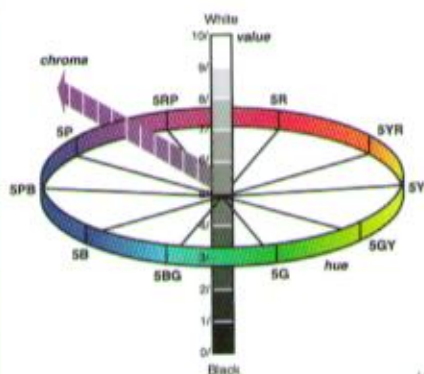


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Colour measurement

Principles, advances and industrial applications

Edited by M. L. Gulrajani



The Textile Institute

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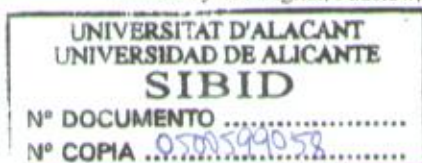
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Contents

<i>Contributor contact details</i>	<i>xi</i>
<i>Woodhead Publishing Series in Textiles</i>	<i>xv</i>
Part I Theories, principles and methods of measuring colour	1
1 Colour vision: theories and principles	3
V. V. PÉREZ, D. DE FEZ SAIZ and F. MARTINEZ VERDÚ, University of Alicante, Spain	
1.1 Introduction	3
1.2 Human colour vision	6
1.3 Chromatic perception	10
1.4 Defective colour vision	12
1.5 Colour constancy	15
1.6 Bibliography	17
2 Scales for communicating colours	19
A. K. ROY CHOUDHURY, Government College of Engineering and Textile Technology, India	
2.1 Introduction	19
2.2 Systematic arrangements of colours	22
2.3 Colour order systems	23
2.4 Various colour order systems	31
2.5 Comparison and interrelation of various systems	51
2.6 Accuracy of colour order systems	54
2.7 Computer-based systems	54
2.8 Universal colour language (UCL)	61
2.9 Future trends	63
2.10 References	65

vi	Contents	
3	Expressing colours numerically	70
	V. C. GUPTA, Advanced Graphic Systems, India	
3.1	Introduction	70
3.2	Colour specifications	70
3.3	The Commission Internationale de l'Eclairage (CIE) system	72
3.4	The CIE standard light sources/illuminants	72
3.5	The CIE Standard Observer and unreal primaries	74
3.6	Computation of tristimulus values	77
3.7	Reflectance measurement	79
3.8	Chromaticity coordinates and chromaticity diagram	80
3.9	Usefulness of the CIE XYZ system	81
3.10	Limitations of the CIE system	82
3.11	Transformation and improvement of the CIE system	82
3.12	Future trends	86
3.13	References	86
4	Visual and instrumental evaluation of whiteness and yellowness	88
	R. HIRSCHLER, SENAI/CETIQT Colour Institute, Brazil	
4.1	Introduction: whiteness and yellowness	88
4.2	Visual assessment of whiteness	90
4.3	Measuring techniques and instruments	95
4.4	Indices for whiteness and yellowness	100
4.5	Applications in industry, cosmetics and dentistry	111
4.6	Future trends	115
4.7	Sources of further information and advice	117
4.8	References	119
5	Use of artificial neural networks (ANNs) in colour measurement	125
	M. SENTHILKUMAR, PSG College of Technology, India	
5.1	Introduction	125
5.2	Artificial neural networks (ANNs): basic principles	126
5.3	Architecture of an artificial neural network	127
5.4	Learning process	129
5.5	Feed-forward neural network	130
5.6	Training of an artificial neural network using back propagation algorithm	130
5.7	Application of artificial neural networks to colour measurement	132
5.8	Recipe prediction	135
5.9	Evaluation of the ANN method	140
5.10	Case studies	140

5.11	Future trends	141
5.12	Sources of further information and advice	144
5.13	References	144
6	Camera-based colour measurement	147
	F. MARTÍNEZ-VERDÚ, E. CHORRO and E. PERALES, University of Alicante, Spain, M. VILASECA and J. PUJOL, Technical University of Catalonia, Spain	
6.1	Introduction	147
6.2	Principles of camera-based colour measurement	149
6.3	Procedures of camera-based colour measurement	151
6.4	Strengths and weaknesses	154
6.5	Case studies	158
6.6	Future trends	162
6.7	Conclusions	163
6.8	Sources of further information and advice	163
6.9	References	163
7	Colour shade sorting	167
	M. L. GULRAJANI, India Institute of Technology, India	
7.1	Introduction	167
7.2	(555) Fixed-grid shade sorting system	168
7.3	Clemson Colour Clustering	174
7.4	K-means clustering	178
7.5	Modified CCC shade sorting method	180
7.6	Shade sequencing and clustering	180
7.7	References	182
8	Determining uncertainty and improving the accuracy of color measurement	184
	J. A. LADSON, Color Science Consultancy, USA	
8.1	Introduction to determining uncertainty	184
8.2	Uncertainty	185
8.3	Definitions	186
8.4	Tables of results	187
8.5	Conclusions: determining uncertainty	189
8.6	Improving accuracy: the absolute correction of instrumentally generated spectrometer values	190
8.7	Introduction to improving accuracy	190
8.8	Experimental modeling	191
8.9	Applications	193
8.10	Conclusions: improving accuracy	194
8.11	References	195

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Abstract: For several decades, imaging sensors (CCD and CMOS) have been extensively used in many types of imaging capture devices (cameras and scanners). This first stage in any digital imaging workflow is very important in order to control the exact colour reproduction of images in subsequent applications (astronomy, television, cinema, printing, machine vision, mobiles, etc). However, there are many parameters (spectral sensitivities, white balance, dynamic range, etc) which can negatively influence accurate control of the colour reproduction of digital imaging devices. Nevertheless, if all these parameters are controlled, it is possible to transform a conventional digital imaging capture device into a versatile tele-colorimeter or even tele-spectrocolorimeter. In this chapter, the fundamentals and challenges of camera-based colour measurement will be explained, including several aspects of special interest, such as the control of raw RGB colour space, and the similarities and differences between spectral and colorimetric characterization and calibration. Finally, future trends with clear industrial applications will be described, including case studies focused on the spatial-chromatic dithering of texture images (textiles, ceramic tiles, natural stones, etc), and the pseudo-visualization of non-visible images from multi-spectral imaging capture.

Key words: imaging sensor, digital imaging workflow, spectral sensitivity, white balance, exposure level, dynamic range, raw RGB colour space, colour gamut, calibration vs. characterization, luminance adaptation, multi-spectral imaging, spatial-chromatic dithering in texture images, pseudo-visualization of non-visible images

6.1 Introduction

With the invention in 1969 of the charge-coupled device (CCD) (Holst 1998) by Willard S. Boyle and George E. Smith – both awarded the Nobel Prize in Physics in 2009 – and its combination with photo-detection sensors, it was possible to expand many industrial applications, and even introduce new ones. In digital colour imaging, this invention was considered a significant milestone, together with the invention in 1993 of the CMOS or active pixel sensor by E. Fossum (Lee 2005; Nakamura 2006; Ohta 2008). Although both imaging sensors present similarities and differences, it is probable that the specific advantages and drawbacks of each in respect to each particular application will condition future trends in their application fields (see Fig. 6.1).

In digital colour imaging these imaging sensors are essential elements for any digital imaging workflow (Jacobson et al. 2000; Saxby 2002; Sharma 2003; Peres

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The measurement of colour is important in many commercial operations and professions, such as bleaching and coloration of textiles, applications of paints, dentistry and coloration of food products. This book will discuss colour measurement theories, the latest technological and scientific developments in measuring colour and the applications of colour measurement.

Part I reviews the underlying theories, principles and methods of how to measure colour. It includes topics such as expressing colours numerically, camera-based colour measurement, colour shade sorting and determining and improving the accuracy of colour measurement. Part II presents a selection of industrial applications illustrating the use of colour measurement in textiles, paint, teeth, hair and food.

With its international range of contributors, *Colour measurement: principles, advances and industrial applications* is aimed at a variety of readers including colour technologists, colour quality inspectors, product developers, dentists, cosmetologists and anyone who uses colour in their work. It will also be beneficial for academics and students studying design, fashion or colour-related subjects.

Dr M. L. Gulrajani is a Professor at the Indian Institute of Technology in Delhi. He has undertaken more than 50 consultancy projects from various textile industries, published over 150 research papers, edited 24 books, including conference proceedings and has five Indian patents. He is a Fellow of the Society of Dyers and Colourists (UK), the Textile Association (India) and is an Honorary Member of the Association of Chemical Technologists (India).

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