Linearized printer output of corresponding colours by the MTL code

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Reproduction of ISO/IEC-test charts according to ISO/IEC 15775 on colour printers and monitors

The four ISO/IEC-test charts according to ISO/IEC 15775 and DIN 33866-1 to 5 include 16 step colour series which are equally spaced in CIELAB between White *W* and the six chromatic colours *CMYOLV* and Black *N*. The test charts are also available as files with input colours in corresponding colour spaces *cmyn* (cmyk), olv* (rgb),* and *LAB** (CIELAB). The * (star) indicates the intended colorimetric reproduction equally spaced in relative CIELAB.

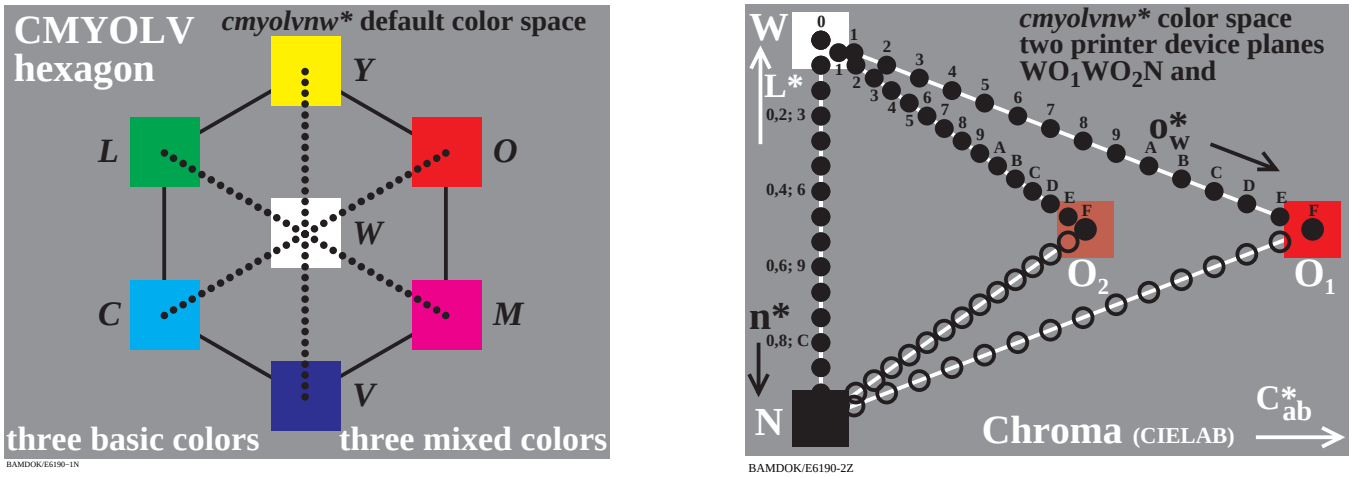

Figure 1: 16 CIELAB colour scales from White *W* to *CMYOLV* (left) and to O_1 or to O_2 (different chroma, right)

For corresponding colours often different output colours are produced on colour printers and monitors.The 16 step output colour series are often not equally spaced in the relative CIELAB colour space which is intended in Fig. 1.

5 steps of colour series cyan blue - white (C - W)	**Colour space, colour space coordinates and PostScript operator calculations according to ISO/IEC 15775:1999-12**		
Linear mixture between cyan blue and white in CIELAB colour space	**CIELAB** ***LAB* (absolute)*** ***LAB* setcolor***	**CMYN (CMYK)** ***cmy0* (relative)*** ***cmy0* setcmykcolor***	**OLV (RGB)** ***olv* (relative)*** ***olv* setrgbcolor***
1,00 C + 0,00 W (cyan blue C)	58.62 -30.62 -42.74	1,00 0,00 0,00 0,00	0,00 1,00 1,00
0,75 C + 0,25 W	67.82 -23.21 -30.86	0,75 0,00 0,00 0,00	0,25 1,00 1,00
0,50 C + 0,50 W	77.02 -15.80 -18.98	0,50 0,00 0,00 0,00	0,50 1,00 1,00
0,25 C + 0,75 W	86.21 -8.39 -7.11	0,25 0,00 0,00 0,00	0,75 1,00 1,00
0,00 C + 1,00 W (white W)	95.41 -0.98 4.76	0,00 0,00 0,00 0,00	1,00 1,00 1,00

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Figure 2: Corresponding colours in three different colour spaces *LAB*, cmy0 and *olv****

The available *PostScript MTL* Code (Measurement, Transfer and Linearization) produces

1. equal colour output for corresponding colours and
2. equally spaced output for the above seven colour series

All corresponding colour data which are placed before the different *PostScript* operators produce identical LAB^*_{in} data by the *MTL* transform. Therefore the output colours must be identical.

The *MTL* code additionally linearizes the output process for the seven colour series in relative CIELAB space. For this linearization method the measurement data of a “start” 16 step output must be included in the MTL code.

Fig. 3 shows the main features of the *MTL* code. On the left side the input coordinates of corresponding colours (in *cmy0*, olv**) are transferred to *LAB** (CIELAB) with the 8 standard or 8 device LAB^*_{in} data (in=input). From the

*LAB**$_{in}$ data the output device coordinates are calculated with the 8 standard or 8 device *LAB**$_{ou}$ data (ou=output). The aim is to minimize the measured CIELAB colour differences between relative or absolute output coordinates *lab**$_{ou}$ or *LAB**$_{ou}$ and the intended relative or absolute input coordinates *lab**$_{in}$ or *LAB**$_{in}$.

For this the *MTL* code linearizes the output. If e. g. the input value (CIELAB lightness) *L**$_{in}$ =50 produces *L**$_{ou}$ =55 then the inverse input *L'**$_{in}$ =45 may produce the intended *L**$_{ou}$ =50 with a high accuracy. By an inverse input the MTL code produces the 16 step output series which are equidistant in CIELAB from White *W* to *CMYOLV* and Black *N*.

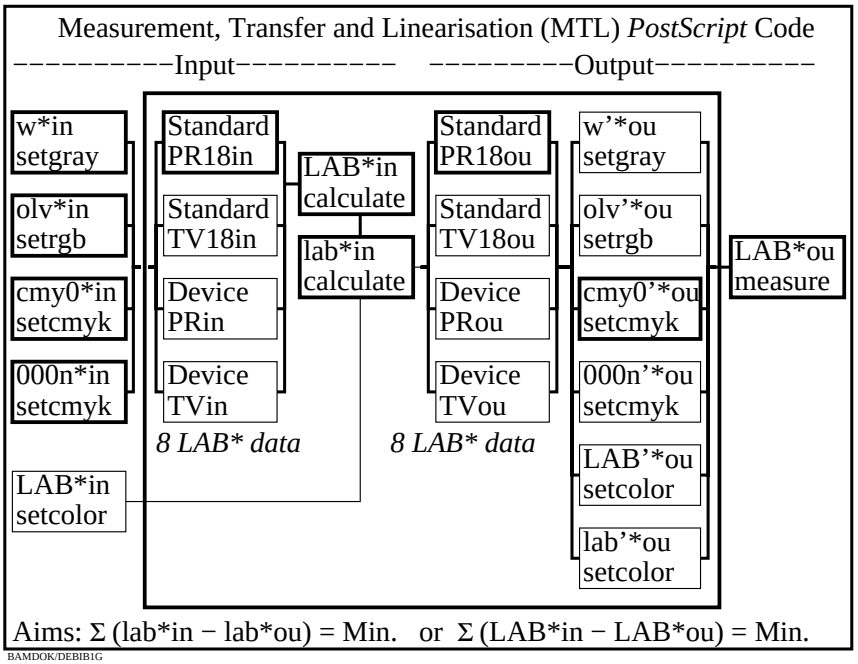

Figure 3: *MTL* code for the transformation of corresponding colours to *LAB** and ***lab**** **(absolute and relative CIELAB, left side) and output linearization by the inverse '* (dash-star) coordinates (right side).**

According to Fig. 3 it is assumed that the input colours are defined by four data *cmyn**$_{in}$ and the *PostScript* operator *setcmykcolor* (and/or the equivalent device coordinates. *olv** or *w** or the CIELAB coordinates *LAB** of Fig. 2*).* If we assume that the colours of the input and output device are identical to the printing (PR) standard colours PR18=PR18$_{in}$=PR18$_{ou}$ then the standard colours PR18$_{in}$ must be used to calculate the *LAB**$_{in}$ data from the *cmyn**$_{in}$ input colour data. The inverse output data *cmyn'**$_{ou}$ which are computed with the PR18$_{ou}$ data and the measured *LAB** data of a start output are used to produce the intended output colours *LAB**$_{ou}$.

The MTL code may be used at different places within the colour workflow, e. g. in the file, in the PS device, in the printer driver or in the *Startup* directory of the software *Adobe Acrobat Distiller.* For more information, see [3] and [4].

It is recommended that a user may study first the output of the different ISO/IEC-test charts on different monitors and printers [2] in his office area, see examples in [5]. The best workflow choice depends on the properties of this study.

References:

[1] ISO/IEC 15775:1999-12: Information Technology - Office machines - Method of specifying image reproduction of colour copying machines by analog test charts - Realisation and Application, 50 pages

[2] DIN 33866-1 to -5, edition:2000-07 – Information technology - Office machines - Colour image reproduction equipment - Method for specifying image reproduction of colour devices by digital and analog test charts, Part 1 to 5 for Classification and principles. Copiers, Printers, Scanners, and Monitors. This standard includes four analog DIN-test charts no. 1 to 4 with the 16 step series of Fig. 1 all equally spaced in CIELAB.

[3]Draft Technical Report ISO/IEC 19797:2003, Device output of 16-step colour scales, output linearization method (LM) and specification of the reproduction properties, see on the following SC28 or BAM web-sites

[4]Draft Technical Report ISO/IEC 24705:2003, Method of specifying image reproduction of colour devices by digital and analog test charts, see on the following SC28 or BAM web-sites

http://www.jbmia.or.jp/sc28

[5] K. Richter, Analog and digital ISO/IEC-colour charts for different reproduction tests and for the efficient use of colour in design, (1000 kByte, 6 pages), AIC meeting, Maribor/Slowenien, 2002

http://www.ps.bam.de/AICMAR.PDF

For further information see e. g. the section publications by the URL
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