

Spot color matching between Pantone and ICC press profiles

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Introduction

The prime objective of this study is to evaluate spot color matching performances between Pantone and custom ICC press profiles by simulation using the Adobe Photoshop 7.0 API.

In this particular methodology, the measured CIELAB values for the color swatches were taken as the reference and converted to their respective CMYK working spaces (B to A conversion, absolute). The Heidelberg output press profile was taken as the destination space and the CMYK values were converted to CIELAB (A to B conversion, absolute).

Procedure

1. Fifteen color patches from the Pantone Color Imaging Guide (1996) were selected and their measured CIELAB values specified as aim points. The patches were measured using a calibrated X-Rite 528 spectrodensitometer under D50 illuminant and 2 deg. observer.
2. Two profiling packages, Kodak Colorflow v2.1 and GretagMacbeth ProfileMaker v4.0 were used to build an ICC press profile. The output profiles were built for the Heidelberg M-1000B perfecting web offset press on which this publication is printed. The profiles were based on test targets printed earlier on the same equipment. (see the article on page 33 for details)
3. There is a Pantone profile for 150 lpi screen available in the ColorSync folder on Apple Macintosh workstations. Since the colors specified were those taken from Pantone, we wanted to see how the Pantone profile performs in matching its own set of colors using the Heidelberg M-1000B press. To ensure further accuracy and to avoid any gamut-clipping, all colors specified were those which can be reproduced using web-offset inks.

4. The color settings were set to the output working space of the three profiles (namely Pantone, Kodak and GretagMacbeth). The rendering intent was set to Absolute Colorimetric for maximum color accuracy. Black point compensation and dither boxes were left unchecked. The colors specified were converted to their CMYK values using the Adobe Photoshop 7.0 API.
5. The recorded CMYK values for the three test conditions were converted back to CIELAB (A to B conversion, absolute) using the press profile as the output working space. Pantone and GretagMacbeth color patches were rendered using the output press profile created by GretagMacbeth ProfileMaker v4.0. The Kodak color patch was rendered using the output profile created using Kodak Colorflow v2.1.
6. Color matching accuracy is judged by the average ΔE between the 15 color samples produced and their original color specifications. Table 1 shows the three different conversion methods.

Method	B to A (Abs)	A to B (Abs)
Pantone	Pantone 150 lpi	ProfileMaker
Custom 1	ProfileMaker	ProfileMaker
Custom 2	Colorflow	Colorflow

Table 1. The three color matching methods used

Results

A summary of the minimum, maximum and average L^* , a^* and b^* differences are given below in tables 2a, 2b and 2c.

n=15	ΔL^*	Δa^*	Δb^*	ΔE
Min.	-1.27	-2.24	-0.54	0.24
Max.	0.49	1.03	2.98	3.76
Ave.	0.09	0.00	0.62	1.06

Table 2a. Results for GretagMacbeth ProfileMaker v4.0

n=15	ΔL^*	Δa^*	Δb^*	ΔE
Min.	-0.76	-1.97	-1.34	0.44
Max.	0.49	1.27	4.43	4.57
Ave.	0.02	0.07	0.55	1.37

Table 2b. Results for Kodak Colorflow v2.1

n=15	ΔL^*	Δa^*	Δb^*	ΔE
Min.	-6.70	-3.97	-1.34	1.70
Max.	-1.06	6.06	4.51	7.69
Ave.	-3.25	1.00	1.62	5.15

Table 2c. Results for Pantone 150lpi

Visual differences perceived between the Pantone and ICC color patches are indicative of quantitatively measured color differences. To enable perceived differences in color, the specified colors reproduced using the Pantone and custom ICC (Kodak Colorflow v.2.1 and GretagMacbeth ProfileMaker) methods are shown in figure 3.

Discussion

For this study no physical printed output was used. The analysis was done using the Photoshop API. Hence, any variations due to random errors present in measuring instruments and the printing process itself were eliminated. In theory ΔE should be zero. In practice however this is not the case and we notice small ΔE differences which are due to rounding and interpolation errors of the profiling package and CMM used.

The ΔE was calculated using this CIELAB value as the sample and the CIELAB values of the specified color patches as the reference. Since ΔE as a total color difference is used as a major parameter to judge the degree of a color match, we can conclude that the custom ICC profile does indeed provide a closer match to the specified color than the Pantone profile.

Pantone ID	CIELAB (ref)	Pantone	Gretag	Kodak
OSAO-C	L*	84.7		
	a*	-0.5		
	b*	35.34		
OJTO-C	L*	69.76		
	a*	18.94		
	b*	27.83		
OTPO-C	L*	53.27		
	a*	48.37		
	b*	14.49		
YYOO-C	L*	34.51		
	a*	22.24		
	b*	-39.98		
PLOO-C	L*	46.55		
	a*	8.03		
	b*	-23.43		
TOAO-C	L*	61.71		
	a*	-24.06		
	b*	-24.46		
NDOA-C	L*	62.62		
	a*	-7.73		
	b*	-17.56		
SOLK-C	L*	38.94		
	a*	-16.32		
	b*	-2.62		
NOXJ-C	L*	48.42		
	a*	-15.89		
	b*	18.08		
OWNK-C	L*	33.57		
	a*	31.97		
	b*	6.64		
OIVD-C	L*	57.67		
	a*	15.73		
	b*	21.1		
OMZP-C	L*	30.06		
	a*	13.78		
	b*	12.08		
OAAD-C	L*	77.97		
	a*	2.57		
	b*	2.08		
AOOI-C	L*	64.63		
	a*	-2.18		
	b*	-2.3		
OOCW-C	L*	31.3		
	a*	-0.93		
	b*	2.43		

Figure 3. Colors specified and reproduced, but not measured

This article in its printed state will provide us with a continuing basis for analysis. The color patches as rendered by the three solutions have been included in figure 3 of this document. The CIELAB values of these patches can now be measured and ΔE s calculated. The resulting color difference will give us further insight into the process capabilities of the press and accuracy of the profiling packages.