

ICC Colour Management

- What is the ICC?
- Why Colour Management?
- ICC Profiles and the PCS
- Future Directions of the ICC

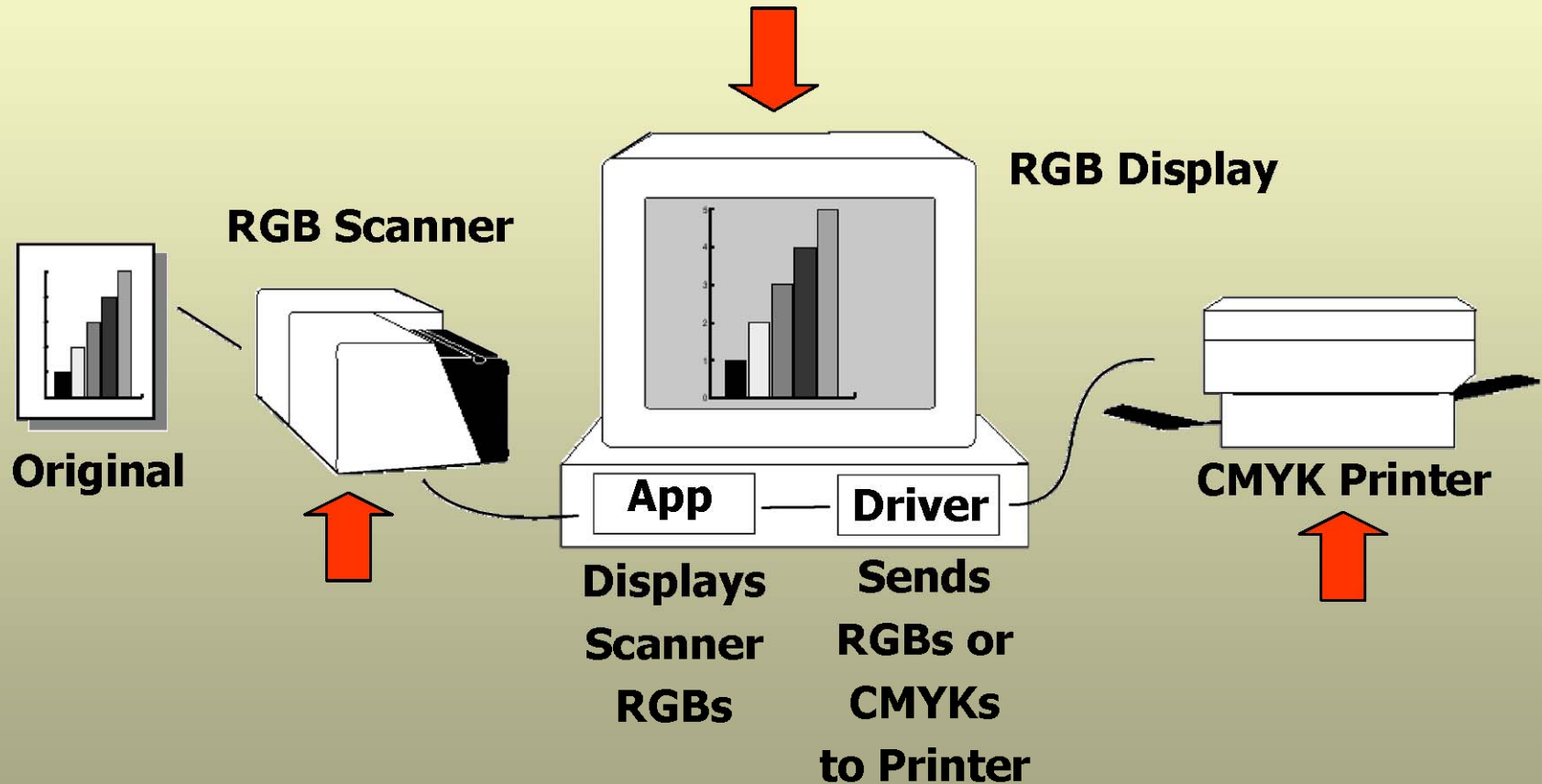
The International Color Consortium (ICC)

- An industry consortium
- Established in 1993 by eight industry vendors
- Now approximately 70 members
- Goal: Create, promote and encourage evolution of an open, vendor-neutral, cross-platform colour management system architecture and components

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"Colour" Workflow



Everyday problems...

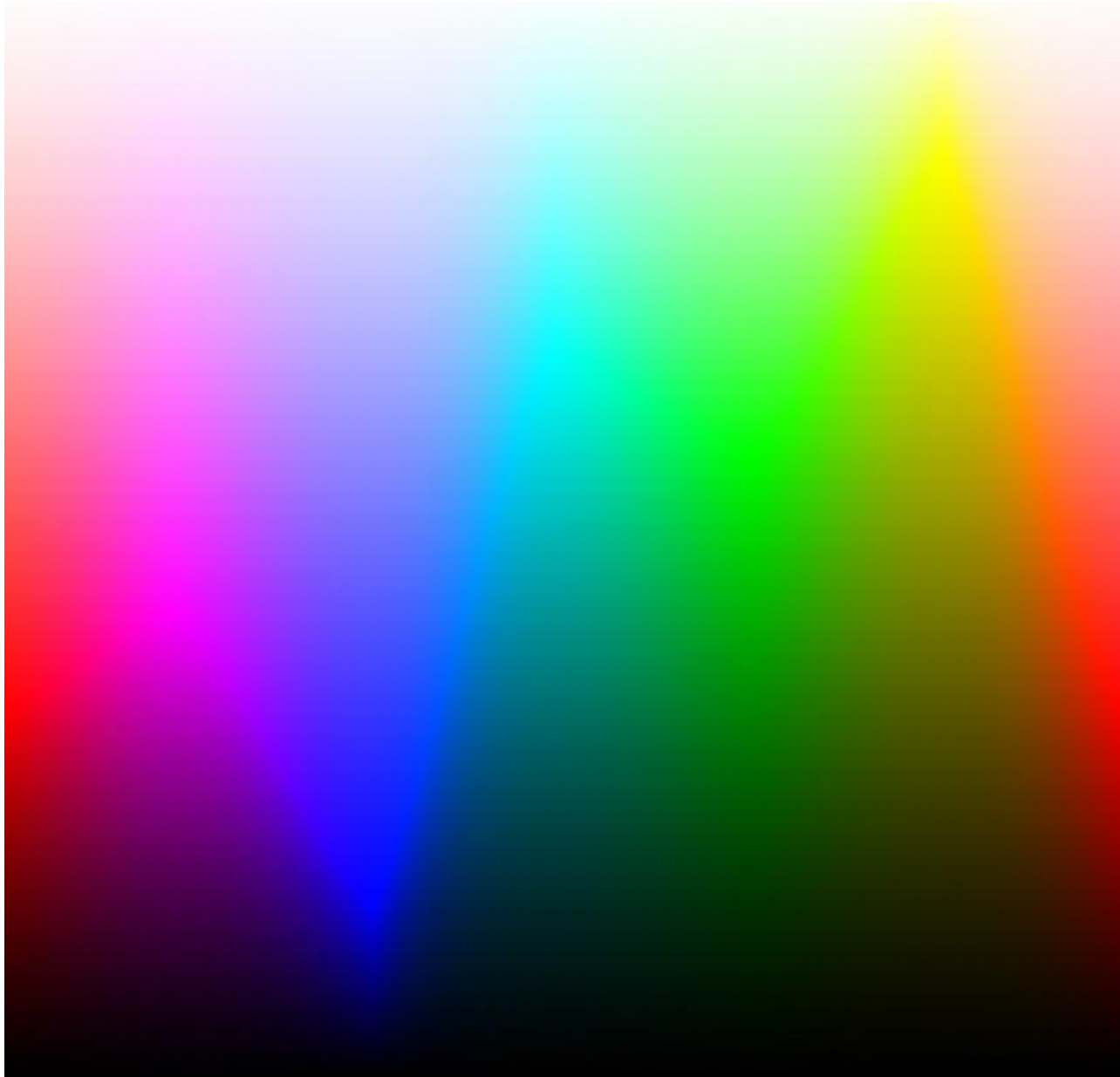
- *The same document looks different when*
 - printed on different printers
 - viewed on different monitors
 - printed on a printer and viewed on a monitor
 - viewed in a light booth and under office lighting

Why ?

- Devices, drivers, operating systems, and applications can all interpret and reproduce colours differently.
- Input --
Scanners, digital cameras often have different spectral responses
- Output --
Printing: offset, gravure, inkjet, laser
Display: CRT, LCD, PMP, DMD, video projectors...

Device Colour Gamuts

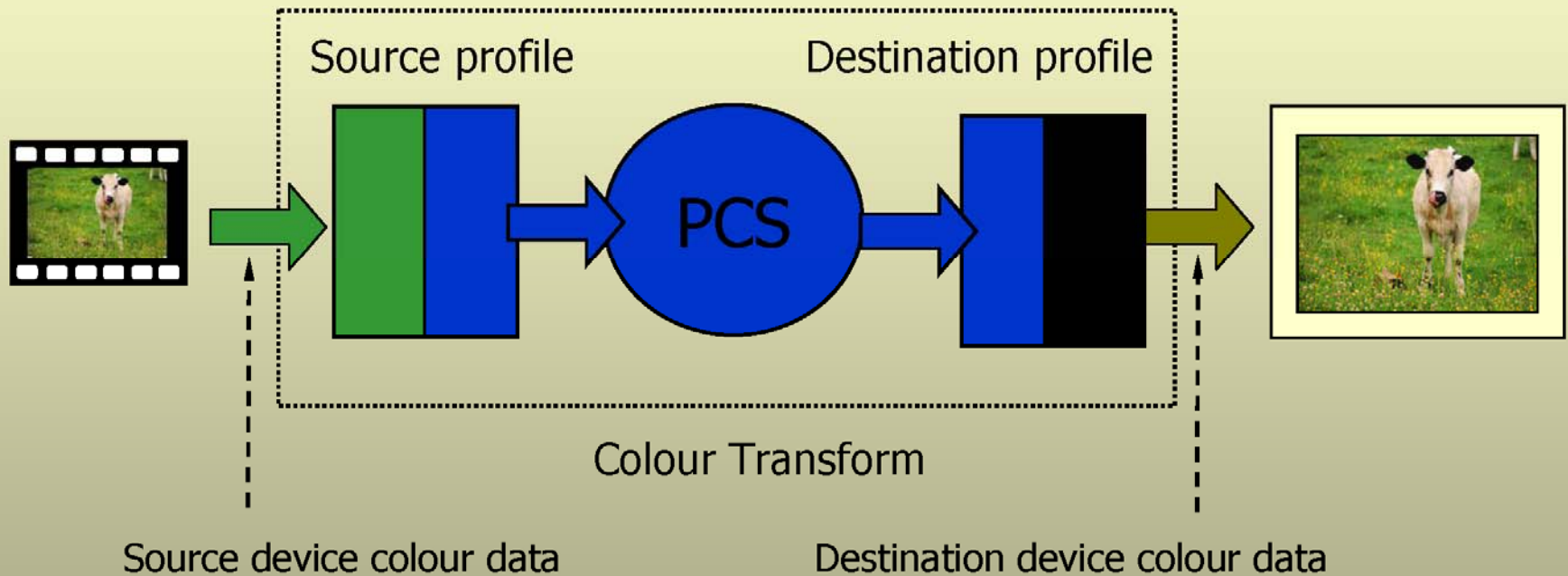
- Gamut = range of realisable colours.
- A colour gamut for a device depends on the device, media and viewing conditions:
 - e.g. dynamic range and separation quality for input, or ink and substrate for printers.
 - chromaticity and illumination level of the illuminant, and colour and luminance of the surround, for viewing the image.
- A gamut can be visualised as a plane or volume in a standard colour space



ICC Workflow

- The transforms from device to standard colour space are embedded in the **ICC profile**.
- The standard colour space is called **PCS** (profile connection space).

ICC Workflow



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The ICC Profile

- The ICC profile contains the transforms from "device" to PCS.
- There are several kinds of profiles:
 - *Input device* (scanner, digital camera, etc.)
 - *Output device* (printers, film recorders, etc.)
 - *Display* (CRTs, LCDs, projectors, etc.)
 - *Device Link* (dedicated device-to-device)
 - *Colour space* (sRGB, CIE XYZ, L*a*b*, etc.)
 - *Abstract* (effects, PCS-to-PCS, etc.)
 - *Named Colour* (Pantone[®], Truematch[®], etc.)

The PCS

- In the ICC workflow, the standard colour space is called the **profile connection space (PCS)**.
- Each profile describes the transformation from source (device) space to PCS, and vice versa in case of output profiles.
- The PCS is based on a D50 illumination environment, but comes in two forms – one for the colorimetric renderings and one for the perceptual and saturation renderings.

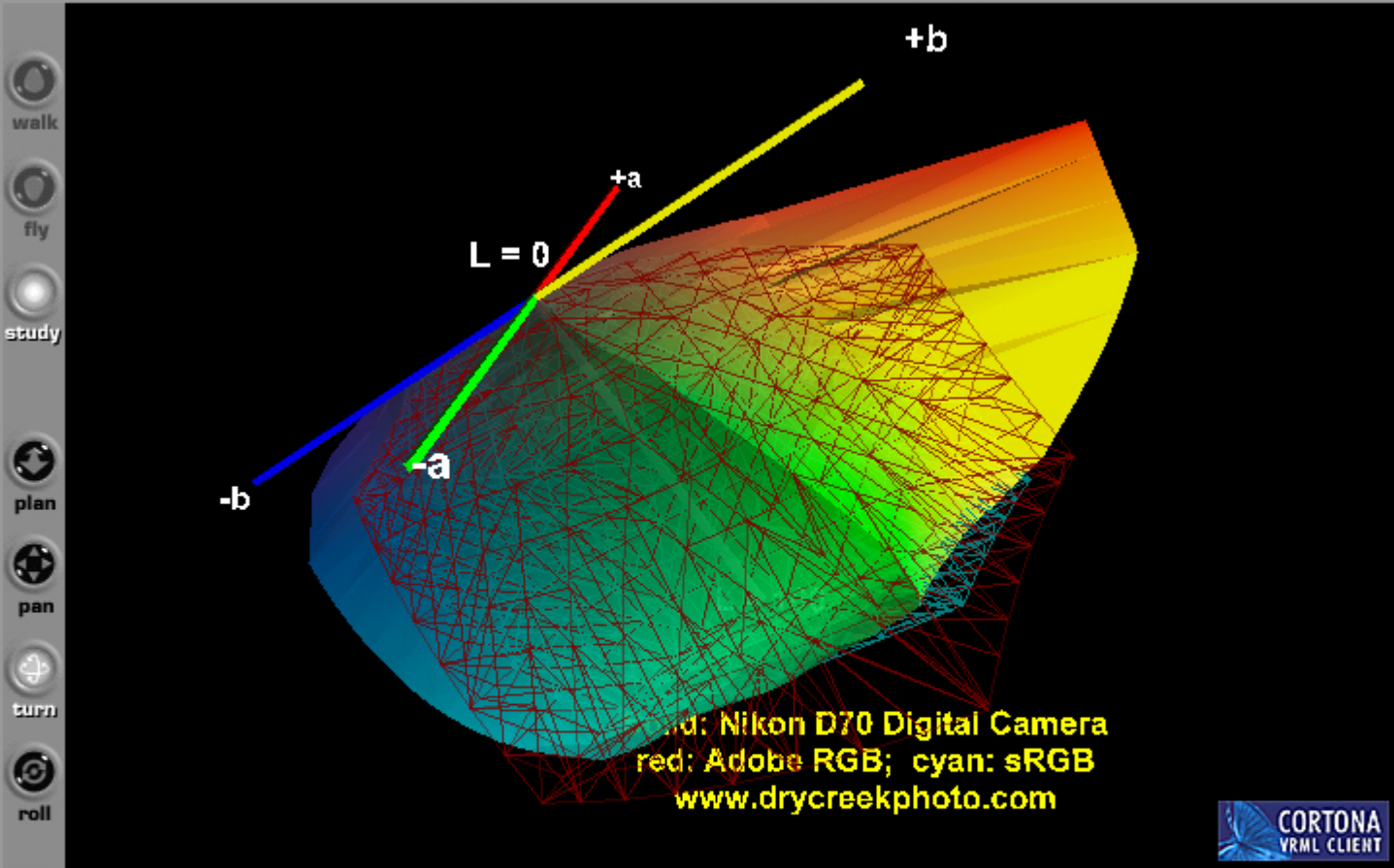
PCS definitions

- Colorimetric renderings define black as $L^*a^*b^* = 0,0,0$. White (100, 0, 0) is either the perfect diffuser (absolute) or the medium (relative).
- While the PCS is defined using D50 for all renderings, the illumination level and definition of the surround does not need to be specified for colorimetric renderings.
- Perceptual rendering requires a PCS definition which includes these.

Reference Viewing Condition and Medium

- Perceptual PCS (in v4.0 spec.) defines:
 - Viewing environment of D50 at 500 lux with a 20% reflectance surround
 - Reference medium of 89% reflectance for white and approximately 0.31% for black
- The use of a reference medium with a well defined dynamic range and viewing condition ensures less ambiguity in gamut mapping.

Nikon D70 Digital Camera Color Gamut



- walk
- fly
- study
- plan
- pan
- turn
- roll
- goto
- align
- view
- restore
- fit

Use the [Interactive Gamuts tool](#) to choose from all color spaces

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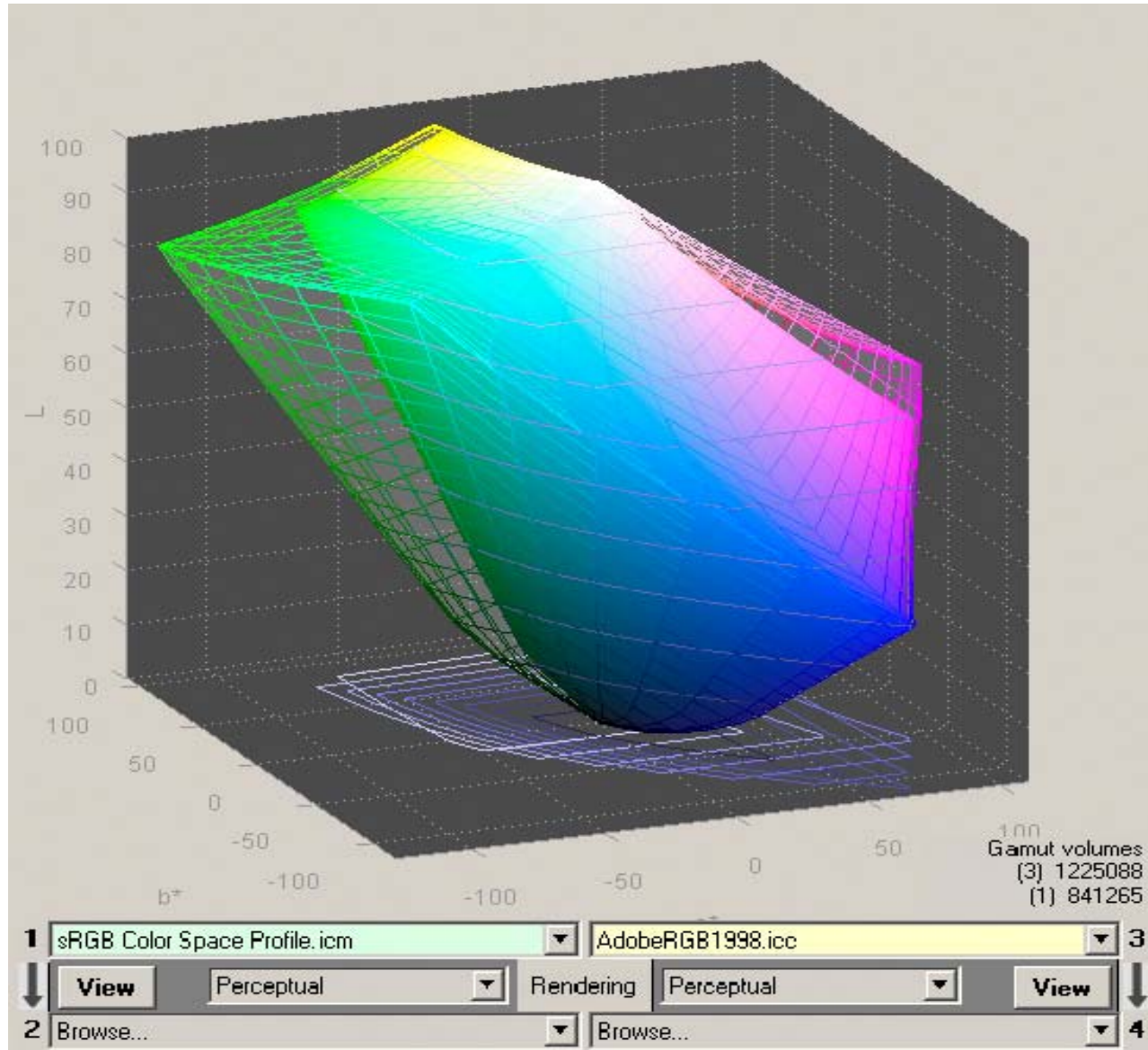
Four Rendering Intents

- **Relative colorimetric**
 - the white point of the **actual medium** is mapped to the white point of the reference illuminant (i.e. $L^*a^*b^* = 100, 0, 0$ for the medium). The colours map accordingly.
- **Absolute colorimetric**
 - the white-point of the **illuminant** maps to the white point of the reference illuminant (i.e. $L^*a^*b^* = 100, 0, 0$ for D50). The colours map accordingly.
- **Note:** Both may allow for chromatic adaptation.

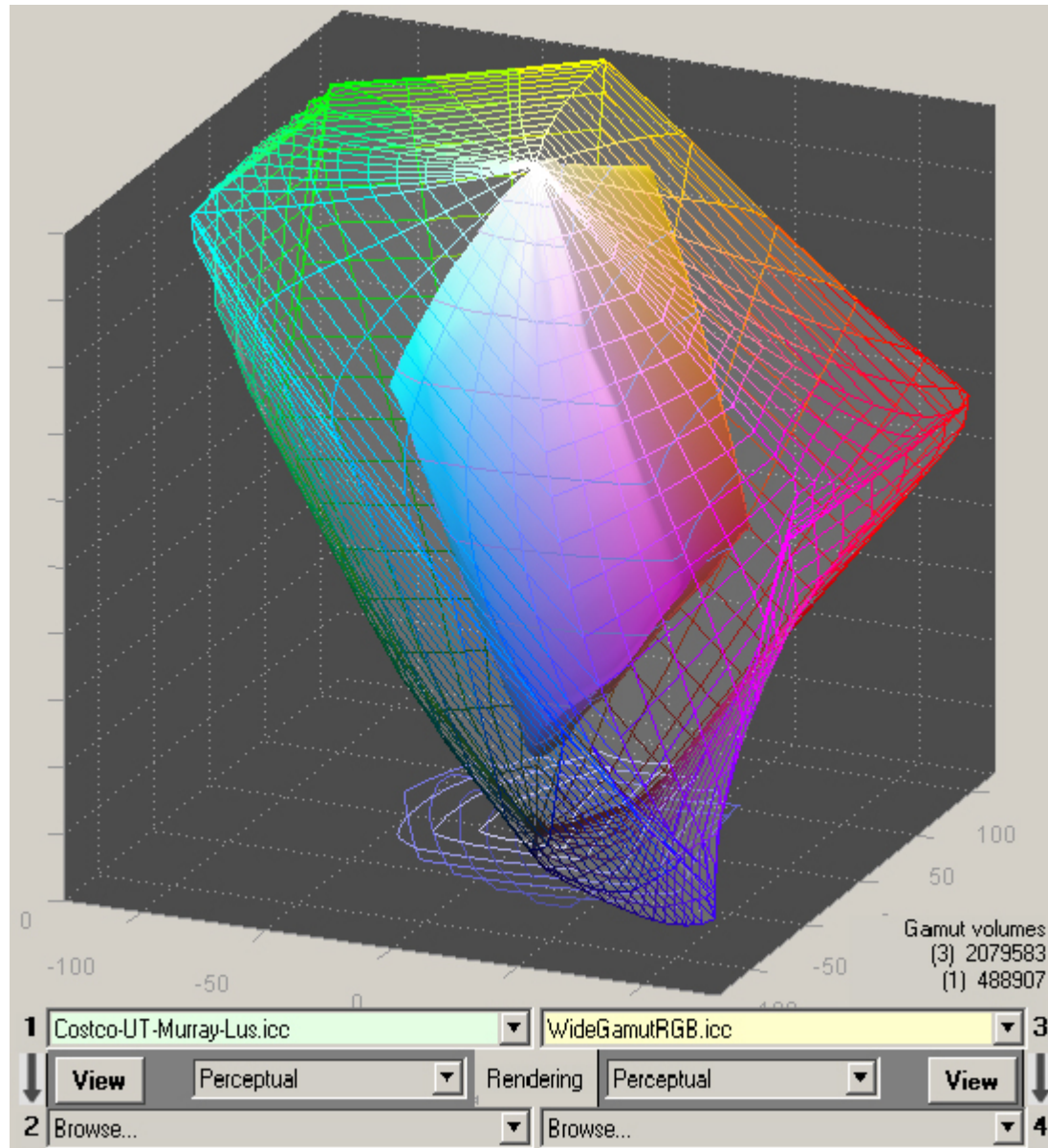
Four Rendering Intents

- **Perceptual**
 - the full gamut of the image is compressed or expanded to fill the gamut of the destination device. Grey balance is usually preserved, but colorimetric accuracy might not be.
- **Saturation**
 - the saturation of the pixels in the image is preserved, perhaps at the expense of accuracy in hue and lightness.

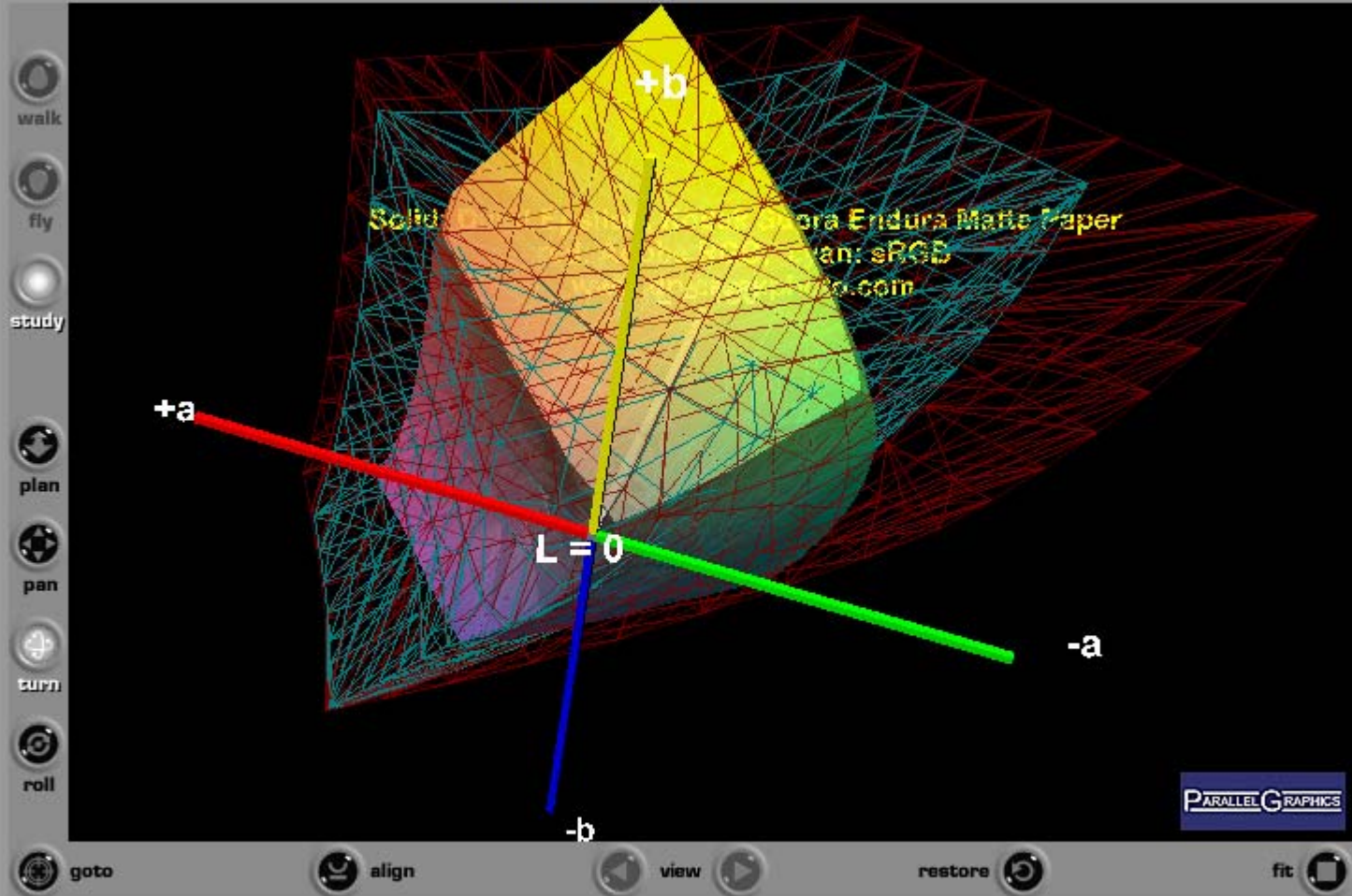
SRGB vs ADOBE-RGB1998



Typical Printer Gamut (solid) inside WideGamutRGB color space.



Durst Epsilon 2 gamut - Kodak Supra Endura Matte Paper
Print contrast ratio: 115:1

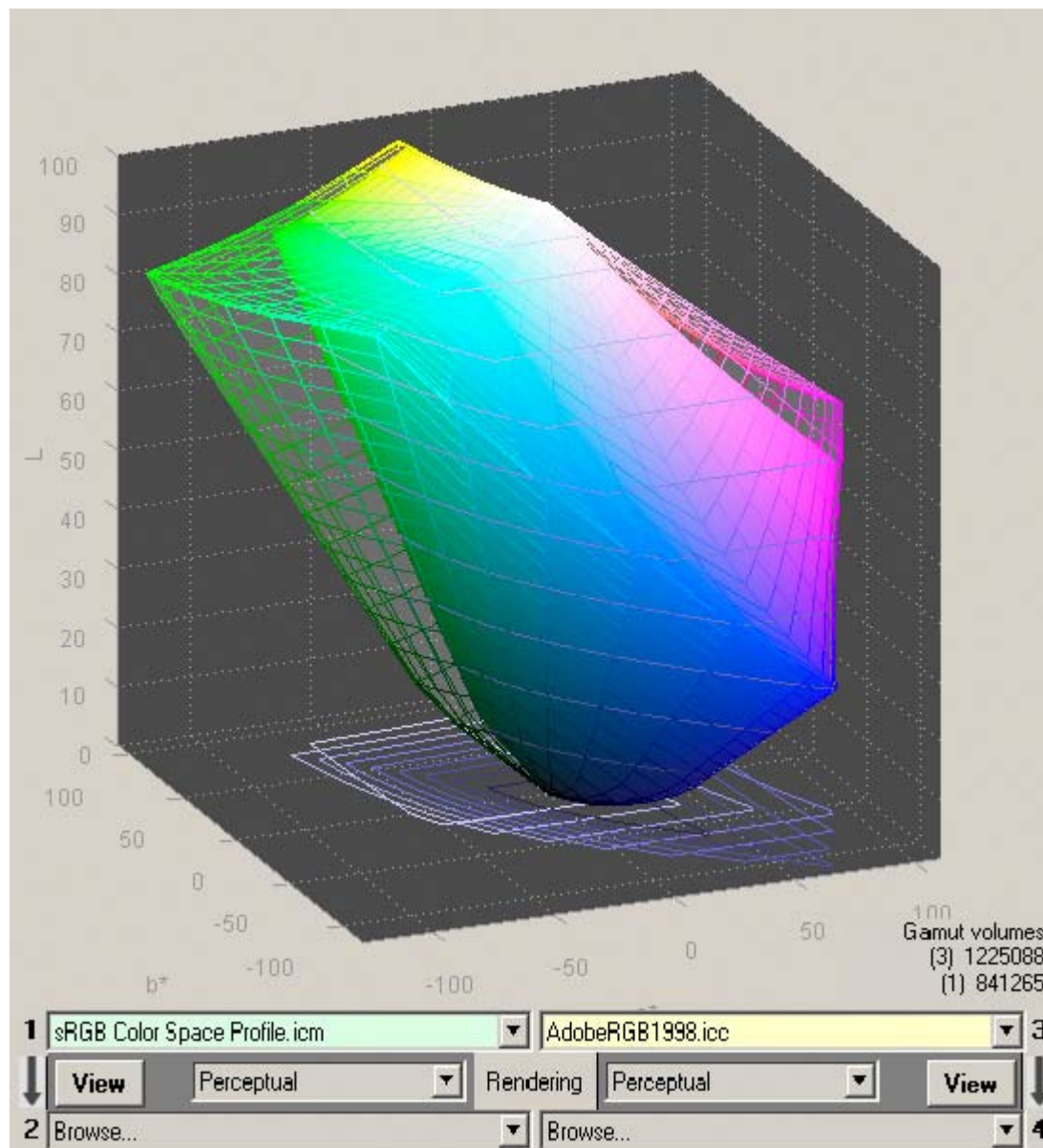


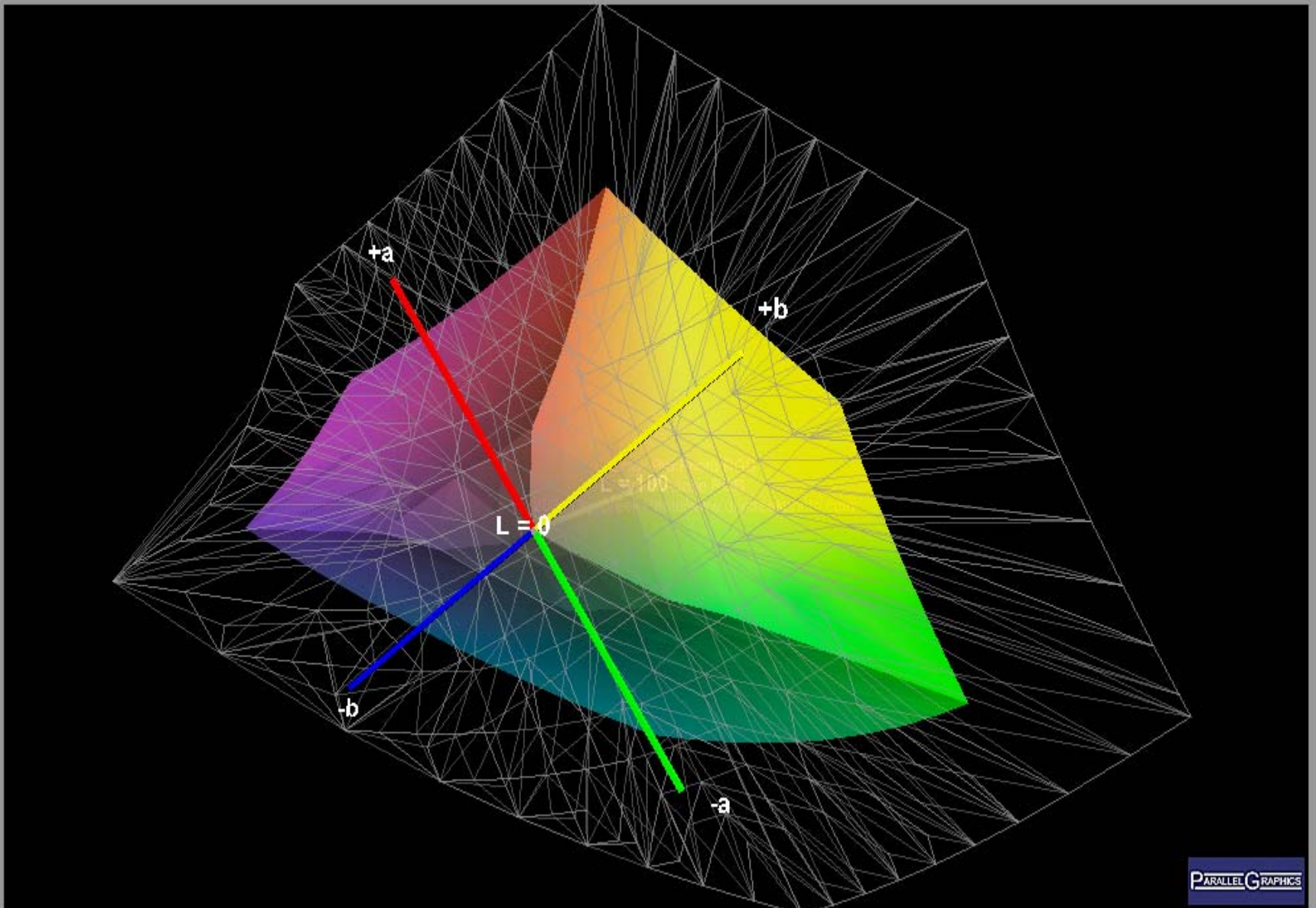
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sRGB Color Space (solid) inside AdobeRGB Color Space





AdobeRGB1998 inside ProPhotoRGB



Photographic Section

Durst Epsilon 30

Printer output = 254 dpi

- RGB LED light source
- Photographic paper
 - 30"X164' roll stock with semi-matte finish
- Up to 900 megabyte file
- 4 minute average for a 25 micron scan



— Print is processed to final product.

Photographic Section

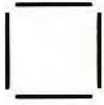


RIP Workstation

- Input Magnification
- Converts TIFF Files to PPM Format
- Nesting

Kodak

Process RA-4

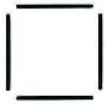


8038

11-27-08
1200

Kodak

Process RA-4



Reference Strip

8038

RA-4 Processor Control

