International Color Consortium®

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The value of iccMAX

Introduction

iccMAX is a color management interchange format that addresses use cases beyond those addressed by the ICC v4 (ISO 15076-1) color management profile format. ICC v4 is widely used today in graphic arts workflows. For most of these workflows, v4 is straightforward to use and uniformly implemented across a large number of different software applications from different vendors. ICC v4 has enabled users to get the same or very similar results when color managing files through multiple different workflows, especially for the graphic arts.

In other applications, however such as managing digital photographs or color managing packaging in store lighting conditions, v4 is missing some key features. iccMAX evolved from work within the ICC to extend the v4 profile format beyond the graphic arts. iccMAX workflows are intended to be backward-compatible with v4, which means that iccMAX-aware applications also have to be able to use v4 profiles.

This paper is addressed to end users of color management systems, and is intended to be used to decide when an iccMAX rather than ICC v4 is the appropriate choice.

When does v4 get used?

To a large extent, v4 has worked well for applications such as (but not limited to) the following:

i) Viewing of color-aligned reflective prints under D50-like illumination conditions

This is the main use case for which v4 profiles have been adopted in the graphic arts industry. Practical situations for such comparisons include proof-to-press color alignment as well as presswork color signoff, and is the primary application which comes to mind for most people when thinking of ICC v4 workflows – in other words, “make this look like that”. The goal here is to match the appearance of one print to the appearance of another one under the same viewing conditions by matching the colorimetry (typically L*a*b*) of one print to another. Presumably, when the colorimetry measurements are aligned, then the visual appearance is also aligned between the two prints.

ii) Specifying color separation

This is another common workflow use case. Technically, color separation as it applies to v4 profiles implies the conversion from Profile Connection Space (PCS) coordinates – device independent color, typically CIELAB L*a*b* - to device-dependent coordinates such as CMYK or CMYKOGV. Practically, this includes such activities as converting RGB images to CMYK images for the purposes of preparing these images for print output. Currently, v4 profiles are most commonly used for color separation to CMYK.

iii) Alignment of color appearance, soft proofing

This case is similar to #1, but because one of the images being compared is reflective while the other one is emissive (ie, a monitor), directly comparing L*a*b* colorimetry between the two has to be done with some caution, especially in measurement and calculation. Putting that aside, however, ICC v4 color management for the soft proofing case largely works in a similar manner as for reflective print color management.

Unfortunately, there are some challenges when using v4 profiles. These include:

i) Dependency on D50/2° colorimetry

When color matching where one or both of the prints being measured is viewed under non-D50 lighting (e.g., grocery store fluorescent lighting), then using v4 chromatic adaptation often does not yield good color-aligned results. Chromatic adaptation, unfortunately, is the only mechanism allowed under v4.

ii) Size of profiles

For 2 use cases – color management of photographic images, and for color management of extended process printing systems with 7 or more inks, v4 profiles can end up too large for easy handling. For digital photography, the overhead of the v4 profile format, repeated over a large stock of digital image files, means that a lot of space is wasted duplicating the overhead for each image. In the case of extended process printing, the size of v4 profiles goes up in a geometric manner with the number of colorants or inks. Especially when the extended process system goes beyond 7 inks, the size of v4 profiles can get distinctly unwieldy.

iii) Color managing objects with fluorescence

v4 profiles use colorimetry which assumes that the illumination is always D50. Very frequently, it is necessary to find out what something such as packaging artwork will look like if moved into and out of an area with UV levels different than that specified by D50, such as moving between indoors and outdoors. Fluorescence of paper and inks can cause the color appearance to shift a great deal in such moves. v4 profiles are unable to adequately contain all the information needed to predict such color shifts.

iccMAX Features

The iccMAX format is based on the v4 profile format, with the same type of header and tags structure. This makes it easy for software which interprets iccMAX profiles to also use existing ICC v4 profiles mixed in with the iccMAX profiles. The iccMAX profile format extends v4 by adding both new data types as well as new capabilities in the profile header. This extension is what enables all the new iccMAX features.

iccMAX enables new features vs. v4 which include:

- non-D50 Profile Connection Space
- spectral Profile Connection Space
- support for fluorescence (eg, optical brightening agents in paper)
- support for embedding procedural algorithms enabling more compact profiles
- support for "tag-less" ICC profiles
- support for directional color appearance

The next section discusses how these features are useful.

When would iccMAX be used?

Although active work is progressing on how to use iccMAX profiles in established workflows, such as PDF-based ones, a great deal of work and implementations have already been demonstrated in a number of applications. These applications include:

i) Supporting lighting-independent color representation.

An iccMAX profile can directly use spectral color data. This spectral data is required in order to predict color appearance under different lighting conditions. This can be used in a couple of ways. For example, this spectral data could be used to produce a print which is designed to simulate the correct color under a specific lighting condition, such as store lighting. In other cases, the spectral data could be used as part of a multispectral reproduction system, to make an output which is color correct under numerous lighting conditions.

ii) Supporting lightweight profiles for photographic workflow.

"Tag-less" iccMAX profiles only contain their headers – essentially communicating information such as "Color Space = sRGB". While lightweight in size, these tag-less iccMAX profiles are still compatible with other iccMAX profiles in a color managed workflow. This means that it is easier to have a workflow where all photographic images are tagged without excessive data bloat.

iii) Predict the effect of fluorescence on color

iccMAX can encode the extra information required to calculate color changes due to OBAs (optical brightening agents). This means that it would be possible to accurately predict and reproduce the color appearance given a measurement of the actual lighting condition including its UV component.

iv) Predict color in 3D rendering applications.

It is possible to capture the different color visible from different directions. This type of data is commonly used in 3D rendering applications so that, as the object being rendered is rotated, the color can be correctly rendered. The idea with this is to tag such a 3D object with a single iccMAX profile for each material being rendered.

v) Create (relatively) compact extended process profiles.

By encoding extended process data as part of an algorithm inside the iccMAX profiles rather than as sampled lookup table data, it is possible to create iccMAX profiles whose size does not grow geometrically with the number of colorants in the extended process set for a given level of encoding resolution. This makes it easier to have compact iccMAX profiles which are easier to embed inside content files for the purposes of blind or complete exchange, for example.

vi) Encode complex spectral mixing models

iccMAX profiles can be used to encode and carry mixing models where such models are available, such as when using spectral tint ramp measurements found in CxF/X-4 data.

The use cases above are largely drawn from packaging. Other use cases also exist for the medical imaging industry which are not covered in this paper.

Conclusion

iccMAX extends beyond the functionality of v4 profiles in order to support use cases within photography and packaging. The intention of iccMAX is to support those applications which are not already supported by v4, so that the overall color management ecosystem can contain both types of ICC profiles. Users can keep their existing ICC v4 profiles where they are already working for them, and use iccMAX profiles to work where v4 profiles do not.