
**Graphic technology — Multispectral
imaging measurement and
colorimetric computation for graphic
arts and industrial application —**

**Part 1:
Parameters and measurement
methods**





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Foreword

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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.

Introduction

Multispectral imaging is an image capture technology with more than three channels or wavelengths. This document focuses on multispectral image capture of surfaces with spatially varying colour. To achieve this, a contiguous band of wavelengths are sampled including the visible range and, in some cases, including ultraviolet and infrared.

NOTE The term hyperspectral imaging is typically used for systems capturing multiple wavelength bands such as infrared, visible, ultraviolet and other electromagnetic ranges^[1]. Usually, these bands are non-contiguous or are overlapping. The boundary between multispectral and hyperspectral in practice is sometimes not precise and the usage of each term is often inaccurate, often for marketing reasons. To avoid any confusion, this document uses the term multispectral imaging to mean capture of image data across a single continuous band of wavelengths sampled at regular intervals across the visible range and which can extend into the infrared or ultraviolet.

In the past, assessment of object surfaces with spatially varying colour was carried out by visual inspection by experienced personnel. In some cases, area-averaging (pointwise) measurements were made to obtain the average value of the spatially varying colour of the object surfaces. The object surface was sampled at regular spatial intervals, however low spatial resolution and imprecise re-positioning between repeated measurements limited the success of such approaches. With the advent of modern lighting and 2D-sensor technologies, multispectral imaging devices are increasingly being used for this purpose.

Many laminations, decorations and materials containing patterns of various colours are produced by printing processes that include offset lithography, letterpress, flexography, gravure, screen and digital printing. To characterize the appearance of these objects effectively, the spectral reflectance factor must be read at many points across and down the object. Multispectral imaging devices can do this very effectively and provide an unprecedented advantage allowing pixel-wise evaluation of colour image difference to be used for quality assessment. Improved digital colour transforms based on this assessment can be used to reduce spatial colour differences leading to better reproductions. One benefit over RGB-based imaging systems is the improved colour accuracy when characterizing printing systems that use process colorants beyond CMYK, for example including orange, green and violet inks.

There are only a few choices allowed by the CIE when making spectral measurements and performing colorimetric computations. The specific choice will result in numerical values for the specific property for a specific specimen that are in agreement with the results from national standardizing laboratories. Similarly, two instruments from different manufacturers, that are both different from the CIE recommendations can be different from each other.

ISO 13655 specifies a limited number of such choices for the measurement and computation of the colorimetric characteristics of single printed patches providing a solid foundation for consistent colour communication within the graphic arts community. There is a need to have multispectral measurement system attributes documented and standardized in order to achieve a similar solid foundation so that multispectral images can reliably be compared.

Spectral imaging systems aim for spectrally resolved pixel data of an image of a scene. The objectives of these systems include object or material identification, and monitoring of manufacturing processes. Current multispectral imaging technologies restrict the number of spectral image channels to a set that is smaller than the minimum required by ISO 13655 for spectral measurements (400 nm to 700 nm at 20 nm intervals, requiring 16 channels). While such systems might become more widely available in future, this document provides requirements for systems with fewer channels.

There are many commercially available multispectral imaging systems which provide spectral diffuse reflectance factor measurements at many pixels, from which colorimetric values can be calculated. The majority of these instruments do not conform to ISO 13655 guidelines for spectral measurements. In practice, it might not be possible to achieve all requirements of speed, spatial resolution and ISO 13655 spectral sampling in a cost-effective multispectral imaging system. One trade-off is to decrease the number of spectral channels. This can result in different numerical values for the colorimetry of a specimen when compared to measurements conforming to ISO 13655. Unless the data being compared