CIELAB definition and application of device independent *rgb** colour coordinates for output of elementary colours

Dr. Klaus Richter, BAM and TU Berlin

Federal Institute for Materials Research and Testing (BAM), VIII.1

Unter den Eichen 87, D-12205 Berlin

Tel. +49 30 8104 1834; Fax +49 30 8104 1807

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klaus.richter@bam.de

www.ps.bam.de

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Elementary Colours

The elementary colours Red (R) and Green (G) within a hue circle are both defined as neither yellowish nor blueish by visual assessment. Similar the elementary colours Blue (B) and Yellow (J= Jeane according to ISO/IEC 15775) are both defined by the criteria neither reddish nor greenish.

For example the *Swedish Natural Colour System* (NCS) is based on the four elementary colours RJGB determined by many observers. The NCS hue circle shows the colours R – G and J – B on the horizontal and vertical axis.

In the *Munsell* colour order system the four elementary hues RJGB correspond to the Munsell hue names 5R, 5Y, 5R and 5PB. The “strong” chromatic CIE-test colours no. 9 to 12 have been chosen from approximately these four elementary hues. The four CIE-test colours have the CIELAB hue angles h_{ab} 25, 92, 162 and 272.

User requirement for elementary colour coordinates and output

Up to now in image technology device specific or defined *rgb* colour data, for example interpreted as *sRGB* or *Adobe RGB* colour data, are used. The standard colour data are (1,0,0) for red, (0,1,0) for green, and (0,1,0) for blue. Instead of the elementary hues these standard data produce on devices usually very different hues and the colour hues appear usually yellowish red, yellowish green, and reddish blue. Therefore the hues of the output colour are called Orange-Red (O), Leaf-Green (L) and Violet-Blue (V), for example according to ISO/IEC 15775:1999 and ISO/IEC TR 24705:2005. The data called *olv* data for both the standard offset printing and the television process.

However, most of the users require in application *olv* data interpreted as *rgb** data with the following properties:

The equal or equally spaced *olv* data in the output file shall be interpreted as *rgb** data and shall produce

1. output of the same hue on different devices for standard input data (1,0,0), (1,1,0), (0,1,0).
2. output of the four elementary hues RJGB for standard input data (1,0,0), (1,1,0), (0,1,0) and (0,0,1).
3. output equally spaced in CIELAB for equally spaced *rgb* data.

CIELAB definition of *rgb** colour coordinates for elementary hues.

In image technology the four *olv* colour data (1,0,0), (1,1,0), (0,1,0), (0,0,1) interpreted as *sRGB* or *Adobe RGB* data produce the three colours OYLV (Orange-Red, Yellow, Leaf-Green and Violet-Blue) with CIELAB hue angles 35, 103, 137 and 304 on a standard screen. However the four elementary hues RJGB have approximately the different hue angles 25, 92, 162, 272 in CIELAB. The CIE-test colours no. 9 to 12 according to CIE-Publ. 13.3 are representatives of the four elementary hues. If additionally the device is linearized according to ISO/IEC 19797:2004 then the output is equally spaced in CIELAB, for example for the 16 step colour series between White and the elementary Red (R).

Application: *olv* data in the file and interpreted as *olv** or *rgb** data for device output

Two PDF files with *olv* data and interpreted as *olv** data produce monitor or printer output in 10 hue planes for the three basic colours (OLV), the three mixed colours (CMY), and for the four elementary colours (RJGB). For a display with the standard television colours (see ISO/IEC TR 24705:2005) the output of the PDF-file (10 pages, 350 kByte)

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produces the television device colours on pages numbers 1 to 6 and the four elementary colours of the four CIE-test colours on the page numbers 7 to 10 all equally spaced in CIELAB for the 3 step series for example between White and Cyan C on page number 4. In a similar PDF file the *olv* data interpreted *rgb** data produce the colours R, J, G, G50B, B, and B50R of the NCS system on pages 1 to 6 and the hues of the four CIE-test colours on pages 7 to 10.

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In all example files the *olv* data interpreted as *olv** or *rgb** data and the CIELAB data are on the output pages. For different layouts and up to 16 step colour series for example between White and Orange Red (O) or Red (R) see

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Printer outputs with equally spaced colours in CIELAB for device and elementary hues will be shown at the poster.