Sneaking Scientific Validity into Imaging Tools for the Masses

Roy S. Berns
Munsell Color Science Laboratory, Rochester Institute of Technology
Rochester, New York
e-mail: berns@cis.rit.edu

Abstract

Consider how imaging is used commonly by various professionals. Photographers are just as likely to use a digital camera as one loaded with film. Although they expect the images to look different, they may not know why they do. If they want them to match, they probably don't know how, or they won't know why they might never exactly match. A graphic designer works with direct-capture digital-image data, scanned photography, and synthetically rendered imagery. (The same is true for a movie editor.) In the long run, it is not cost effective to visually edit each image iteratively until they appear to originate from a single imaging device. A computer scientist may be expected to understand all computer peripherals, including digital-imaging devices such as scanners, displays, and printers. They may need to deal with setting up the color preferences in Photoshop, creating ICC color profiles, and using various hardware and software to achieve acceptable color quality. A librarian is expected to handle digital image archives as seamlessly as a collection of books. An art historian viewing a downloaded image from a museum website (or any image database) assumes that their perceptions are similar to viewing the actual work of art. An archivist is expected to digitize photographic reproductions such that the digital archive is an accurate color reproduction of the original work of art. Professionals dealing with digital imaging are suddenly expected to have the expertise of knowledgeable color imaging scientists and engineers. (Many of these professionals may not even realize that there is such a thing as an imaging or color scientist.) These practices, assumptions, and expectations are real. Are they realistic? Are they achievable? To a large extent, they are realistic and achievable by treating imaging as an analytical tool, a scientific tool. How can typical imaging practices become scientific imaging practices? This is the subject of this keynote address. The following will be discussed: Education in imaging and color science, Review of the human visual system, Input device spectral sensitivity, bits and encoding, color management, image quality metrics, characterization and calibration targets, multi-channel visible spectrum imaging, metadata, and standards.

Introduction

Consider how imaging is used commonly by various professionals:

The photographer: they are just as likely to use a digital camera as one loaded with film. Although they expect the images to look different, they may not know why they do. If they want them to match, they probably don't know how, or they won't know why they might never exactly match.

The graphic designer or movie editor: they work with direct-capture digital-image data, scanned photography, and synthetically rendered imagery. In the long run, it is not cost effective to visually edit each image iteratively until they appear to originate from a single imaging device.

The computer scientist: they may be expected to understand all computer peripherals, including digital-imaging devices such as scanners, displays, and printers. They may need to deal with setting up the color preferences in Photoshop, creating ICC color profiles, and using various hardware and software to achieve acceptable color quality.

The librarian: they are expected to handle digital image archives as seamlessly as a collection of books.

The art historian: they view downloaded images from a museum website (or any image database) and assume that their perceptions are similar to viewing the actual work of art.

The archivist: they are expected to digitize photographic reproductions such that the digital archive is an accurate color reproduction of the original work of art.

Professionals dealing with digital imaging are suddenly expected to have the expertise of knowledgeable color imaging scientists and engineers. (Many of these professionals may not even realize that there is such a thing as an imaging or color scientist.)

These practices, assumptions, and expectations are real. Are they realistic? Are they achievable? To a large extent, they are realistic and achievable by treating imaging as an analytical tool, a scientific tool.

Perhaps an analogy is comparing an architect's conceptual rendering with a detailed set of plans. From the plans, one can create a conceptual rendering. The plans can be used to build a nearly identical facsimile at a different location. The reverse is not true; the rendering does not lead to a facsimile. The scientific image is equivalent to the detailed set of plans. Non-scientific images are equivalent to conceptual renderings.

How can typical imaging practices become scientific imaging practices? This is the subject of this keynote address. The following will be discussed:

- Education in imaging and color science,
- Review of the human visual system,
- Input device spectral sensitivity,
- Bits and encoding,
- Color management,
- Image quality metrics,
- Characterization and calibration targets,
- Multi-channel visible spectrum imaging,
- Metadata,
- and Standards.

Educational resources can be found on the author's website: www.cis.rit.edu/people/faculty/berns/.