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Image technology colour management — Black point compensation for n-colour ICC profiles

Technologie de l'image — BPC pour profil à n couleurs

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Introduction

The xCLR ICC profiles that are used in digital printing applications are often CMYK ICC profiles extended with red, orange, green, blue and/or violet colourants. Hence there is a need to specify black point compensation (BPC) for a well-defined class of xCLR ICC profiles, where xCLR refers to a device-dependent colour space defined in ISO 15076-1 and ICC.1:2001-04, specified for 3 to 15 device colourants wherein the value of x is a hexadecimal digit within the range 3 to F inclusive. Such xCLR ICC profiles are also commonly referred to as n-colour profiles.

To guarantee continuity of the black point compensation procedure between CMYK devices and printing devices with extended colourant sets, xCLR ICC profiles follow the constraints and calculation of output-capable CMYK ICC profiles wherever possible, as specified in ISO 18619:2015.

Limiting xCLR ICC profiles to CMYK plus combinations from the set of red, orange, green, blue and violet colourants is a logical extension of the CMYK colourant set to enhance the printing gamut as applied in digital print. Some of the key additional assumptions which will likely result in predictive and expected behaviour for black point compensation calculations include:

— in a similar fashion to most CMYK colourants, the colourants chosen for use with the xCLR ICC profiles should result in a colour gamut featuring a large range of neutral colours;

— the physical colourants should be sufficiently transparent with well-saturated CMY primaries in order to keep the gamut shell well-formed and permit the black point compensation algorithm to work correctly;

— a well-behaving forward model can be constructed near the darkest neutral, with a well-defined darkest colour, thus guaranteeing a good approximation using curve-fitting as defined by ISO 18619:2015, 4.2.5.5.

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In the case of 4CLR ICC profiles, which are constrained by ISO 15076-1 as well as ICC.1:2001-04 to not refer to CMYK device-dependent colour spaces, the 4CLR colour space should behave similarly to CMYK device-dependent colour spaces, and conforms to the requirements defined by the key assumptions given above for other xCLR ICC profiles.

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An additional class of xCLR ICC profiles for consideration by this document are 3CLR and CMY ICC profiles. For 3CLR ICC profiles, the colourants should be CMY-like in the sense of being chromatic colourants with widely-spaced hue angles (as distinct from achromatic colourants such as grey or black). As a result, BPC for 3CLR ICC profiles is defined by this document, and follows the same approach as for CMY ICC profiles.

The BPC method described in this document does not give meaningful results for most 2CLR ICC profiles, hence these types of ICC profiles are excluded from this document.

In addition, this document extends the BPC method for the ICC v4 profile types with the device-dependent colour spaces described above for corresponding ICC v2 profiles as defined by ICC.1:2001-04.

The black point compensation procedure defined in ISO 18619:2015 is specified for ICC profiles with data colour spaces Gray, RGB, CMYK and CIELAB, as identified in 15076-1. As an increasing number of output ICC profiles for digital printing applications are available with more than four colourants, there is a need to extend black point compensation to n-colour ICC profiles, also referred to as xCLR or extended process ICC profiles.

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