Creating a simple sRGB ICC profile using LCMS

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1 Introduction

Color management is a critical aspect of ensuring consistent color reproduction across different devices such as monitors, printers, and cameras. The International Color Consortium (ICC) has established standards for creating profiles that manage how colors are interpreted across various devices. This document explains the purpose and functioning of a C program that generates an sRGB ICC profile using the Little CMS (lcms) library, a widely used tool for color management.

1.1 Purpose of the Code

The provided C code is designed to generate an sRGB ICC profile. This profile is essential for devices like monitors, which typically use the sRGB color space. The code uses the Little CMS (lcms) library to accomplish this task, leveraging its capabilities to define the profile's color space, white point, tone reproduction curves (TRCs), and other essential metadata.

The key tasks performed by the code include:

- Setting the white point to D65 and defining the sRGB primaries.

- Creating a tone reproduction curve (TRC) specific to the sRGB color space.

- Generating the ICC profile with appropriate tags and saving it to a file.

This document provides a detailed explanation of the tags and headers used in the ICC profile and their significance in ensuring accurate color representation.

1.2 Little CMS (lcms) Library

Little CMS (lcms) is an open-source color management library that simplifies the process of creating, manipulating, and applying ICC profiles. It supports various color spaces and profiles, making it a popular choice for developers working with color management.

The lcms library is lightweight, efficient, and highly customizable, allowing users to create ICC profiles tailored to specific devices and applications. In the context of the provided code, lcms is used to define the sRGB color space and generate an ICC profile that can be applied to devices requiring consistent color reproduction in the sRGB space.

2 ICC Profile Headers

The headers in an ICC profile provide essential metadata about the profile, ensuring that color management systems can correctly interpret and apply the profile. The following are the key headers used in the sRGB ICC profile generated by the code:

2.1 Profile Version

The profile version indicates the version of the ICC specification that the profile adheres to. This ensures compatibility with color management systems that support different ICC versions.

2.2 Profile Device Class

The **Device Class** header specifies the type of device for which the profile is intended. In this case, the profile is for an output device such as a monitor, which typically uses the sRGB color space.

2.3 Color Space

The **Color Space** header defines the color space of the device that the profile represents. For the sRGB profile, the color space is set to RGB, which is standard for monitors and other display devices.

2.4 Profile Connection Space (PCS)

The **Profile Connection Space** (PCS) is a device-independent color space used as an intermediary in color transformations. The PCS is typically the CIELAB or CIEXYZ color space. In the provided code, the PCS is implicit in the use of the sRGB color space, which assumes a connection to CIEXYZ space with a D65 white point.

2.5 Manufacturer Signature

The **Manufacturer Signature** header identifies the entity that created the profile. In the code, the manufacturer is set to "sRGB custom profile generator," which signifies the source of the profile. This information is important for tracking the profile's origin and ensuring its authenticity.

3 ICC Profile Tags

Tags in an ICC profile store specific data about the profile, such as color transformations, metadata, and more. Below are the key tags used in the sRGB profile generated by the code and their purposes:

3.1 Media White Point (cmsSigMediaWhitePointTag)

The **Media White Point** tag defines the reference white point for the profile. For the sRGB profile, the white point is set to D65, which is standard for most display devices. This white point ensures that the colors are interpreted correctly relative to this reference point.

3.2 Copyright (cmsSigCopyrightTag)

The **Copyright** tag contains information about the ownership and usage rights of the profile. This tag protects the intellectual property of the profile creator and specifies the terms under which the profile can be used.

3.3 Profile Description (cmsSigProfileDescriptionTag)

The **Profile Description** tag provides a human-readable description of the profile. In the code, this tag is generated based on the profile's filename, providing a description like "sRGB-custom-V4-srgbtrc.icc". This tag helps users identify the profile and understand its purpose.

3.4 Device Manufacturer Description (cmsSigDeviceMfgDescTag)

The **Device Manufacturer Description** tag contains a description of the device manufacturer. In the code, this is set to "sRGB custom profile generator," indicating that the profile was generated specifically for an sRGB device. This tag helps in identifying the source of the profile and understanding the context in which it was created.

3.5 Tone Reproduction Curve (cmsSigRedTRCTag, cmsSigGreenTRCTag, cmsSigBlueTRCTag)

The **Tone Reproduction Curve** (TRC) tags define the transfer function for each of the red, green, and blue channels. The provided code uses a parametric curve specific to the sRGB standard, defined by the parameters:

$$f(x) = \begin{cases} \frac{x}{12.92}, & x \leq 0.04045 \\ \left(\frac{x+0.055}{1.055}\right)^{2.4}, & x > 0.04045 \end{cases}$$

These TRCs ensure that the colors are reproduced accurately on devices adhering to the sRGB standard.

4 File Naming

The provided code also generates a filename for the profile based on various parameters such as the base name, profile ID, version, TRC type, and file extension. This systematic naming helps in organizing and identifying different profiles generated by the system.