

CIE Online Tutorials on Colorimetry and Visual Appearance

TUTORIAL ON THE REPRODUCTION AND MEASUREMENT OF 3D OBJECTS

Convener: Dr Kaida Xiao (k.xiao1@leeds.ac.uk)

Summary

3D printing technology, also known as additive manufacturing technology, is one of the most revolutionary technologies in recent years. Yet despite the advances in production technology, characterizing the surface appearance of 3D objects remains a challenge. Methods of analysis and measurement are highly desired that can economically capture the relevant physical properties of materials and their visual appearance independent of viewing condition. This research topic is defined as one of top priority topics by CIE and known as Research Strategy: Reproduction and Measurement of 3D objects. This tutorial will focus on this research topic to introduce recent research related to 3D printing technology, measurement of 3D objects, appearance of 3D objects and colour difference of 3D objects respectively.

CIE Related Publications and Current Work

- CIE Research Strategy : Reproduction and Measurement of 3D objects
- TC 8-17: Methods for evaluating Colour Difference between 3D colour objects
- JTC 17 (D1/D2/D8) Gloss measurement and gloss perception: A framework for the definition and standardization of visual cues to gloss

Presentations

- **CIE D8 research strategy, Measurement and Reproduction of 3D objects**
Po-Chieh Hung, CIE Division 8 Director, USA

Brief introduction of CIE D8 Research Strategy, Measurement and Reproduction of 3D objects.

- **Recent Milestones on the Road to Realistic 3D Modelling**
Yoav Bressle, Stratasys, Israel

Recent development of 3D colour printing technologies and colour appearance reproduction.

- **Factors affecting the accuracy of image-based colour measurement for 3D objects**
Pei-li Sun, National Taiwan University of Science and Technology, Chinese Taipei

Recent research in developing image based colour measurement for 3D objects.

Chromatic adaptation in 3D scene

Shining Ma, KU Leuven, Belgium

New experiment to assess chromatic adaptation for 3D objects and modelling.

- **Color difference evaluation for 3D printed object**
Guihua Cui, Wehzhou University, China

Data collection for colour difference evaluation between pairs of 3D objects and colour difference modelling.

Overview

Topic	Length	Presenter
Tutorial introduction	<i>5 min</i>	Kaida XIAO
CIE D8 research strategy, Measurement and Reproduction of 3D objects	<i>5 min</i>	Po-Chieh HUNG
Recent Milestones on the Road to Realistic 3D Modelling	<i>20 min</i>	Yoav BRESSLE
Factors affecting the accuracy of image-based colour measurement for 3D objects	<i>20 min</i>	Pei-Li SUN
Chromatic adaptation in 3D scene	<i>20 min</i>	Shining MA
Colour difference evaluation for 3D printed objects	<i>20 min</i>	Guihua CUI

Presenters



Dr Kaida Xiao (convener)

Associate Professor in University of Leeds, Leeds, United Kingdom

Kaida received his PhD from the Colour and Imaging Institute at the University of Derby in the United Kingdom in 2007. He is now an Associate Professor in Colour and Imaging Science at the School of Design of the University of Leeds, United Kingdom. His research interests are related to 3D colour image reproduction, 3D colour printing, skin image capture and analysis, colour appearance modelling and image quality enhancement. He is Chair of CIE Technical Committee TC 8-17 *Methods for Evaluating Colour Difference between 3D Colour Objects*.



Dr Po-Chieh Hung

CIE Division 8 Director, USA

Po-Chieh received his BSc and MSc degrees in Electronic Engineering from Waseda University and his PhD in Imaging Science from Chiba University, Japan. He has been involved in the developments of various colour and imaging devices for industry for more than 30 years.

He has been serving as CIE Division 8 director since 2015.



Mr Yoav Bressler

Senior Research Scientist at the Stratasys R&D, Israel

Yoav received his MSc with distinction from the Interdisciplinary Department of the School of Engineering, Tel-Aviv University, Israel, in 1986. His interest in colour technology started in 1988 at Scitex Corporation and continued in large companies, including Kodak and HP as well small start-ups, including Shira Computers and RealTimeImage. Since 2007, Yoav has taken a special interest in UV cured ink-jet printers, cumulating in 3D Poly-jet full colour printing in Stratasys Ltd. for the last six years.



Dr Pei-Li Sun

Associate Professor at National Taiwan University of Science and Technology, Chinese Taipei

Pei-Li received his PhD from the Colour and Imaging Institute of Derby University in the United Kingdom in 2002. He is now an Associate Professor of the Graduate Institute of Colour and Illumination Technology at National Taiwan University of Science and Technology, Taipei, Chinese Taipei. His research interests lie in the fields of colour engineering, 3D imaging and image quality enhancement. He is a member of CIE TC 8-17.



Ms Shining Ma

PhD student at KU Leuven, Belgium

Shining received her BSc and MSc in optical engineering from Zhejiang University in 2017. She now is a PhD researcher at the ESAT/Light & Lighting Laboratory, KU Leuven, Belgium. Her PhD subject is 'Chromatic adaptation in the complex scene'.



Dr Guihua Cui

Professor at Wenzhou University, China

Guihua received his PhD in Colour Science and Imaging from the University of Derby, United Kingdom, in 2000. His research interests include colour-difference evaluation, uniform colour space and colour image processing. He is now working as a full professor of colour science at the Wenzhou University, China. He is a member of CIE TC 8-17.