~~ISO/TC 130 N 4680~~

ISO/TS PRF 18621-11:~~2021~~2022(E)

ISO/TC 130/JWG 14

~~Date: 2021-11-26~~

Secretariat: SAC

Graphic technology — Image quality evaluation methods for printed matter — Part 11: Colour gamut analysis

ISO copyright office

CP 401 • Ch. de Blandonnet 8 • CP 401

CH-1214 Vernier, Geneva, Switzerland

Tel. + Phone: +41 22 749 01 11

Fax + 41 22 749 09 47

Email: copyright@iso.org

Website: www.iso.org

Published in Switzerlandwww.iso.org

Contents

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see ~~www.iso.org/directives~~www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see ~~www.iso.org/patents~~www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT~~) see www.iso.org/iso/foreword.html~~), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 130, *Graphic technology*.

This second edition cancels and replaces the first edition (ISO/TS 18621-11:2019), which has been technically revised.

The main changes are as follows:

— Formula (1) has been corrected;

— requirements for conformance were clarified throughout;

— the list of example gamut volumes in Table B.1 has been revised.

A list of all parts in the ISO 18621 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at ~~www.iso.org/members.html~~www.iso.org/members.html.

Introduction

The colour gamut that can be achieved by a reproduction system is an important attribute. It enables users to compare the colour reproduction capabilities of different printing systems and to determine whether one system can simulate all the colours available in another. This document describes procedures to define and compare colour gamuts.

Given a set of coordinates known to lie on the surface of a colour gamut, the volume of the gamut can be determined by segmenting the gamut into a series of tetrahedra, computing the volume of each tetrahedron and summing the results. For a reproduction process with three colour components, a colour will lie on the surface if it satisfies the condition that at least one component has a value of 0 or 1, where 1 represents the maximum amount of the colour component. However, printing processes usually have four or more colour components (e.g. Cyan, Magenta, Yellow and Black in four-colour process printing), and determining which coordinates lie on the gamut boundary cannot be done solely from the relative amounts of the colour components. For CMYK processes, in almost all cases, the Black colorant extends the gamut below the gamut vertex at each hue angle. This makes it possible to identify a set of coordinates which are expected to lie on the gamut surface from the relative colorant amounts and the coordinates of the two- and three-colour overprints. For processes with more than four colour components, some knowledge of the colorimetry of a sample of colours from the colour data encoding is needed in order to determine which colours lie on the boundary.

For these reasons, coordinates on the surface of the gamut of RGB and CMYK printing processes can be determined by printing a test chart with suitable colorant combinations, and measuring the colours; while for other printing processes, it is necessary to model the colorant-to-colorimetry relationship in order to identify colours on the gamut boundary. (RGB here refers to the input signal and supports the common situation where the printer driver accepts RGB instead of CMYK.)

Graphic technology — Image quality evaluation methods for printed matter — Part 11: Colour gamut analysis

IMPORTANT — The electronic file of this document contains colours which are considered to be useful for the correct understanding of the document. Users should therefore consider printing this document using a colour printer.

Scope

This document defines procedures to measure and compare the colour gamuts of RGB and CMYK printing processes.

It is not applicable to other printing processes.

Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

~~ISO 15076-1, *Image technology colour management — Architecture, profile format and data structure — Part 1: Based on ICC.1:2010*~~

~~ISO 12642-1, *Graphic technology — Input data for characterization of four-colour process printing — Part 1: Initial data set*~~

ISO 13655, *Graphic technology — Spectral measurement and colorimetric computation for graphic arts images*

ISO 15076-1, *Image technology colour management — Architecture, profile format and data structure — Part 1: Based on ICC.1:2010*

Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at ~~https://www.iso.org/obp~~https://www.iso.org/obp

— IEC Electropedia: available at ~~http://www.electropedia.org/~~https://www.electropedia.org/

3.1
colour gamut
range of colours that can be reproduced by an output device on a given medium, represented in a CIE-based colour space

Note 1 to entry: The CIE colour space for representation of colour gamuts is normally CIELAB.

3.2
gamut vertex

coordinate in a CIE-based colour space which represents a point on a *colour gamut* (3.1) surface and which is used in defining the surface of the gamut

3.3
gamut face
planar sub-division of the *colour gamut* (3.1) surface formed by three or more coplanar *gamut face edges* (3.4)

Note 1 to entry: The colour gamut of most output devices can be described in terms of a set of gamut faces that completely enclose all the colours that can be reproduced by the device, with no gaps or overlaps.

Note 2 to entry: In this document, gamut faces are defined as having three gamut vertices.

3.4
gamut face edge
line connecting two adjacent vertices of a *gamut face* (3.3)

Note 1 to entry: In a continuous gamut surface, each gamut face edge is shared by two gamut faces.

3.5
characterization model
mathematical model that converts between coordinates in a device colour encoding and a CIE-based colour space

3.6
device gamut
range of colours that corresponds to all possible combinations of colour channels of the device within the device data encoding, when printed on a substrate

3.7
usable gamut
subset of the *device gamut* (3.6) that corresponds to the set of combinations of colour channels of the device in practical use, when reproduced on an output medium

Note 1 to entry: The usable gamut of an output device is normally smaller than the device gamut owing to practical limitations in the combinations of colour channels. Most CMYK devices cannot produce a print in which all channels are set to the maximum. The usable gamut is applicable when the gamut to be determined is that of the system when used as part of a reproduction workflow, using an ICC profile to convert to output channels; while the device gamut is applicable when the gamut to be determined is that of the reproduction device independently of the profile and its colour separation method.

Note 2 to entry: In practice, some printers do not allow all possible combinations of ink to be printed, and an ink-limiting procedure is applied automatically in the printer. Where this is done, this "ink-limited" mode of printing still should be considered to be the "device gamut".

Describing a colour gamut

General

The colour gamut of a reproduction system is a volume in 3D colour space. It shall be mathematically described as a closed set of triangular faces on the surface of the gamut which completely encloses the gamut volume.

Requirements of a gamut boundary description

Each face should be defined by three colorimetric coordinates, and the set of faces shall be defined in such a way that it encloses the volume of the gamut without gaps or overlaps. The surface shall be encoded as an nx3 array of vertices (in which there are n vertices and each row represents the colour space coordinates of