

Linearisation methods for reproduction of CIELAB data

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Introduction:

An increasing number of applications uses the CIELAB colour space. Therefore methods are needed to reproduce colours defined in the CIELAB space on an arbitrary colour reproduction device. Here two linearisation methods are shown. Both methods are mapping the CIELAB space onto the device colour space. Instead of using device dependent colour values (e. g. rgb or cmyk values) the reproduction device can then be accessed via colour coordinates which are linear to the CIELAB colour space.

The methods can be used to produce test charts¹⁻⁴, like the ISO/IEC 15575 test chart (figure 1) with a high accuracy.

Linearisation methods:

The methods are based on geometric models. A geometric model uses a set of reference data for a local interpolation, for example a set of device independent CIELAB data and corresponding signal values, for the calculation of values between the reference data. One method uses the trilinear interpolation the other one a tetrahedral interpolation in a Delaunay tetrahedrisation.

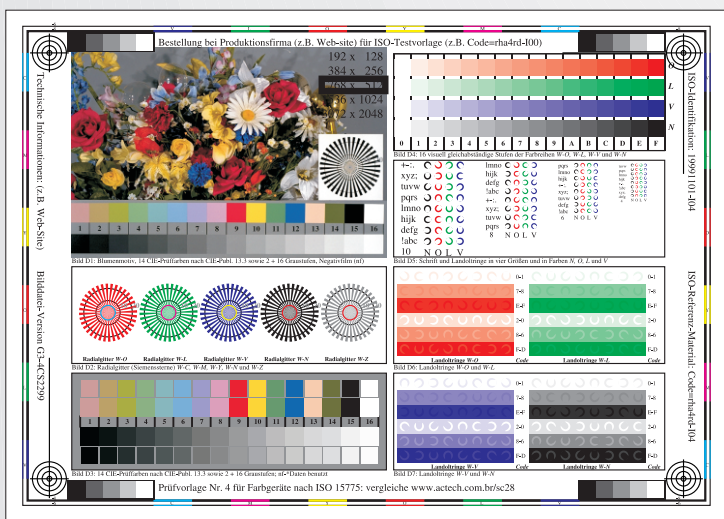


Figure 1: Test chart No. 4 of ISO/IEC 15575

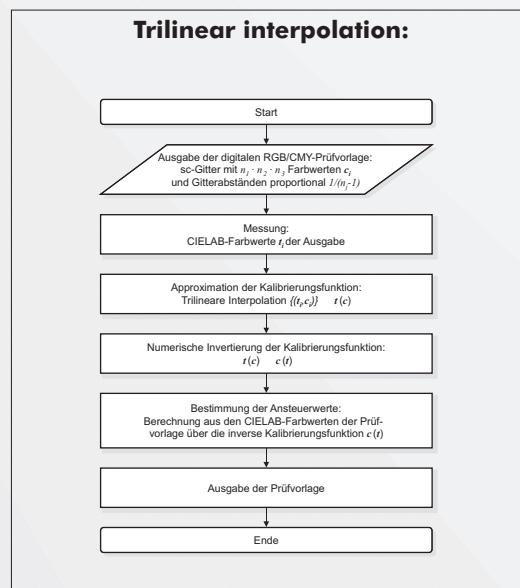


Figure 2: Trilinear interpolation

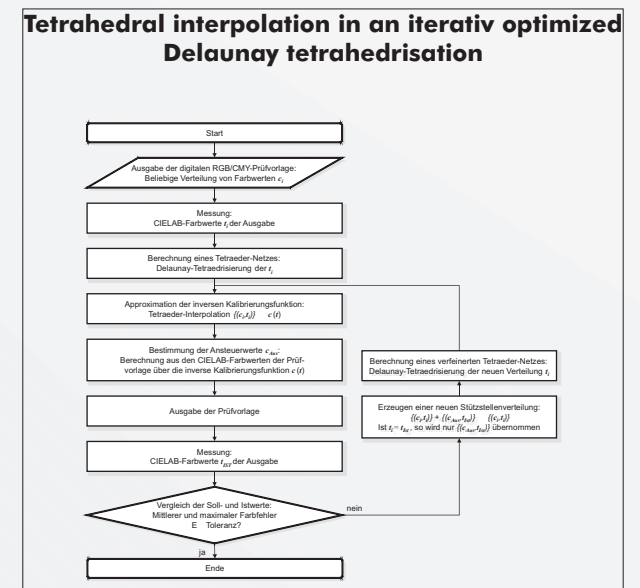


Figure 3: Tetrahedral interpolation

Investigations:

Using a Fuji Fujix Pictography 3000 digital image printer the reproduction properties of the different methods were determined. Therefore the test chart number 4 of the ISO/IEC 15575 was printed. The measurement device used was a Gretag-Macbeth Spectronscan.

Results:

The 14 CIE test colours⁵ could be reproduced with a colour difference below $\Delta E^*_{ab} = 1.4$ which is in the range of the printer reproducibility. The regularity of the 16-step colour scales according to ISO/IEC 15575:1999 was $g^* = 100 \cdot L_{min}/L_{max} = 89$, which is also in the range of the printer reproducibility. Both methods show better results than the ICC colour management, the linearisation method of ISO/IEC TR 19797 and commercially available test charts⁶.

For more details see: <http://opus.kobv.de/tuberlin/volltexte/2006/1363/>

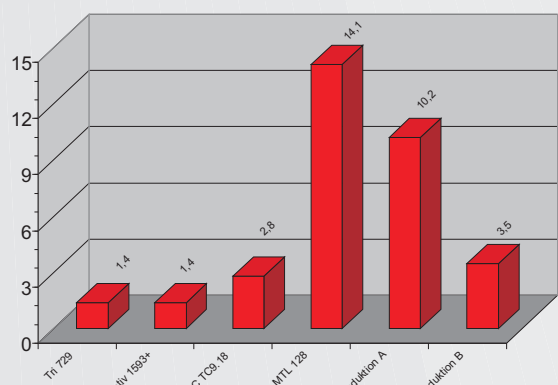


Figure 4: Mean colour difference of the 14 CIE test colours

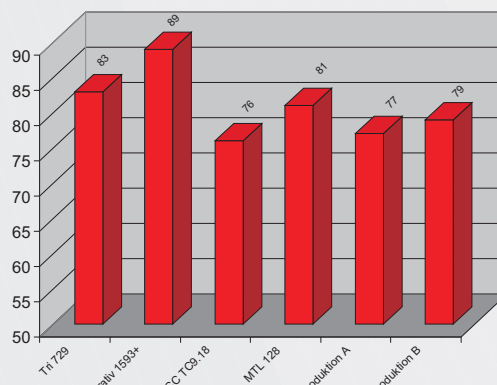


Figure 5: Regularity of the 16-step colour scales

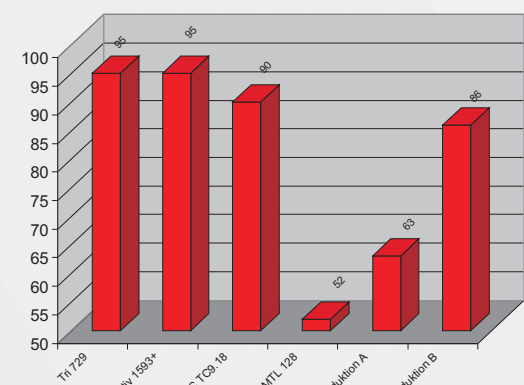


Figure 6: Color reproduction index of the test chart

References:

- 1: Norm ISO/IEC 15575:1999-12. Information technology - Office machines - Method of specifying image reproduction of colour copying machines by analog test charts Realisation and application
- 2: Norm DIN 33866-1 bis -5:2000. Informationstechnik - Büro- und Datentechnik; Farbbildwiedergabegeräte
- 3: Technischer Bericht ISO/IEC TR 19797:2004. Information technology - Office machines - Device output of 16 colour scales, output linearization method (LM) and specification of the reproduction properties
- 4: Technischer Bericht ISO/IEC TR 24705:2005. Information technology - Office machines - Machines for colour image reproduction - Method of specifying image reproduction of colour devices by digital and analog test charts
- 5: Method of Measuring and Specifying Colour Rendering Properties of Light Sources. Commission Internationale de l'Eclairage (CIE), Wien, 1995. CIE Publikation 13.3:1995
- 6: J. Witt: Colorimetric methods for the production of test charts for colour copiers, colour scanners and colour monitors, Berlin, Technische Universität, Diss., Internet: <http://opus.kobv.de/tuberlin/volltexte/2006/1363/>, 2006