TOPICALITIES

Edited by Markéta Držková

CONTENTS

News & more – J. Print Media Technol. Res. – Vol. 11 No. 4 (2022), 293–294

293

News & more

The activities of CIE in 2022

In the first weeks of 2022, the International Commission on Illumination established its new Research Forum CIE RF-04 Lighting in the Usage of Augmented, Virtual, and Mixed Reality Devices. During the following months, four Technical Committees (TCs) were newly formed: two under Division 2, Physical Measurement of Light and Radiation, and the other two as a part of Division 3, Interior Environment and Lighting Design. The task of CIE TC 2-97 is to prepare a revision of CIE S 025/E:2015 Test Method for LED Lamps, LED Luminaires and LED Modules and its supplement CIE S 025-SP1/E:2019 that were both introduced quite recently, whereas CIE TC 2-98 will revise an older technical report CIE 130-1998 Practical Methods for the Measurement of Reflectance and Transmittance. The aim of CIE TC 3-61 is to review regional daylight requirements and assess the feasibility of global harmonisation. The last one, CIE TC 3-62 Resilient Lighting, should develop lighting requirements and plans for disaster lighting.

Besides several events held in the year 2022 by the CIE National Committees, the one-day CIE Symposium on Advances in Measurement of Temporal Light Modulation took place in October in Athens, Greece. The proceedings with 9 of the 13 papers were published as CIE x049:2022. All papers are also available individually, six of them with open access. Their topics include, for example, implementing lock-in detection in photometry and spectroradiometry using temporal light modulation and minimising the uncertainties in the calculation of stroboscopic effect visibility measure.

Since the end of 2021, the requirements to perform reproducible photometric and colorimetric measurements of devices used in road vehicles for road illumination, light-signalling, and retroreflection are available as a draft international standard CIE DIS 027:2021. The document was prepared by the corresponding committee of Division 2 and is still subject to changes. Among other recent publications, the Technical Report CIE 249:2022 Visual aspects of time-modulated lighting systems deals with distortions in the perception of the environment that are caused by the fast change in luminous output. These effects are mostly undesired and bring the risk of negative impact not only on the experience of the illumination quality but also on performance and health. The report was prepared under Division 1, Vision and Colour, and builds on the Technical Note CIE TN 006:2016, which defined the perceptual effects modulated light can produce, the methods for quantifying these temporal light artefacts and the parameters that influence their visibility. The effects of light on human health, performance and well-being are also presented in the joint ISO/CIE TR 21783:2022 Light and lighting – Integrative lighting – Non-visual effects, published in September 2022. This document reviews the relevant scientific background on the non-visual responses to light and discusses beneficial aims, avoidance of risks and implementation considerations. Another joint ISO/CIE document, which revises ISO 23539:2005 Photometry – The CIE system of physical photometry to bring the standard up to date with recent developments, is under publication. Five recently published documents most relevant to the scope of JP-MTR are presented on the next page in more detail.

Fogra research projects and new tools in 2022

Recently, two projects of Fogra were completed by dedicated research teams, both from the field of prepress technology. DeepQuality, the joint project of Fogra and the Institute of Imaging and Computer Vision at the RWTH Aachen University, applied machine learning for dynamic image style evaluation to increase automation of image retouching. Besides the report, the output of this project includes a publicly available WebApp where users can test trained artificial intelligence systems on their images. The second project, TextileRGB, was concerned with colour communication in digital textile printing. The work employed the colour appearance assessment of 110 textile samples with disperse dyes, sublimation dyes, reactive dyes, pigment inks and acid dyes. The research was also focused on the suitable ICC RGB exchange colour spaces and production of paper proofs where it is important to consider the relevant paper characteristics, i.e. its shade, the content of optical brightening agents, gloss and texture. The tools developed within the project include an RGB-based test form for RGB process control and quality assurance and a spreadsheet for instrumental evaluation, both available for free. The test form serves for the characterisation of digital textile printing processes, enabling analysis of their output, as well as for the validation of the accuracy of profiling and proof printing. The proposed RGB workflow makes use of the exchange colour space FOGRA58, further developed within this project, and enables accurate colour reproduction of D65/10°-based textile originals. For OBA-rich substrates, it is recommended to use the M2 measurement mode. The new MediaWedge Textile RGB, a subset of the established chart TC 9.18 RGB, is available in the Fogra shop.

The ongoing Fogra research projects include those started in 2021 (see JPMTR Vol. 10, No. 4), which are to be completed now or in the coming months. Among the projects started in 2022, two are worked on by the Printing Techniques Department. The first one explores the use of LED UV lamps instead of the hot-air units for ink drying in web offset presses to increase the economic efficiency and sustainability of print production through independence from natural gas, a topic which gained even more importance due to the present energy crisis. The approach is based on developing a cost and CO_2 calculator and obtaining the required data through extensive research. Also, the suitability of papers for the proposed process needs to be investigated. The second project concerns the visual and metrological characterisation of metallic effects to increase process reliability in packaging printing. The solution comprises the production and measurement of different metallised prints and defining an appropriate scale for the metallic effect using pairwise visual comparisons under different lighting conditions to determine a functional relationship between the strength of the metallic effect and the metrological parameters. In the area of prepress technology, two new projects were started as well. One builds on a past project focused on modelling colour appearance for full-colour 3D printers (see also JPMTR Vol. 10, No. 4) and deals with 3D soft proof for an accurate simulation of volumetric light transport effects and geometric errors in 3D prints. It aims to develop and validate two renderers, one device-independent and one device-specific, using deep-learning approaches. Further, a new 3D printing exchange colour space should be created and integrated into the iccMax framework. Another project is dedicated to the development of a cross-process print quality assessment procedure and the corresponding indicator, the so-called ISO index. Finally, the new project in the area of security applications investigates electrostatic discharge methods for integrated biometric sensors in smart cards.

ISO/CIE 11664-2:2022 and ISO/CIE 11664-6:2022
Colorimetry
Part 2: CIE standard illuminants
Part 6: CIEDE2000 colour-difference formula

The current versions of these two parts of the ISO/CIE 11664 series on colorimetry were published in August 2022. The first edition of Part 2 cancels and replaces ISO 11664-2:2007 (CIE S 014-2:2006). The CIE illuminant D50, commonly used in graphic arts and printing, is now defined as a CIE standard illuminant, representing the main change in this revision. Values for D50 relative spectral power distribution at 1 nm intervals from 300 to 830 nm are included in Annex B. The second edition of Part 6 is a minor revision of its first edition from 2014. First editions of Part 1: CIE standard colorimetric observers, Part 3: CIE tristimulus values, and Part 4: CIE 1976 L*a*b* colour space were published in June 2019, see JPMTR Vol. 8, No. 4 (2019). Part 5: CIE 1976 L*u*v* colour space and u′, v′ uniform chromaticity scale diagram was published in 2016, and its second edition is under development.

CIE TN 013:2022 – Terms related to Planckian radiation temperature for light sources

This Technical Note defines the terms thermodynamic temperature, Planckian radiator (blackbody) temperature, radiance temperature, colour temperature, correlated colour temperature, distribution temperature and ratio temperature, highlighting their relationships. For each term, it provides relevant details and information on the applicability, for example, limited by chromaticity. For correlated colour temperature and distribution temperature, it also describes the sources of uncertainties. This document supersedes CIE 114-1994 CIE Collection in photometry and radiometry, Part 4 Distribution temperature and ratio temperature, and is available for free.

CIE 248:2022 – The CIE 2016 colour appearance model for colour management systems: CIECAM16

This document was prepared under Division 1 and Division 8, Image Technology, and supersedes CIE 159:2004 A colour appearance model for colour management systems: CIECAM02. The report describes the evolution and application of the CIECAM16 colour appearance model, including its use in practical applications. It provides a chromatic adaptation transform and equations to calculate a set of perceptual attribute correlates using the CIE 1931 standard colorimetric observer. The revised model maintains the same prediction performance for visual data as the previous model but is simpler. It may be helpful for colour management systems that involve related colours, especially for evaluating photographic prints and self-luminous displays.

CIE 250:2022 – Spectroradiometric measurement of optical radiation sources

With 94 pages, this report is the most extensive one among those published in 2022. It was prepared under Division 2 and, after almost 40 years, supersedes CIE 063-1984 The spectroradiometric measurement of light sources. The document explains the basic measurement principles and measured quantities and provides instructions for measurement in the wavelength range of 200–2 500 nm. It describes optics, measurement geometries for irradiance, radiant intensity, radiant flux and radiance, lamps and source spectra determination. Also, it presents in detail different aspects contributing to measurement uncertainty, from wavelength scale to coherence.

Bookshelf – J. Print Media Technol. Res. – Vol. 11 No. 4 (2022), 295–300

295

Bookshelf

**Smart Materials in Additive Manufacturing
Volume 1: 4D Printing Principles and Fabrication
Volume 2: 4D Printing Mechanics, Modeling, and
Advanced Engineering Applications**

These two new volumes were contributed by almost 80 experts from across the globe and bring a comprehensive account of current advances in a rapidly evolving field of 4D printing where 3D-printed smart materials form dynamic objects responding in a controlled way to external stimuli. The first volume is intended to help all entering the field further familiarise themselves with the concepts and principles of 4D printing technology, while the second volume focuses on a top-down approach to modelling and designing 4D printing applications. Overall, readers may find the text useful for identifying related research and business opportunities.

The first volume begins with an introduction to 4D printing, highlighting the contents of the book and their significance. Then, 11 chapters deal with modelling, fabrication and other aspects of various 4D-printed structures. These include the soft robots made from dielectric elastomers, especially the systems having high bending actuation, the light-responsive structures, including their potential applications in encryption, anti-counterfeiting, self-healing and photo-controlled microfluidics, the low-voltage electroactive polymers fabricated by the technology based on direct ink writing, and the formulation composition and chemistry of stimuli-responsive hydrogels. Further, they present the specifics of 4D bioprinting, the approaches for 4D printing at the microscale and the design of suitable inks, different soft materials for 4D printing from hydrogels to nanocomposites, 4D printing of natural fibre composite changing shape by hygro-morphing, the functionalised 4D-printed sensor systems for human–device interfaces, the origami-inspired 4D printing, and the successful approaches to achieving reversible transformations of 4D-printed structures. The last chapter discusses the considerations for closing the gap between research and industrial applications.

The second volume overviews recent techniques and tools for 4D printing design and then, in 14 chapters, presents selected examples from various areas in depth. These include 4D printing of electro-induced shape memory polymers, modelling using the Abaqus software and via machine learning, 4D-printed pneumatic soft actuators, structures with tunable mechanical properties, shape memory polymer, 4D textiles, closed-loop control of 4D-printed hydrogel soft robots, the hierarchical motion of 4D-printed structures using the temperature memory effect, manufacturing highly elastic skin integrated with twisted and coiled polymer muscles, multi-material 4D printing simulation using a Rhinoceros 3D Grasshopper plugin, origami-inspired tunable radio frequency and wireless 4D structures and modules, shape-reversible 4D printing aided by shape memory alloys, and variable stiffness 4D printing.
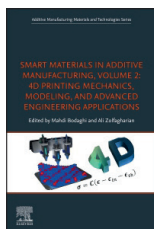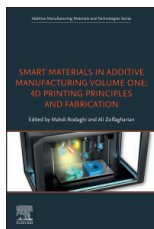
Editors: Mahdi Bodaghi, Ali Zolfagharian

Publisher: Elsevier
1st ed., June 2022
ISBN: 978-0-12-824082-3 & 978-0-323-95430-3
482 & 464 pages
Softcover
Available also as an eBook

Interdisciplinary Research for Printing and Packaging

Editors: Pengfei Zhao, Zhuangzhi Ye, Min Xu, Li Yang, Linghao Zhang, Shu Yan

Publisher: Springer
1st ed., April 2022
ISBN: 978-9811916724
557 pages, 364 images
Hardcover
Also as an eBook

This volume includes a selection of about 80 peer-reviewed papers from the 2021 12th China Academic Conference on Printing and Packaging held in Beijing, China. The topics cover colour science, image processing, reproduction quality, material properties, machinery, printed electronics, 3D printing, and more. The papers deal, for example, with colour-matching functions, structural colours, denoising methods, a halftone blind watermark, a flexible tactile sensor, mechanical properties of honeycomb paperboard, an edible ink based on chlorophyll and chitosan, thermal expansion microcapsules, a sound-absorbing ink, and smart storage location optimisation.

Sustainability for 3D Printing

Editors: Kamalpreet Sandhu, Sunpreet Singh, Chander Prakash, Karupppasamy Subburaj, Seeram Ramakrishna

Publisher: Springer
1st ed., September 2021
ISBN: 978-3030752347
205 pages, 68 images
Hardcover
Also as an eBook

As a part of the Springer Tracts in Additive Manufacturing series, this new book focuses on transforming different types of waste into 3D-printable materials appropriate for design and engineering applications. It reviews the practical examples with the corresponding models, machine tools and processing routes. Also, it deals with the life cycle assessment and evaluation of sustainability and eco-friendliness

FIRST 7.0
### Flexographic Image Reproduction Specifications & Tolerances

The anniversary edition of this comprehensive guide for the flexographic industry, first published in 1997, reflects the changes in referenced methods and standards implemented during the past five years since the sixth edition and also brings improvements in the structure of the text. The Communication and Implementation section, which presents the methods for press optimisation, fingerprinting and characterisation, as well as process control and improvement, includes the updates based on CGATS TR 012-2020, the current version of the technical report prepared by the Committee for Graphic Arts Technologies Standards and registered with ANSI, the American National Standards Institute. The completely rewritten Design section with eight chapters introducing the relevant terms and concepts, type and design elements, digital photography, graphic arts software, document structure, file formats, usage and handing over to prepress can be downloaded for free. The updated Prepress and Print sections are followed by the new Measurement and Verification section, which collects information on barcodes, process control test elements, instrumentation, ink room procedures and testing, and ink trapping. The end part provides a glossary, index and eight appendices with contacts, extensively updated references, targets, 2D codes and guides to creating tone scale, process control of spot colours, understanding opacity and The Optimal Method for colour calibration.

Publisher:
Flexographic Technical Association, Inc.
7th ed., October 2022
ISBN: 978-1-735-28936-6
866 pages
Hardcover
Available also as an eBook

Industry 4.0 in Small and Medium-Sized Enterprises (SMEs)
Opportunities, Challenges, and Solutions

In twelve chapters, this new book introduces the Fourth Industrial Revolution in the context of small and medium-sized enterprises and discusses various related aspects as well as opportunities and issues in different areas. While some authors focus on the situation in India, some deal with the topic in general. One case study analyses technology gaps in the Mysore Printers Cluster with about 250 enterprises, identifying training requirements and proposing an action plan to create an attractive opportunity in the Industry 4.0 market. The last chapter deals with the Education 4.0 concept, the essential skills and competencies, and the related changing role of academics.
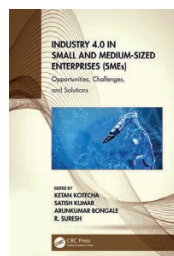
Editors: Ketan Kotecha, Satish Kumar, Arunkumar Bongale, R. Suresh

Publisher: CRC Press
1st ed., March 2022
ISBN: 978-1-03-206131-3
216 pages, 66 images
Hardcover
Available also as an eBook

Bookshelf – J. Print Media Technol. Res. – Vol. 11 No. 4 (2022), 295–300

297

Print Culture, Agency, and Regionality in the Hand Press Period

This book is published in the established New Directions in Book History series, reassessing and building upon the early work to advance the knowledge by employing advanced methods and exploring the subjects not studied before. The introductory chapter of the presented collection of essays establishes the historical context and defines the book's key concepts. The remaining chapters are organised into four parts. Three chapters of the first one present the printers of Yorkshire, including the career of York's first female printer, Alice Broad, between 1661 and 1680. The second part deals with circulation and networks, describing the Newcastle book trade and the circulation of chapbooks – the small books sold by peddlers – in early nineteenth-century Northumberland. The third part discusses the Scottish print trade in the late 16th century and compares the regional newspapers and directories in Liverpool and Glasgow two hundred years later. The last part focuses on the lack of letters that limited printing of foreign languages and the rise of jobbing printing in the 19th century connected with sans serif typography. The book is concluded with the afterword essay.

Editors: Rachel Stenner, Kaley Kramer, Adam James Smith

Publisher: Palgrave Macmillan
1st ed., April 2022
ISBN: 978-3-030-88054-5
294 pages, 18 images
Hardcover
Available also as an eBook

Visual Research
An Introduction to Research Methods in Graphic Design

The original edition of this book was written by Russell Bestley and Ian Noble and published in 2005, with the second edition from 2011 and the third one from 2016. The individual chapters introduce the need for design research and critical thinking, the fundamental design principles, approaches to analysis and proposition, the role of visual comparisons, bringing theory to practice, identifying the audience and the right message, considerations related to the production process and materials, and the process of synthesis. The main content is complemented by Ellen Lupton's foreword and the appendices with recommended reading and index. The current edition features several new case studies; their total number increased to 19. Also, it includes a Manifesto for Higher Learning in Design based on the text by Andrew Howard in Design Observer, 2013, and a new chapter collecting in alphabetical order the key concepts to facilitate the application of presented tools and methods in both print and on-screen design.

Authors: Russell Bestley, Paul McNeil

Publisher: Bloomsbury Visual Arts
4th ed., September 2022
ISBN: 978-1-350-16056-9
240 pages, 200 images
Softcover
Available also as an eBook

of the resulting feedstock and final products. The topics include laser additive manufacturing, fused deposition modelling, biomaterials printing and utilisation of agricultural waste, 3D-printed concrete and improving its strength, a material-driven design approach, and supply chain management. Considering the importance of the topic, the text would deserve more careful proofreading or at least spell checking, as illustrated by the book highlights on the Springer website: "This is is focused".

The Printing and the Printers of The Book of Common Prayer 1549–1561

Author: Peter W. M. Blayney

Publisher: Cambridge University Press
1st ed., January 2022
ISBN: 978-1108837415
278 pages, Hardcover
Also as an eBook

The author brings a deep insight into the genesis of the important prayer book based on a thorough examination of its printed copies, correctly identifying the editions of 1549, 1552 and 1559 versions and documenting cooperation between the two teams of printers producing the first two editions of 1559, with title pages probably finished on the same day.

Abstract Pattern Illustrations for Textile Printing

Authors: K. Murugesh Babu, M. Selvadass, Megha Shisodiya, Abera Kechi Kabish

Publisher: Springer
1st ed., November 2021
ISBN: 978-9811659744
283 pages, 251 images
Hardcover
Also as an eBook

This volume presents a selection of 250 designs suitable for textile surface printing and different types of fabrics, highlighting the importance of colour and colour combinations.

IoT-enabled Smart Healthcare Systems, Services and Applications

Editors: Shalli Rani, Maheswar Rajagopal, Neeraj Kumar, Syed Hassan Ahmed Shah

Publisher: Wiley
1st ed., January 2022
ISBN: 978-1119816799
256 pages
Hardcover
Also as an eBook

The scope of this new book encompasses different fields, which is reflected in the backgrounds of its over 30 contributors. The text reviews emerging technologies in smart healthcare, i.e. artificial intelligence, the Internet of Things, blockchain, 3D printing and 5G technology, and their applications. It introduces the fundamental concepts, practical implementation and use cases, as well as current limitations, future directions and related challenges, such as security and privacy issues in smart healthcare systems using the Internet of Things.

Natural Polymers
Perspectives and Applications for a Green Approach

Editors: Jissy Jacob, Fernando Gomes, Józef T. Haponiuk, Nandakumar Kalarikkal, Sabu Thomas

Publisher: Apple
Academic Press
1st ed., March 2022
ISBN: 978-1771889605
336 pages, Hardcover
Also as an eBook

About 30 mostly Indian contributors of this new book present natural polymers like biodegradable, biocompatible, nontoxic, and also economical and readily available alternatives to synthetic polymers, thus being attractive for many applications. Among other topics, the text reviews chitosan biopolymer and its composites for 3D printing and nanocomposite flexible films based on cellulose acetate and TiO_2 for photochromic applications.

Flexible Supercapacitors
Materials and Applications

This new book, with almost 30 contributors, all except one affiliated in China, reviews the recent extensive research on flexible supercapacitors as energy storage devices essential for the development of flexible electronics in general. The topics cover flexible asymmetric supercapacitors, stretchable supercapacitors, flexible fibre-shaped supercapacitors, flexible supercapacitors based on ternary metal oxide nanostructures, transition metal oxide-based electrode materials for supercapacitors, and 3D nanoarray flexible electrodes for supercapacitors, including those based on self-supported metal oxide array materials. One chapter is dedicated to printed flexible supercapacitors. It presents the structure and elements of devices, printable materials for supercapacitors, namely carbon-based materials, electrolytes and flexible substrates, printing methods for fabrication of flexible supercapacitors, which include inkjet printing, screen printing, transfer printing and 3D printing, the possibility of integration with flexible/wearable electronics, and also the restrictions implied by required rheological properties. The next chapter deals with printing flexible on-chip micro-supercapacitors, including the printable materials for electrodes, current collectors and electrolytes, as well as inkjet printing, spray printing and screen printing as suitable fabrication techniques. The last chapter summarises the recent advances in flexible micro-supercapacitors.

Editors: Guozhen Shen, Zheng Lou, Di Chen

Publisher: Wiley
1st ed., April 2022
ISBN: 978-1-119-50616-4
336 pages
Hardcover
Available also as an eBook

Smart 3D Nanoprinting
Fundamentals, Materials, and Applications

In this new book, almost 50 contributors review in 16 chapters the emerging field of 3D printing at the nanoscale. The applications range from 3D nanoprinting in the aero and automobile industries to biomedical and health-care applications, including oral health care, to 3D-printed nanosensors and batteries, up to the evolution of 4D printing. The text presents various additive manufacturing methods and suitable nanomaterials, including 3D printing of hybrid nanocomposites, 2D nanomaterials, shape memory alloys, and metal alloys. Further, it discusses the impact of fused deposition modelling and nanofillers on the shape memory properties of polyurethane and the evaluation of dimensional inaccuracy in 3D-printed products.

Editors: Ajit Behera, Tuan Anh Nguyen, Ram K. Gupta

Publisher: CRC Press
1st ed., August 2022
ISBN: 978-1-03-203861-2
341 pages, 110 images
Hardcover
Available also as an eBook

Bookshelf – J. Print Media Technol. Res. – Vol. 11 No. 4 (2022), 295–300

299
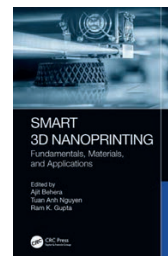
Bookshelf

Academic dissertations

Reliable Classification in Digital and Physical Worlds Under Active Adversaries and Prior Ambiguity

The topic of this thesis is of high importance due to the growing use of artificial intelligence and machine learning in various applications, accompanied by a rising threat of adversarial attacks. In particular, the presented research was focused on the security of printable graphical codes, especially their reliable authentication on smartphones to prevent counterfeiting and piracy. The proposed defence mechanism employs a key-based multi-channel randomisation in a specific transform domain. In addition, the study considered the lack of labelled training data and the occurrence of adversarial examples designed to trick machine-learning models.

The introductory chapter of the dissertation briefly overviews anti-counterfeiting technologies and concepts, including authentication, track and trace options and physical unclonable functions, especially the printable graphical codes and their security. The main content is organised into three chapters, each presenting the background, methods, results and their discussion. The strategy for the classification robust to the adversarial attacks comprises creating an information advantage of the defender over the attacker by using the secret key and applying randomised perturbations to more channels with the following aggregation. The method was tested on the general classification of natural images. The results show high efficiency against three selected attacks, two of which are gradient-based. Further study was focused on the possibilities of semi-supervised classification. The text describes the formulation of a variational information bottleneck for two types of priors on the latent space of the classifier – the hand-crafted and learnable ones. Finally, the work discusses the authentication and clonability aspects of printable graphical codes used as copy-detection patterns. Attention is also paid to the quality and accuracy of produced machine-learning fakes influenced by different factors, including the printing equipment and size of basic elements.

Doctoral thesis – Summary

Author:
Olga Taran

Speciality field:
Computer Science – Physical Objects Authentication

Supervisor:
Slava Voloshynovskiy

Defended:
*9 June 2021, University of Geneva, Faculty of Science, Computer Science Department
Geneva, Switzerland*

Contact:
taran.olga@gmail.com

On the Appearance of Translucent Objects: Perception and Assessment by Human Observers

This thesis contributes to the knowledge of how appearance is perceived and assessed and its relationship with the corresponding material and object properties. Among the significant appearance attributes, translucency was the main focus of the research. The aim was to identify the links between the physical and the perceptual properties, essential for relevant characterisation and applicable in various fields where translucency plays an important role, from 3D printing to visual arts. The research hypotheses were defined after observation of the process of assessment material appearance in general and then experimentally tested. Besides translucency as a material property, the work considered the effect of geometric properties because they inherently contribute to the perception of translucent objects. Other experiments were focused on digital stimuli and the extent to which they can emulate real-world experience. The study included selected image features possibly related to translucency. All findings were analysed in the context of state-of-the-art knowledge and its advancement.

Doctoral thesis – Summary

Author:
Davit Gigilashvili

Speciality field:
Computer Science and Vision Science

Supervisors:
*Jon Yngve Hardeberg
Marius Pedersen
Jean-Baptiste Thomas*

Contact:
davit.gigilashvili@ntnu.no

After the introduction and the background on appearance, its attributes, measurement, modelling and perception, the dissertation summarises the contributions presented in ten manuscripts (appended in Part II). The next chapter discusses in depth the answers to research questions. These begin with describing observers' behaviour when assessing appearance and the factors facilitating this process. The next group includes the factors affecting translucency constancy, translucency contributing to glossiness perception, the shape of the object impacting the perceived magnitude of translucency and detection of translucency differences, with the latter also depending on the magnitude of the subsurface scattering. Further sections describe the differences in appearance assessment between physical objects and displayed images together with the significance of the direct interaction with the objects, the presence of caustics and image blur as cues for judging the material translucency, and the possibility of using the luminance histograms for prediction of apparent gloss and translucency. In addition, the obstacles to advancing translucency perception research are outlined, as well as the knowledge status and future perspectives in this area. The discussion also points out the implications for prospective studies and highlights further findings and the identified limitations.

Doctoral thesis – Summary

Author:
Liwen Zhang

Speciality field:
Polymer Science, Nanomaterials and
Advanced Manufacturing

Supervisors:
Cyrille Boyer
Yun Hau Ng

Contact:
liwen.zhang@uq.edu.au

Metalloporphyrin Based Photocatalysts for PET-RAFT Polymerization and Applications

The research within this thesis contributes to the development of reversible-deactivation radical polymerisation and its applications in 3D printing. The focus was on the reversible addition–fragmentation chain-transfer polymerisation with photoinduced electron/energy transfer. The particular aim was to enable effective polymerisation mediation under far-red light irradiation, eliminate the side effects of oxygen, and address the poor recycling stability by developing a new metalloporphyrin-based photocatalyst.

The dissertation reviews the relevant background, going from reversible-deactivation radical polymerisation in general to polymerisations mediated using homogeneous or heterogeneous photocatalysts to utilising metal–organic frameworks as (photo)catalysts. The experimental part describes the catalytic use of oxygen in the radical photopolymerisation of acrylate and acrylamide monomers mediated by zinc (II) (2,3,7,8,12,13,17,18-octaethyl-5,10,15,20-tetraphenylporphyrin) under irradion at $\lambda = 690$ nm (3 mW/cm^2), resulting in well-defined polymers with low dispersity thanks to excellent control and end-group fidelity. This is marked as an oxygen paradox because the photopolymerisation of the proposed system can be controlled in time not only by light but also by the presence of oxygen, serving as a co-catalyst alongside a tertiary aliphatic amine instead of its typical inhibitory effect. Besides detailing the methods and results, the work discusses the proposed mechanism. Next, four porphyrinic zirconium metal–organic frameworks were synthesised, characterised and successfully tested as heterogeneous photocatalysts under different wavelengths, also demonstrating oxygen tolerance and temporal control. The work discusses the effect of their size and surface area on polymerisation rates and shows the possibility of separating, recycling and using these photocatalysts for up to five independent polymerisations. The proposed systems were processed by stereolithography controlled by visible light in an open-air environment. Finally, porphyrinic metal–organic frameworks in the form of 2D nanosheets were used as multidimensional photocatalysts for functional materials. Their application in stereolithographic 3D printing yielded well-defined objects with improved mechanical properties. In addition, they exhibited effective antimicrobial photodynamic activity.

Events – J. Print Media Technol. Res. – Vol. 11 No. 4 (2022), 301–302

301

Events

Electronic Imaging 2023

San Francisco, California, USA
15–19 January 2023

After two years, when this IS&T International Symposium was held online, the 2023 edition returns to the in-person format. The plenary speakers are Anima Anandkumar, who introduces the use of Fourier neural operators for solving partial differential equations, Eric Chan and Paul M. Hubel with a lecture on 'Embedded gain maps for adaptive display of high dynamic range images' and Andrew B. Watson presenting the so-called Pyramid of Visibility, a structural description of human visual sensitivity, with its benefits for display engineering. In 2023, the symposium comprises 18 technical conferences. Their list includes a new one, High Performance Computing for Imaging. Its focus is on research topics that converge high-performance computing and imaging research. The Imaging for XR workshop takes place on the last day. Its programme features invited speakers and a panel on the visual quality of XR displays. The IS&T EI Conference Proceedings are open access.

SPIE Events

Photonics West 2023

San Francisco, California, USA
28 January – 2 February 2023

This established, large-scale event again offers thousands of presentations, several tens of which deal with printing. Their topics include, for example, a novel dry multi-material 3D printing technology for flexible hybrid electronics, sensors and energy devices, additive nanomanufacturing of electronics with high electrical and mechanical performance, digital printing of photonic devices by inkjet and aerosol-jet printing, example applications of planar- and continuous, roll-based transfer printing for scalable heterogeneous integration, generation of photonic nanojets using 3D microstructures printed by two-photon polymerisation, 3D-printed milli-fluidic passive mixers for rapid and low-cost point-of-care analysis of biofluids, and accuracy evaluation of a new 3D photogrammetric position measurement system for 6D printing.

Smart Structures / Nondestructive Evaluation 2023

Long Beach, California, USA
12–16 March 2023

The papers presenting various applications of printing are also included in the programme of this SPIE event, such as those dealing with the fabrication of different types of electrodes by inkjet printing, a stretchable resistive heater textile enhanced using printed electronic coatings, inkjet and 3D printing of structurally coloured photonic colloidal glasses, and in-situ monitoring of composite materials additive manufacturing process, to name a few.

Packaging, Labelling and Printing Events by EasyFairs

In the first months of 2023, two EasyFairs events – Packaging Innovations and Empack – are co-located in Birmingham, UK (15–16 February) and accompanied by the Contract Pack & Fulfilment event. A month later, on 14–16 March, Sign & Print Expo 2023 takes place in Gorinchem, The Netherlands, covering the visual communication chain from the creative design to possibilities in recycling and circularity of a product.

VISIGRAPP 2023
18th International Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications

Lisbon, Portugal
19–21 February 2023

This established event again offers an intensive schedule planned into up to seven tracks. The keynote lectures announced for the 2023 edition deal with the synergy between multidimensional projections and machine learning (Alexandru Telea), the data-centric computer vision (Liang Zheng), the design of haptic interfaces (Vincent Hayward), and the research towards adaptive 3D user interfaces (Ferran Argelaguet).

High Security Printing EMEA

Abu Dhabi, UAE
7–9 March 2023

This Reconnaissance event also returns to the in-person format and keeps the proven schedule with seminars on the first day followed by two conference days.

INGEDE Symposium 2023

Munich, Germany
8 March 2023

This event is held in a hybrid format and can be participated online or in person. The focal point is the lack of quality raw material for the recycling paper industry. The sessions deal with the availability and supply of paper for recycling, the impact of packaging regulations and trends, the changes in recycling flows, the projects focused on certification and circular economy, and new solutions and developments in the field of paper recycling.

ICE Europe 2023

Munich, Germany
14–16 March 2023

The 13th International Converting Exhibition showcases solutions for management, measurement, printing, coating and laminating, and other processes. It is co-located with CCE International, the 6th International Exhibition for the Corrugated and Folding Carton Industry.

FESPA Digital Printing 2023

São Paulo, Brazil
20–23 March 2023

The calendar of Fespa events also seems to stabilise after the disturbances due to the pandemic. The first exhibition in 2023 takes place in South America.

InPrint Munich Conference 2023

Munich, Germany
21–23 March 2023

The InPrint Munich technical conference focuses on industrial printing solutions for packaging and manufacturing. Hosted by Werner Zapka, it offers each day about a dozen presentations on recent developments and new trends.

innoLAE 2023
Innovations in Large-Area Electronics

Cambridge, UK
21–23 February 2023

Returning to the in-person format for its 9th edition, this event offers two short supporting courses focused on dry and wet processing technologies on the first day and then two conference days with oral and poster presentations accompanied by the exhibition. The announced keynote speakers are Juha Virtanen, focusing on technical challenges for wearable patient monitoring sensors intended for use inside hospitals, Sebastian Meier, presenting design opportunities enabled by printed organic solar cells, and Natalie Stingelin, discussing the materials for flexible electronics, especially the use of multicomponent systems prepared by blending polymeric insulators with organic semiconductors in different devices that include organic field-effect transistors, organic solar cells and organic electrochemical transistors. The technical programme is scheduled into two parallel tracks with sessions dedicated to manufacturing, high-performance materials, bioelectronics, novel devices, systems and applications, sustainability and energy efficiency.

LOPEC 2023

Munich, Germany
28 February – 2 March 2023

Traditionally, the schedule of this event focused on printed electronics comprises short courses and presentations in business, technical and scientific conference tracks, as well as the accompanying two-day exhibition. For the current edition, the topics of the plenary lectures cover electrophoretic displays, smart tyres, the utilisation of spot robots for maintenance, unconventional materials and platforms for flexible and stretchable electronic devices, inkjet-printing technologies for the manufacturing of displays, innovation drivers for sustainable digital triggers, flexible electronics for human-centric health care, and the demand for mass-production of printed batteries. The sessions are mainly dedicated to various applications of printed electronics and the relevant materials and processes, including their upscaling.

TAGA 2023 Annual Technical Conference

Oklahoma City, Oklahoma, USA
12–15 March 2023

In 2023, the programme of this conference held by the Technical Association of the Graphic Arts begins with the keynote sessions. The announced presentations include 'Sensory experiences: bringing printed designs to life' by Kate Stone, 'Where is the future of printing headed?' by Volker Jansen, and 'Process and workflow innovations in digital textile printing' by Kerry Maguire King. The sessions on the next two days feature papers dealing with a wide range of topics, from the book printing history to web-based colour correction for social media content, from advanced colour management solutions to innovative processes and applications of printing, and more.