

Test Targets Showcase: Device Characterization by Colorimetry

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Objectives

The reproducible range of colors which can be obtained from an output device depends on a variety of factors such as the type of reproduction process used, the consumables such as colorants and substrates. The aim of this study is to show the use of IT8.7/3 (ISO12642) to colorimetrically characterize an output device. In other words, to show how the IT8.7/3 can be used to find out the reproducible range of CMYK (device dependent) colors of a particular device. A plausible application of this device characterization target could be its use to compare the gamuts which can be obtained from two different output devices. Care should be taken that the materials such as substrate and measurement criteria are standardized in order to obtain a meaningful result.

Procedures

1. Print the IT8.7/3 on an Indigo UltraStream 2000 Sheetfed digital press using default conditions (145 lpi and 14% dot gain).

2. Measure the IT8.7/3 target using the Spectrolino Spectroscan (Figure 1).



Figure 1. GretagMacbeth Spectrolino Spectroscan.

3. Enter the data in to the Print•RIT template B_color_IT8(V3.2).xls (see Table1). To explain, Section 1 of Table 1 indicates the Patch ID on the

Sect.1	Sect.2				Sect.3			Sect.4
Loc	C	M	Y	K	L*	a*	b*	C*
0B13	paper				93.91	0.81	-3.19	3.29
0C13	3	0	0	0	93.45	0.24	-3.88	3.89
0C12	7	0	0	0	91.64	-1.43	-6.04	6.21
0C11	10	0	0	0	90.82	-2.27	-7.10	7.45
0C10	15	0	0	0	88.61	-4.38	-9.68	10.62
0C09	20	0	0	0	86.77	-6.08	-11.94	13.40
0C08	25	0	0	0	84.49	-8.25	-14.63	16.80
0C07	30	0	0	0	83.19	-9.38	-16.05	18.59
0C06	40	0	0	0	79.45	-12.89	-20.43	24.16
0C05	50	0	0	0	76.12	-16.22	-24.36	29.27
0C04	60	0	0	0	72.02	-20.53	-29.20	35.69
0C03	70	0	0	0	68.28	-24.15	-33.53	41.32
0C02	80	0	0	0	63.82	-29.19	-38.72	48.49
0C01	90	0	0	0	60.58	-33.91	-42.85	54.64
0A01	100	0	0	0	57.71	-37.43	-45.95	59.27
0M03	100	0	0	20	50.69	-33.71	-39.88	52.22
0N05	100	0	0	70	31.29	-22.36	-25.04	33.57
0B05	100	0	0	100	12.68	-8.55	-6.64	10.83
0B11	100	100	100	100	8.32	0.32	-0.71	0.78

Table1. Data table in Print•RIT templB_color_IT8(V3.2).xls.

IT8.7/3 target. Section 2 indicates the known CMYK values per IT8.7/3 (1993); section 3 indicates the measured CIELAB for the respective patches; and section 4 calculates the resulting C* value for the measured a*b* values.

4. Use section 3 of table 1 to plot the a*b*slice

The a*b* values can be used to show the color gamut of the printing device as shown in Fig 2. The a*b* slice is a means of visualizing the boundaries of the color gamut which can be reproduced by an output device. It acts as a tool to provide the first approximation of the colors which can be reproduced by the device.

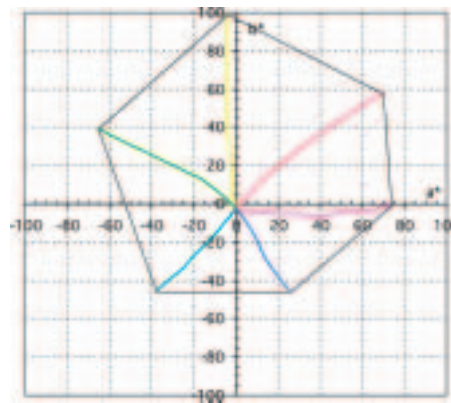


Figure 2. a*b* slice showing the reproducible gamut of Indigo UltraStream 2000.

5. Use section 3 and 4 to plot the L*C* slice.

It should be noted that color space is 3-D in nature. A major drawback of the a*b* slice is that all the colors represented, lie on a non constant L* plane. This means that even though a color may lie within the gamut boundaries of an a*b* diagram it may still not be reproducible by the output device. The L*C* slices help us to visualize the relationship between L*(Lightness) and C* (Chroma) for any given process color. Fig3 shows the L*C* slice for the blue (C+M) and yellow printers. It can be seen from the figure that the yellow which is reproducible by the device has very high chroma at very high lightness values (nearly paper white) however for low lightness values it shows a steady decrease in chroma. However in the case of blue it may be noted that the shape of L*C* slice is almost the opposite.

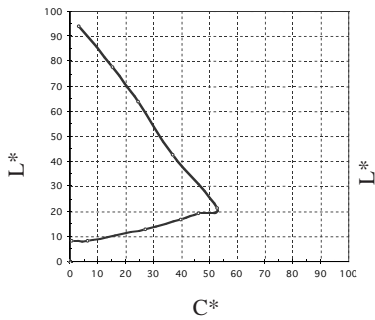


Figure 3 a. L*C* slice for Blue

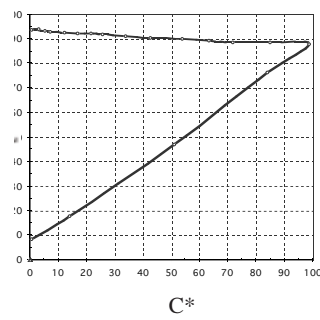


Figure 3 b. L*C* slice for Yellow

6. Colorimetric comparison

The IT8.7/3 can be used for colorimetrically comparing different devices. The figure 4 and 5 show the colorimetric comparison between the Indigo and the Xiekon. The a^*b^* slice and the L^*C^* slice clearly indicate that the reproducible range of colors. In other words the total gamut volume which can be obtained from the Indigo is much larger.

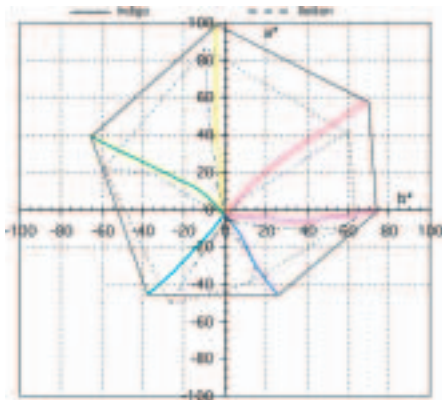


Figure 4. a^*b^* plot comparing Indigo and Xiekon.

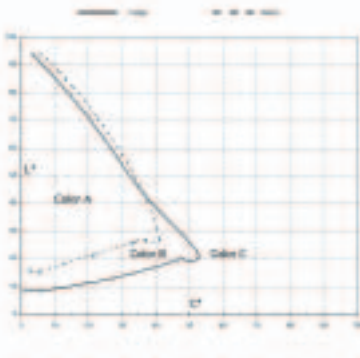


Figure 5. L^*C^* plot comparing Indigo and Xiekon.
 Color A-Reproducible by both Indigo and Xiekon.
 Color B-Reproducible by Indigo but not by Xiekon.
 Color C- This color is beyond the reproducible range of both the Indigo and Xiekon.

Discussion

Colorimetric characterization of an output device can be extremely useful. In addition to indicating the reproducible gamut of an output device, it can further be used as a tool to compare the gamuts of two different devices. The IT8.7/3 can also be used to find the ΔE difference between prints obtained from two different devices. The

CIELAB values can be measured from the IT8.7/3 printed by using two different output devices (in this case the Indigo and Xiekon). The data is entered into the Print•RIT template D_DeltaE_Plot(v2.3).xls. The Template can then be used to derive a ΔE plot between each patch of the IT8.7/3 target (see Fig.6 and 7) indicating the total visual difference between the two output devices.

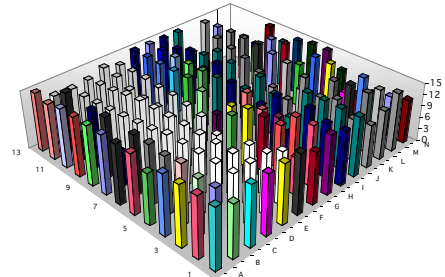


Figure 6. Three-D plot for ΔE . The figure was derived by assuming the output from Indigo as reference and that from Xiekon as the sample.

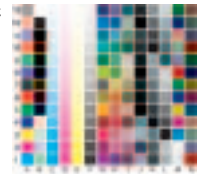


Figure 7. IT8.7/3 Device Characterization Target.

ΔE provides an accurate quantification of the visual differences between a reference and sample. Test form TF_03 can be used to validate the findings which are derived from colorimetric characterization of devices. The visual inspection of these standard pictorial images provides us with an accurate approximation of the reproducible color range of the output devices. In this case the print from the Indigo would have brighter and more saturated colors than those printed from the Xiekon.

References

- www.rit.edu/~rycppr
- www.color.org
- www.gretagmacbeth.com
- B_color_IT8(V3.2).xls
- D_DeltaE_Plot(v2.3).xls

Print•RIT Test Forms used in this study:

