrial applications like e-mail communication and color transfer.

The *Natural Vision data file format* specification[2] is a part of the file format for multispectral imaging used in the Natural Vision project. Natural Vision project was established 1999 by

Telecommunications Advancement Organization of Japan (TAO) (at present known as National Institute of Information and Communications Technology). The file format specification is developed for the purpose of exchanging image data in research and development of multispectral imaging technology. Current version of the Natural Vision specification is 2.0s, that is part of the original Natural Vision data format. The original Natural Vision format specifies both image and color profile data formats, where the profile data is attached to the image file. In the current version only the profile format is given, and the profile data can be attached to any type of image file format where multichannel image data is appropriately expressed. Because only the profile format is defined at the moment, many properties of spectral images depend also on the used image format.

HDF5[3] is a general purpose library and file format for storing scientific data. There doesn't exist yet any standard definition for storing multispectral images in HDF5 format. Unlike HDF5's predecessor *HDF*[4], HDF5 does not limit the size of files or the size or number of objects in a file.

The rest of the formats presented in this chapter are originally designed for storing traditional digital images like RGB. However, the definitions of the following formats are flexible enough so they could possibly be extended also for multispectral image storage.

JPEG2000[5] is the most recent addition to a family of international standards developed by the Joint Photographic Experts Group (JPEG). The original JPEG image compression standard has found wide acceptance in diverse application areas, including the Internet, digital cameras, and printing and scanning peripherals. The JPEG2000 standard is intended as the successor to JPEG in many of its application areas.

TIFF[6] is a tag-based file format for storing and interchanging raster images. TIFF remains limited in cartographic applications, therefore the *GeoTIFF* specification[7] defines a set of TIFF tags provided to describe all cartographic information associated with TIFF imagery that originates from different geographical sources.

3. SAMPLE IMAGES AND SOFTWARE

Some multispectral sample images have been collected under Joensuu Color Group WWW-pages. One very simple image format created for testing purposes is *Spectral Binary Format* (SPB). SPB includes only basic information, wavelength values and image dimensions, about spectral image. In SPB-format, above-mentioned information is stored to file with reflectance spectra in binary format. In this format, word spectral is used instead of multispectral. The idea of this emphasis is to clarify that spectral imaging focuses on extended range of visible light.

There is also a graphical user interface implementation for visualizing and testing different multispectral image formats available in Joensuu Color Group's Matlab Toolbox. Implemented program is compatible with Matlab versions 6.5 and 7.0. With this program called Spectra Viewer, it is possible to examine individual reflectance and radiance spectra, RGB presentation of spectral images and xyY & L*a*b* color coordinates (figures 1 and 2). All these properties can be examined under different standard and hand-defined light sources. Spectra Viewer reads and writes MUSP files (file extension *.aix*), HDF files (*.tc8*) (write and read routines and simple spectral file format for HDF are implemented by Bui & Lenz, University of Linköping), simple binary spectral image files (*.sbp*), and Matlab files (*.mat*). It also reads Natural Vision files (*.nv2*).

Multispectral sample images are available at
http://spectral.joensuu.fi/ (see Joensuu Spectral Image Database)
and software for testing images can be found from
http://soho.joensuu.fi/colorlab_toolbox/ (see folder multiviewer).
Both images and software can be freely used for scientific, non-commercial purposes.

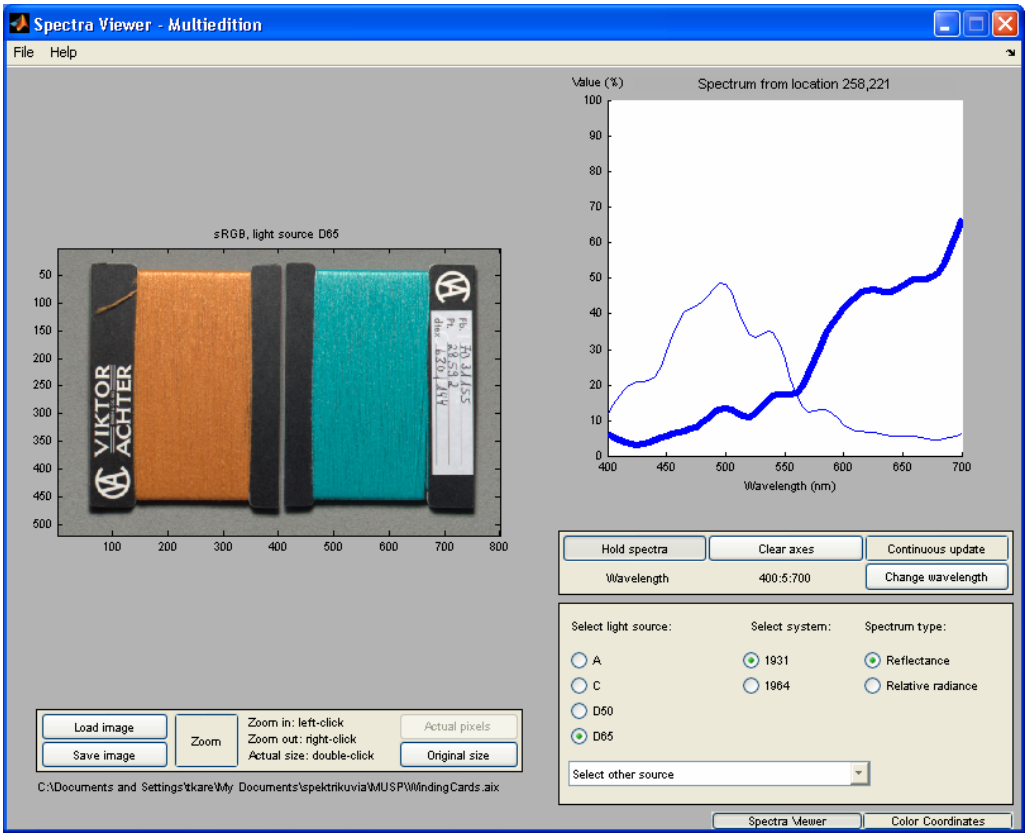

Figure 1: Screenshot from Spectra Viewer – sRGB presentation and two spectra of multispectral image in MUSP format.

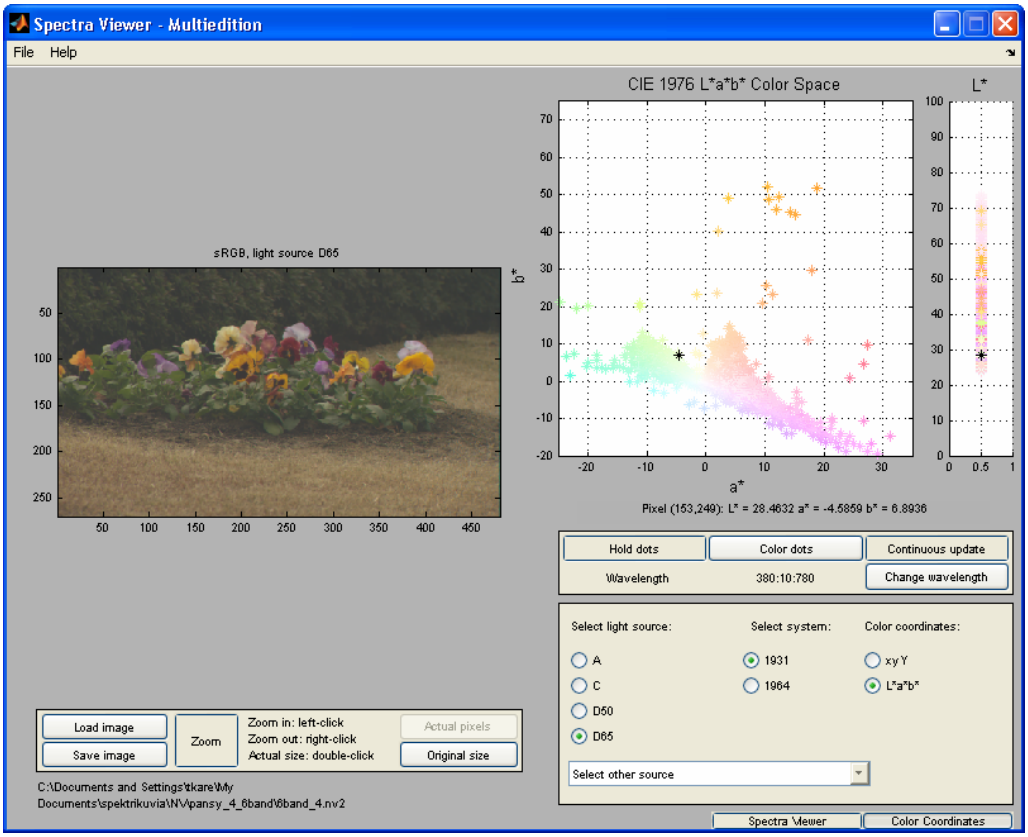

Figure 2: Screenshot from Spectra Viewer – sRGB presentation and sample L*a*b* color coordinates of multispectral image in Natural Vision format.

4. CONCLUSIONS AND FUTURE WORK

It is clear, that needs of research groups are very diverging and it's hard to define a standard that would satisfy needs of all research groups. On one hand, a simple format for storing very basic information about multispectral images is enough. On the other hand, there's also need for attaching very detailed information to images. Standardization is still in a quite early stage and there's a lot of work to do.

TC8-07 members have collected up characteristics of multispectral image formats (MUSP, Natural Vision) and other image formats (JPEG2000, TIFF/GeoTIFF, HDF5) that could be suitable for storing multispectral images. Based on these characteristics, there's priorization of file format requirements going on among the TC8-07 members. In the standardization process, at first a standard format that includes basic multispectral image properties should be defined. After that it's possible to extend format definition for diverging needs of research groups.

References

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