COLOUR TRANSFORMATION FOR SUBSTRATES

Dr Andreas Kraushaar of Fogra, discusses how to achieve the best possible visual match between a print on an OBA-free and an OBA-rich substrate

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Researchers at Fogra tested a number of different colour-matching strategies. Ten different profile variants were generated and visually assessed under M1 and M2 illumination. The results showed that colorimetry works well. However, colour matching between media, with varying amounts of optical brighteners, requires appropriate perceptually-adapted conversion methods.

COLOUR MATCHING CHALLENGES

The reproduction of pictorial originals on media with different amounts of optical brightener agents (OBA) and paper shades still poses a significant challenge to prepress companies and print-service providers. While the colorimetric match works well for media with similar paper shades (CIELAB value of the unprinted paper) and similar amounts of OBA, the situation varies significantly for different white points and OBA amounts. The simultaneous appraisal of two originals with varying shades of paper and quantity of OBA, leads to a complicated visual matching situation. On the one hand, this is due to the varying colour adaptation caused by the sometimes very different white points of the image content or picture areas in the field of view. On the other, the UV amount of the viewing booth stimulates the brighteners. This leads to a more or less pronounced blue shift.

Four different use cases can be identified in the current printing practice to address potential expectations. These cases will most likely have to resort to different adjustment strategies:

1. Colour matching for the best possible visual match between OBA-rich substrates and existing prints/proofs without OBAs
2. Colour matching for the best possible visual match between OBA-rich substrates and CMYK legacy data or RGB data sets seen on screen (media-relative representation on the profiled monitor via sRGB, eci-RGB or AdobeRGB). This comparison is made side-by-side
3. Colour matching for the best possible visual match between OBA-containing substrates with CMYK legacy data RGB data sets seen on screen (media-relative representation on the profiled screen via sRGB, eci-RGB or AdobeRGB). This comparison is media-relative

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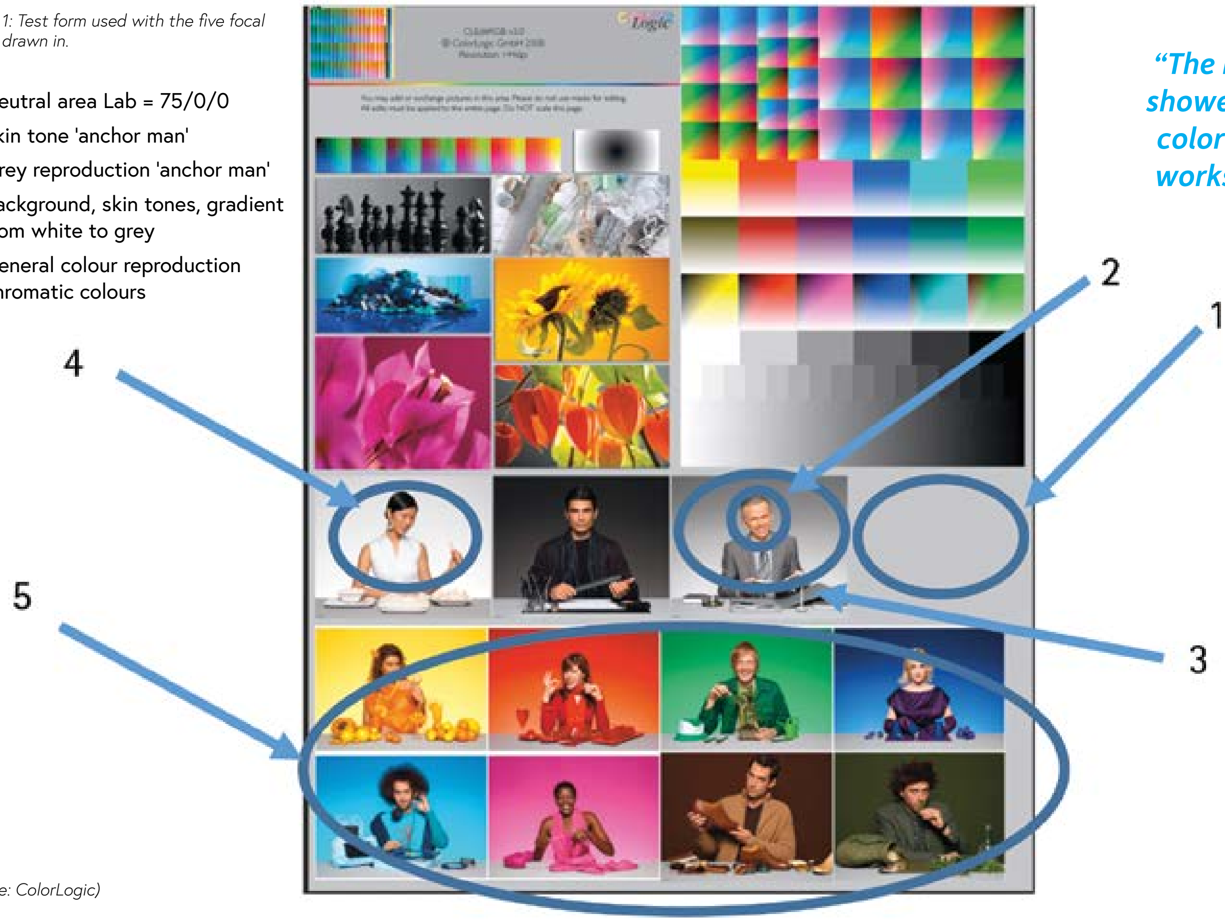
Figure 1: Test form used with the five focal points drawn in.

1. Neutral area Lab = 75/0/0
2. Skin tone 'anchor man'
3. Grey reproduction 'anchor man'
4. Background, skin tones, gradient from white to grey
5. General colour reproduction chromatic colours



(Source: ColorLogic)

"The results showed that colorimetry works well"

4. Colour matching for visually-consistent representation of several reproductions among each other of an original (RGB image stock or print motif). This approach is called consistent colour appearance

The study's researchers focused on verifying the first use case. Different matching strategies are compared to achieve the best possible visual match between an OBA-free original and substrates with medium and high levels of OBA. The main focus of the investigation is the grey axis. The question of which profile variants at a given white point leads to a neutral grey reproduction that matches the original was investigated.

EXPERIMENTAL DESIGN

An RGB test image was used for the visual matching, which includes various test elements (see Figure 1).

The matt Hahnemühle substrate 'Hemp' was chosen as the reference medium. It does not contain any OBAs and has an essentially neutral paper tint. Matt substrates were selected for the other two reproduction substrates to avoid disturbing gloss reflections.

Each of the three substrates was driven linearly with GMG ColorProof to achieve maximum gamut. The IT.8/7–4 chart was used for characterisation. In the present test, profile variations and thus different colour-matching strategies were used with the software programmes CoPrA8 from ColorLogic and MYIRO tools from Konica Minolta. The colour measurement for profile creation was achieved with the Konica Minolta FD9 and FD7 for ambient light measurement. The characterisation data was generated for the standardised measurement conditions M0, M1 and M2 and the user-defined 'User Illu'(UI). It should be noted that M0 is referred to here as the measurement condition using an incandescent light source, i.e., interpreting the 'should' tolerance of ISO13655 as a 'shall'.

COLOUR-MATCHING STRATEGIES

The different colour-matching strategies result from the variation of the measurement basis (M0, M1 or the use of the present illuminant UI) and the profiling software used. With MYIRO tools, the 'neutralise OBA' function was active and only the measurement basis was changed. With the ColorLogic software, the gamut-mapping strategies Absolute (Abs) and Standard Compression (Std) were applied. In addition, an experimental OBA correction method – perceptual grey correction (PCR) – with an intensity of 80% was applied. The aim here was to simulate an M2 measurement.

The different adaptation strategies can be seen particularly in handling the grey axis.

"For the black point, there is no industry-standard procedure"

The ten profile variants, can be seen in Figure 2. Here, a grey scale from CIELAB: 0;0;0 to CIELAB: 100;0;0 is perceptually converted to CMYK with the respective ICC profile. This is followed by the absolute colorimetric transformation, according to CIELAB, where the profile transformation used was based on M1 measurements. This describes the colorimetry that the 'standard observer' sees when viewing the print in a P1 or P2 viewing environment (as defined in ISO3664). Both the black and white points are identical for all variants. In the case of the white point, this corresponds to expectations since no paper simulation (as in the case of proof printing) is commonly used in the industry.

For the black point, there is no industry-standard procedure. This is because the different parameters that lead to slightly different CIELAB colour values depend on the manufacturer and the selected parameters. In the present study, the black points (and also the separation settings) were chosen similarly for better comparability.

CONCLUSION

Findings show that the conversion methods have a significant influence. For instance, the best visual matches are obtained in a side-by-side comparison if the grey axis is converted 'absolutely' over a wide lightness range. In the present case of the CIE a*b* neutral reference ('Hemp'), the grey gradient is also more CIEa*b* neutral, meaning closer to 0. Therefore, no break-ups may be produced by too strong a 'fan-out' onto the paper tone. It can also be noted that the more UV, the bluer or more lilac the paper, the more yellow must be used to compensate for absolute grey adjustment, i.e., with CIELAB colour values close to the CIEa*b*= 0 axis. While this finding reflects preferred matching for pictorial content, it can be expected that for more technical content, other strategies might be preferred. ■

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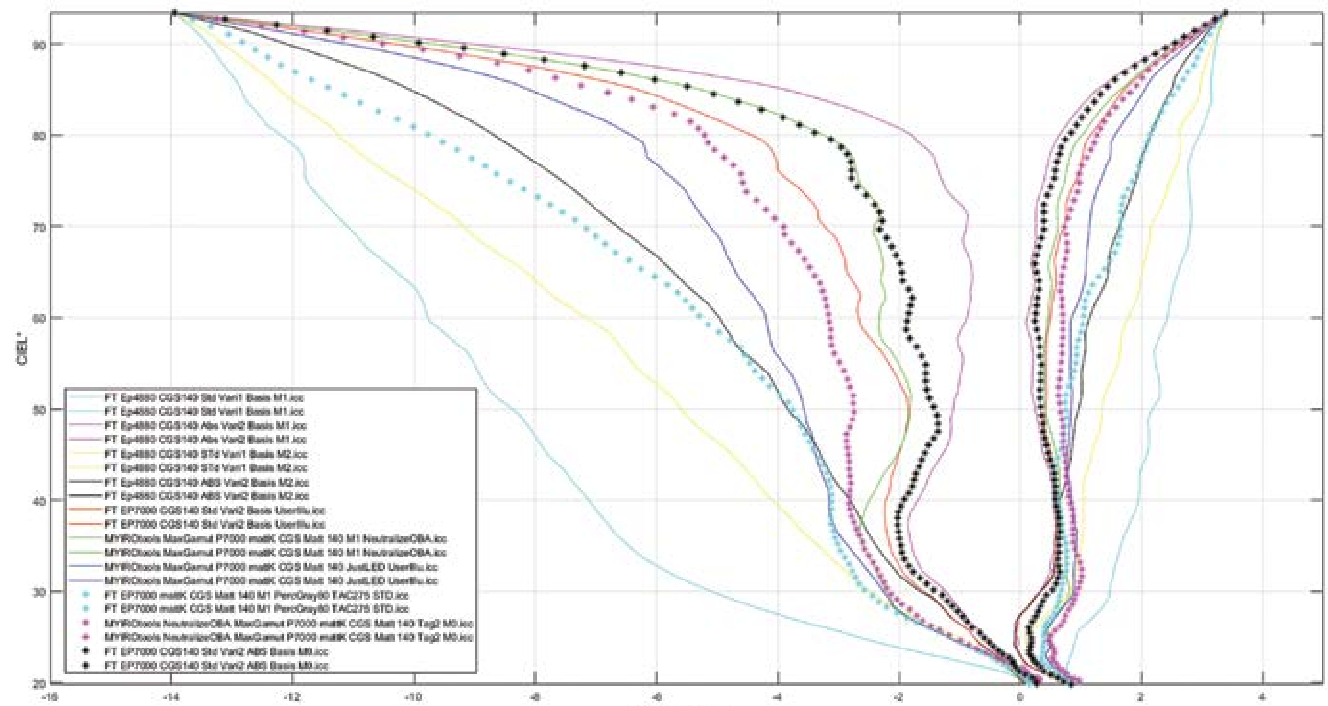

Figure 2: Colour co-ordinates of the CIELAB neutral scale perceptually transformed to CMYK for ten different profile variants