ies
The Lighting Society

Light in Focus Conference

Illuminating Engineering Society of Australia & New Zealand

Melbourne Convention & Exhibition Centre

2 Clarendon Street,
Southbank, Melbourne

21 - 22 November 2019

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IESANZ Welcomes you to Light in Focus

Welcome to the inaugural IESANZ Conference: Light in Focus. As a member-led conference, the Organising Committee has placed great importance on providing professional learning and technical development opportunities for lighting designers and engineers. The conference program and social events have been designed to enable you to connect and share industry insights, emerging technical knowledge and new ideas within a growing community to provide you with the latest knowledge in light.

Our intent has been to engage individuals and organisations from all professional fields working in the built environment. Over the coming days we will explore the creation and application of Human-Centred Design in lighting, and expand the conversation across engineering, construction, design, landscaping, product development and technology.

Human-Centered Design recognizes the importance of behavioural, emotional and environmental contexts in the creation of lighting, products and usable spaces. It encourages designers to see product users as real human beings with real, complex lives, instead of just as numbers.

We acknowledge the support of our industry partners who have come on this journey with us and we encourage you to visit the exhibition and to engage with the companies that have partnered the Society in this inaugural event.

We thank you for your support of the Society in attending this Conference and we hope that you take full advantage of the learning and networking opportunities that this event has on offer. We encourage you to engage actively in the discussions and to connect with your peers to broaden your lighting network.

Vessi Ivanova MIES RLP
MIES, RLP, National Lighting Design Manager, Signify, IESANZ Board Director

Trent Dutton MIES RLP
President, IESANZ

Kirsty Kelly
Chief Executive Officer, IESANZ

Conference Organising Committee

Vessi Ivanova, MIES, RLP, National Lighting Design Manager, Signify, IESANZ Board Director

Tracy Bronlund, Lighting Design Manger, Aesthetics Lighting, NZ

Neil Catterall, Business Development Manager, Think Lighting, WA

Warren Julian AM Emeritus Professor Sydney School of Architecture, Design and Planning, The University of Sydney

Kirsty Kelly, CEO, IESANZ

Anne Truong, Design Manager Light Projects, Tech IES

IES: The Lighting Society

Our goal is to help our members to advance their careers and businesses through access to ongoing professional development, technical information, industry connections and recognition of skill, expertise and achievement.

We provide a range of events, courses and activities for professionals in lighting and associated fields.

To learn more go to **www.iesanz.org**

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IESANZ Conference

Thursday 21 November 2019

7:30am	Registration — *Clarendon Foyer, MCEC*	
8:30am	**Introduction** — *Clarendon Auditorium, MCEC* *Vessi Ivanova, Chair, IESANZ Organising Committee* **President's Message** *Trent Dutton, President, IESANZ* **Welcome Address** *Amy Muir, Victorian President, Australian Institute of Architects*	
8:45am	**Keynote Presentation** Human Centric Lighting Will Not Happen Until We Understand *Dr Mark S. Rea, Rensselaer Polytechnic Institute, USA*	
9:45am	**Keynote Speaker** **Light Environments in the Context of Human Circadian Light Sensitivity** *Dr Sean Cain, Monash University*	
10:15am	Morning Tea — *Clarendon Foyer, MCEC*	
	Concurrent Session 1: *Clarendon Room A* **Human-Centric Lighting in Focus**	**Concurrent Session 2:** *Clarendon Room D* **Future of Lighting**
10:45am	**Understanding and Intrepreting Photometric Files** *Jennifer Jaques, Lighting Application Sciences*	**IoT-Based PHM Framework for LED Lighting Systems** *Shan N Lee, Monash University Malaysia*
11:15am	**Lighting: Human-Centred Design with Radiation** *Tim Shotbolt, Light & the Biosphere*	**Spatial Optimization of a Multispectral Illumination Source** *Sanush Abeysekera, Monash University Malaysia*
11:45am	**A Feasibility Study of Using Ocular Behaviour as an Indicator for Assessing Glare in an Office Setting** *Gillian Isoardi, Light Naturally*	**Spectral Optimization of a Commercialised Multi-channel SSL Luminaire with Tunable Circadian Impact** *Rachel Saw, Monash University Malaysia*
12:15pm	Lunch — *Clarendon Foyer, MCEC*	
1:15pm	**Concurrent Session 3:** *Clarendon Room A* **Health, Wellbeing And Light**	**Concurrent Session 4:** *Clarendon Room D* **Latest In Lighting Standards**
	Human Centric Lighting for Night Shift Workers *Bow Jaruwangsanti, Design by Bow and Umow Lai*	**Why Light Pollution must be a Part of the Conversation** *Landon Bannister, Australasian Dark Sky Alliance*
	Evaluation of Temporal Light Modulation (TLM) in LED Light Sources *Steve Coyne, Light Naturally*	**Signs and Facades** *Scott Forbes, Signs and Facades & Rubidium Light*
2:20pm	**Keynote Presentation** — *Clarendon Auditorium, MCEC* Biologically Focused Lighting - The Truth About Circadian Lighting *Robert Soler, Biological Innovation and Optimization Systems, USA*	
2:50pm	**Invited Speaker** **A Roadmap for Implementation of Human Centric Lighting** *Dr Douglas Steel, NeuroSense, USA*	
3:20pm	Afternoon Tea — *Clarendon Foyer, MCEC*	
3:45pm	**Keynote Presentation** — *Clarendon Auditorium, MCEC* The Lighting Design Objectives (LiDOs) Procedure *Dr Christopher "Kit" Cuttle, Lighting Consultant, NZ*	
4:45pm	**Keynote Presentation** The Effect of Light on our Sleep-Wake Cycle: New Lighting Insights, Definitions and Designs *Luc Schlangen, Eindhoven University of Technology, Netherlands*	
5:30pm	Conference Day 1 Close	
5:45pm	**Welcome Drinks** — *Exhibition Area, Clarendon Foyer, MCEC*	
6:45pm	**Annual General Meeting** — *Clarendon Room D*	
7:30pm	**Walking Tour: City Lights** *Meeting Point – European Bar, 120 Exhibition Street, Melbourne*	

Friday 22 November 2019

7:30am	Registration — *Clarendon Foyer, MCEC*	
8:30am	**Keynote Presentation** — *Clarendon Auditorium, MCEC* From Retinal Cell to Virtual Reality: A Psychobiological Approach to Human Centric Lighting *Dr Motoharu Takao, Tokai University, Japan*	
9:30am	**Keynote Presentation** 'Human Centric Lighting': Does it Really Have to be Blue-Enriched and Tunable? *Dr Mariana G. Figueiro, Rensselaer Polytechnic Institute, USA*	
10:30am	Morning Tea — *Clarendon Foyer, MCEC*	
	Concurrent Session 5: Future of Lighting — *Clarendon Room A*	**Concurrent Session 6: Energy Efficiency** — *Clarendon Room D*
11:00am	**Circa, a Wearable Spectral Sensor to Measure Light Exposure Impacting the Human Circadian System** *Anas Mohamed, Monash University, Malaysia*	**Real Time and Weather Modelling of Daylight Availability in Complex Transport Structures: reduces Illumination and Electricity Capex & Opex by 50%** *Richard Morrison, Light in Design by Jenarick Consulting*
11:30am	**Influence of LED-Based Assistive Lighting on the Autonomous Mobility of Low Vision People** *Vineetha Kalavally, Monash University Malaysia*	**Update on Regulation of Lighting Products under the Greenhouse and Energy Minimum Standards Act** *David Boughey, Department of Environment and Energy*
12:00pm	**Visual Comfort in Green Office Buildings: Using Field Studies to Inform Design** *Veronica Garcia-Hansen, Queensland University of Technology*	**Every Building Counts Introducing a Practical Plan to Reduce Emissions in the Built Environment** *Sandra Qian, Green Building Council Australia*
12:30pm	Lunch — *Clarendon Foyer, MCEC*	
	Concurrent Session 7: Technology Lighting the Way — *Clarendon Room A*	**Concurrent Session 8: Panel Presentations** — *Clarendon Room D*
1:30pm	**Study of Unified Glare Rating of LED Luminaires with Diffusers** *Dariusz Kacprzak, The University of Auckland*	**Industry and Standards Panel** *Moderator: Tim Shotbolt, Light & The Biosphere* David Lewis, DLLD Television Sports Lighting Consultant David Bird, 2B Designed Robert Hamilton, Webb Australia Group Tracy Bronlund, Aesthetics Lighting
2:00pm	**Performance of LED Lighting Systems in the Presence of Load Control Ripple Injection Signalling** *Sean Elphick, Australian Power Quality & Reliability Centre, University of Wollongong*	**Energy Efficiency Panel** *Moderators: Tim Shotbolt, Light & The Biosphere* Adele Lock, Mint Lighting Design John Ford, Relume Consulting Pty Ltd Barry Gull, Affiliation Scott Forbes, Rubidium Lighting
2:30pm	**A Whole New Level of Real-Time Light Simulation and Design Communication Tools** *Christopher Blewitt, migenius Pty Ltd* *Carl Gray, GrayLight*	
3:00pm	Afternoon Tea — *Clarendon Foyer, MCEC*	
3:30pm	**Invited Speaker** — *Clarendon Auditorium, MCEC* **How Things are Connected in the Strangest Ways** *Dr Emrah Baki Ulas, Steensen Varming*	
4:15pm - 5:00pm	**Conference Closing Address** Moderator: Trevor Stork Including discussion with keynote presenters: *Dr Mark S. Rea, Rensselaer Polytechnic Institute, USA* *Dr Kit Cuttle, Lighting Consultant NZ* *Robert Soler, Biological Innovation and Optimization Systems, USA* *Dr Motoharu Takao, Tokai University, Japan* *Dr Mariana G. Figueiro, Rensselaer Polytechnic Institute, USA* *Luc Schlangen, Eindhoven University of Technology, Netherlands*	
6:30pm - Midnight	**IESANZ Awards & Gala Dinner** — *RACV City Club, 501 Bourke Street, Melbourne* *Celebrate the winners of the IESANZ International Awards and IESANZ VIC/TAS Chapter Awards.*	

Pre-Conference Course

SPECIFYING, MEASURING AND APPLYING HUMAN CENTRIC LIGHTING

Wednesday 20 September 2019

Light on the retina stimulates both visual and non-visual responses. Although the many relationships between light on the retina and these physiological responses have been studied for nearly a century, the lighting industry continues to only use the photopic luminous efficiency function V(λ) for specifying, measuring and applying light.

In some cases, as with on-axis visual performance, this reliance on V(λ) is entirely justified. For many others, like discomfort glare and brightness perception, V(λ) is not a suitable metric for characterizing the visual stimulus.
The role of light (and dark) on regulating our circadian rhythms is of particular interest today. The 24-hour, light-dark cycle on the retina synchronizes our physiology to our local position on Earth. A lack of synchrony between with sunrise and sunset and our physiology, called circadian disruption, compromises performance, sleep, and well-being.

Lighting for the many visual and non-visual functions employs lighting design objectives that differ from those used in traditional architectural lighting design. Therefore, new metrics must be employed to effectively deliver light to the retina.

In this workshop, we will discuss:

- Basics of the human retina and neural channels
- Benefit metrics related to human centric lighting
  - Visual Performance, both on-axis and off-axis
  - Glare, both disability and discomfort
  - Brightness perception, both indoor and outdoor
  - Circadian system regulation, both daytime and nighttime
- Limitations of current lighting metrics (e.g., CCT, lux) in specifying human centric lighting
- Laboratory and field studies applying the benefit metrics
- Design patterns for implementing human centric lighting solutions
- Recommended practice for circadian lighting and how it interacts with other human centric lighting requirements

Venue

Garden Rooms, Level 1 Crown Towers, Crown Melbourne, 8 Whiteman Street, Southbank VIC

Course Facilitators

Dr Mark S. Rea, Professor of Architecture and Cognitive Sciences, Rensselaer Polytechnic Institute

Mark S. Rea, Ph.D., is Professor of Architecture and Cognitive Sciences at the Lighting Research Center (LRC) at Rensselaer Polytechnic Institute. He served as LRC Director from 1988 to 2017. Dr. Rea is well known for his research in circadian photobiology, mesopic vision, psychological responses to light, lighting engineering, and visual performance. He is the author of more than 300 scientific and technical articles related to vision, lighting engineering, and human factors and was the editor-in-chief of the 8th and 9th editions of the Illuminating Engineering Society (IES) Lighting Handbook. He has been elected Fellow of the Society of Light and Lighting (UK) and Fellow of the IES. In addition, he is recipient of the IES Medal. Rea has also been honoured with the William H. Wiley Distinguished Faculty Award for those who have won the respect of the faculty at Rensselaer through excellence in teaching, productive research, and interest in the totality of the educational process. Dedicated to the notion that our society undervalues light because we do not properly measure its benefits, his recent book Value Metrics for Better Lighting brings together a wide range of research to illustrate how the effective use of light can benefit society and the environment.

Dr Mariana G. Figueiro, Director of the Lighting Research Center (LRC) and Professor of Architecture at Rensselaer Polytechnic Institute

Mariana G. Figueiro, Ph.D., is Director of the Lighting Research Center (LRC) and Professor of Architecture at Rensselaer Polytechnic Institute. She has also served as Light and Health Program Director at the LRC since 1999. Dr. Figueiro is well known for her research on the effects of light on human health, circadian photobiology, and lighting for older adults. She holds a bachelor's in architectural engineering from the Federal University of Minas Gerais, Brazil, and a master's in lighting and a doctorate in multidisciplinary science from Rensselaer. Her master's and Ph.D. dissertation research focused on the human circadian response to light. Figueiro is the recipient of the 2007 NYSTAR James D. Watson Award, the 2008 Office of Naval Research Young Investigator Award, and the 2010 Rensselaer James M. Tien '66 Early Career Award. In 2013 she was elected Fellow of the Illuminating Engineering Society. She is the author of more than 80 scientific articles in her field of research, along with the AARP-sponsored publication, Lighting the Way: a Key to Independence, which provides guidelines for the design of lighting to meet the needs of older adults. Her research is regularly featured in national media including The New York Times, The Wall Street Journal, and Scientific American. Dr. Figueiro has also brought attention to the significance of light and health as a topic of public interest through her recent TEDMED talk.

Keynote Presentations

Light Environments in the Context of Human Circadian Light Sensitivity

Dr Sean Cain
Associate Professor, Monash University & President, Australasian Chronobiology Society

Abstract
Before the invention of electric lighting, humans were primarily exposed to intense or dim environmental light: stimuli at extreme ends of the circadian system's responsiveness to light. Today, humans spend hours per day exposed to intermediate light intensities, particularly in the evening. We recently characterized individual-level dose-response curves to light-induced melatonin suppression and have found that the human circadian system is highly sensitive to evening light at typical indoor levels, with exceptionally high interindividual variation. Given the nearly ubiquitous use of light at night, the generally high circadian light sensitivity has important implications for general health, including sleep and mood disorders. Furthermore, the high interindividual variability is a key factor in understanding individual vulnerability to the potentially disruptive effects of anthropogenic light at night.

Biography
Sean W Cain is a circadian biologist with experience in both animal and human models. He is an Associate Professor at the Turner Institute for Brain and Mental Health at Monash University. He is the current President on the Australasian Chronobiology Society, the only circadian rhythms research society in the region. He trained in animal models of circadian rhythms at the University of Toronto for his PhD and trained in human circadian rhythms at Harvard Medical School. His research focuses on individual differences in the sensitivity of the circadian system to light and how these differences lead to poor health outcomes, including sleep disorders, metabolic disease, and depression.

The Lighting Design Objectives (LiDOs) Procedure

Dr Christopher 'Kit' Cuttle
Lighting Consultant, New Zealand

Abstract
Lighting standards around the world specify minimum indoor lighting requirements in terms of task illuminance, and while in some circumstances this can be related to specific visual tasks, it is much more common for the prescribed value to be interpreted as the level that is to be provided uniformly over the horizontal working plane. General lighting practice has evolved to provide this illumination distribution efficiently and economically, so that although different luminaire types may be selected for commercial, industrial or decorative applications, the lighting quality delivered comprises a standard solution that is applied universally irrespective of the application. Far from ensuring lighting quality, compliance with lighting standards conflicts with the provision of lighting that is responsive to locations or human activities.

The LiDOs Procedure is based on the understanding that every lighting application, no matter how simple or complex, should be developed from a statement of lighting design objectives (LiDOs) specific to the application.

LiDOs are used to describe selected aspects of how illumination quantity and distribution may influence the appearance of peoples' surroundings in a specific location, and the process of devising a LiDOs statement is the essence of lighting design. The Procedure may then be applied to guide the practitioner towards devising a lighting installation performance specification to achieve the stated LiDOs in the location.

In its present form, the procedure is facilitated by an interactive spreadsheet that enables the practitioner to choose between two tracks. For the 'illumination efficiency' track direct flux from the luminaires is distributed within the space to achieve the LiDOs with optimal flux utilization, and for the 'illumination hierarchy' track the practitioner selects target objects or surfaces onto which flux is directed to achieve an ordered distribution of visual emphasis. Either way, the outcome is a specification of direct flux distribution (DFD) that will achieve the practitioner's choice of LiDOs. The development of a lighting specification to provide the DFD in the location is effected by application of conventional illumination engineering procedures.

Biography
Christopher "Kit" Cuttle, MA, PhD, FCIBSE, FIESANZ, FIESNA, FSLL, is a lighting educator, designer and author. During a long career, he has held the positions of Head of Graduate Education in Lighting at the Lighting Research Center, Rensselaer Polytechnic Institute, Troy, New York; Senior Lecturer at the Schools of Architecture at the University of Auckland, and the Victoria University of Wellington, both in New Zealand; Section Leader in the Daylight Advisory Service, Pilkington Glass; and Lighting Designer with Derek Phillips Associates (now DPA Lighting Consultants), both in the UK.

In addition to more than 140 published papers and articles, he is author of three books: Lighting by Design, Architectural Press, 2008 (2nd edition); Light for Art's Sake, Butterworth Heinemann, 2007, and Lighting Design: A perception-based approach, Routledge, 2015.

His recent awards include the Society of Light and Lighting 2017 Lighting Award; the Professional Lighting Design 2013 Lifetime Achievement Award, and the SLL 2013 Leon Gaster Award for his Lighting Research & Technology paper, A New Direction for General Lighting Practice.

Human Centric Lighting: Does it Really Have to be Blue-Enriched and Tunable?

Dr Mariana G Figueiro
Lighting Research Centre & Rensselaer Polytechnic Institute, New York, USA

Abstract
Lighting for the built environment has traditionally centered on the places that we illuminate and the various things we do in those places. As a result, lighting typically has been designed, specified and manufactured to meet a relatively limited number of very specific objectives. Historically, the primary requirement of lighting has been that it should illuminate spaces to optimize visual performance (addressing concerns such as efficiency, productivity and safety), provide visual comfort to occupants and enhance the space's appearance for aesthetic appreciation. Over time, as indoor lighting proliferated to the point that it virtually became taken for granted by many end users, increasing energy demand and costs led to the adoption of energy conservation as an additional requirement.

The lighting industry has been a key driver of technological advances to address these needs, from the development of incandescent and fluorescent sources to today's rapidly evolving solid-state lighting technologies, and manufacturers have capitalized on these developments every step of the way. The same can also be said of the newly burgeoning industry initiative that has been termed human-centric lighting (HCL).

As the term has come into currency over the past decade, many European manufacturers have added HCL to their product offerings. But apart from being an apparently very effective marketing tool, precisely what is HCL? What scientific research is it based on? What promises does it make, and can these promises be kept? Is it all about tunable light? Do we have to illuminate our spaces with blue light only?
This presentation will attempt to answer some of these questions and discuss what we know, what we don't know and what we need to know about HCL.

Biography
Mariana G. Figueiro, Ph.D., is Director of the Lighting Research Center (LRC) and Professor of Architecture at Rensselaer Polytechnic Institute. She has also served as Light and Health Program Director at the LRC since 1999. Dr. Figueiro is well known for her research on the effects of light on human health, circadian photobiology, and lighting for older adults. She holds a bachelor's in architectural engineering from the Federal University of Minas Gerais, Brazil, and a master's in lighting and a doctorate in multidisciplinary science from Rensselaer. Her master's and Ph.D. dissertation research focused on the human circadian response to light. Figueiro is the recipient of the 2007 NYSTAR James D. Watson Award, the 2008 Office of Naval Research Young Investigator Award, and the 2010 Rensselaer James M. Tien '66 Early Career Award. In 2013 she was elected Fellow of the Illuminating Engineering Society. She is the author of more than 80 scientific articles in her field of research, along with the AARP-sponsored publication, Lighting the Way: a Key to Independence, which provides guidelines for the design of lighting to meet the needs of older adults. Her research is regularly featured in national media including The New York Times, The Wall Street Journal, and Scientific American. Dr. Figueiro has also brought attention to the significance of light and health as a topic of public interest through her recent TEDMED talk.

Human Centric Lighting Will Not Happen Until We Understand V(λ)

Dr Mark S Rea
Rensselaer Polytechnic Institute, New York, USA

Abstract
The photopic luminous efficiency function V(λ) formally defines light for humans and is used in all lighting standards, from the luminous efficacy of light sources (lm/W) to prescribed levels of illuminance (lm/m2) for interior and exterior applications. V(λ) was adopted by the CIE in 1927 and, with minor adjustments, continues to define light and lighting for humans. Since 1927 much has been learned about how optical radiation is processed by human visual and non-visual systems. We now know that there are five photoreceptors in the retina, the outputs of which are combined in various ways to, for example, provide humans with high spatial resolution, detect movement, assess brightness, enable colour vision, and regulate our biological clock. More specifically we now know that only two of the five photoreceptors underlie V(λ), both of which contribute, for example, little or nothing to the regulation of the biological clock. Because the lighting industry relies exclusively on V(λ) we have invented a variety of sub-optimal patches to overcome its inherent limitations for characterizing light and lighting. Since these patches are poor substitutes for characterizing how light and lighting actually affect humans, energy efficiency as well as safety and well-being are compromised. V(λ) does have a place in lighting, but it should not be the only way we characterize optical radiation for humans.

Biography
Mark S. Rea, Ph.D., is Professor of Architecture and Cognitive Sciences at the Lighting Research Center (LRC) at Rensselaer Polytechnic Institute. He served as LRC Director from 1988 to 2017. Dr. Rea is well known for his research in circadian photobiology, mesopic vision, psychological responses to light, lighting engineering, and visual performance. He is the author of more than 300 scientific and technical articles related to vision, lighting engineering, and human factors and was the editor-in-chief of the 8th and 9th editions of the Illuminating Engineering Society (IES) Lighting Handbook. He has been elected Fellow of the Society of Light and Lighting (UK) and Fellow of the IES. In addition, he is recipient of the IES Medal. Rea has also been honoured with the William H. Wiley Distinguished Faculty Award for those who have won the respect of the faculty at Rensselaer through excellence in teaching, productive research, and interest in the totality of the educational process. Dedicated to the notion that our society undervalues light because we do not properly measure its benefits, his recent book Value Metrics for Better Lighting brings together a wide range of research to illustrate how the effective use of light can benefit society and the environment.

The Effect of Light on our Sleep-Wake Cycle: New Lighting Insights, Definitions and Designs

Luc Schlangen
Eindhoven University of Technology, Netherlands

Abstract
Early this century a new retinal photoreceptor, known as the intrinsically-photosensitive retinal ganglion cell (ipRGC), was discovered. Next to receiving input from rods and cones, this photoreceptor senses light via its blue-light-sensitive photopigment melanopsin. The ipRGCs powerfully regulate our sleep-wake cycle and the daily 24-hour/circadian rhythm of our body clock and physiology.

Current lighting standards, regulations and practice often focus on visual and energy efficiency aspects of light without considering light's many non-visual effects on our physiology, mood and behaviour. Typical human indoor environments provide relatively little light during daytime, especially when compared to the natural light outdoors, while the widespread use of electrical light and electronic devices results in extended exposures to light in the late-evening hours and at night. These unnatural lighting conditions compromise our sleep, circadian rhythm, performance, wellbeing and health. Evolution has shaped us to live in much more light than our modern indoor life gives us. We generally need most light in the morning and during the day, less in the evening, and the least possible at night. Morning light is essential to correctly adjust and re-synchronize our circadian rhythm to our artificial 24-hour clocks. Nocturnal light acutely suppresses melatonin, a hormone that is implicated in sleep-consolidation and sleep-wake-cycle regulation. Bright daytime light exposures reinforce the circadian rhythm and can reduce sensitivity to light in the (subsequent) evening/night, making our late-evening light exposures less sleep-disruptive.

This presentation will introduce new metrology, quantities and spectral sensitivity functions to describe optical radiation for its ability to stimulate each of the five photoreceptor classes (rods, cones, ipRGCs) that can contribute to eye-mediated non-visual responses to light (see CIE standard S 026/E:2018). The new metrics will be adopted to translate the latest scientific insights on non-visual effects of light into novel, health and wellbeing promoting lighting strategies.

Biography
Luc Schlangen received his PhD from Wageningen University in 1995. He has worked for more than 20 years at Philips Research Laboratories and Philips Lighting/Signify in Eindhoven. March 2019 he accepted a researcher position at the Eindhoven University of Technology. His main interests (i) visual and non-visual responses to light, (ii) their impact on human health, sleep, performance and well-being, (iii) how to translate these responses into innovative lighting applications and strategies in health/elderly care, education, homes and workplaces. Luc actively contributes to various standardization processes in CEN, DIN, CIE and ISO. He has chaired the CIE JTC9 committee which recently published a new global standard with light metrology for ipRGC-influenced responses to light. Per June 2019 Luc is director of CIE Division 6 "Photobiology and Photochemistry".

Biologically Focused Lighting – The truth About Circadian Lighting

Robert Soler
Biological Innovation and Optimization Systems, California, USA

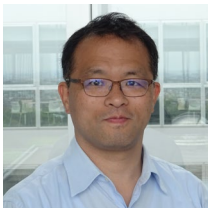
Abstract
Architectural lighting is no longer just for the visual system. With growing emphasis on healthy built environments, circadian lighting is a popular topic that many designers and end-users are being asked to explore.

Within the eye we each have non-visual photoreceptors which assist in regulating our circadian rhythms. Modern architectural lighting has been designed and calibrated to meet the needs of our visual system, however it provides insufficient stimulus for the human circadian system and does not allow our bodies to properly reinforce our natural biological signals.The lack of proper circadian stimulus and the desynchronization of our activity with the solar day has been shown to lead to a state of Social Jet-lag which has been tied to many disfunctions, such as disrupted sleep cycles.

This presentation explores the science behind the circadian system and outlines how to integrate essential spectral content in architectural lighting that helps entrain and reinforce healthy circadian rhythms.

Biography
Robert Soler is Vice President of Human Biological Technologies and Research at Biological Innovation and Optimization Systems (BIOS). Prior to his work with BIOS, his most prominent work was with the Kennedy Space Center, where he helped design and build the first LED light for use on the International Space Station (ISS) and collaborated with scientists to use LED light for photo biological purposes in space, including the circadian lighting system designed to synchronize
circadian rhythms of astronauts aboard ISS. He holds a Master of Science degree from the Lighting Research Center at Rensselaer Polytechnic Institute and has begun a PhD in Behavioural Neuroscience at the University of California, San Diego where he received a fellowship from the National Science Foundation for investigation in circadian lighting paradigms. He currently serves on the light advisory committee for the International WELL Building Standard.

From Retinal Cell to Virtual Reality: A Psychobiological Approach to Human Centric Lighting



Dr Motoharu Takao
Tokai University, Japan

Abstract
My story introduces circadian lighting design from a biological point of view and street lighting design with the aid of virtual reality technology.

Biography
Motoharu Takao received his PhD degree in Medical Physiology from Osaka University in Japan. He studied physiology of visual system at Brown University in the United States as a postdoc. With his mentor, professor David Berson, he found novel retinal cells that set circadian rhythm in 2000. Currently, Motoharu Takao is a professor at Tokai University, Japan, at which he is conducting research activities in the areas of physiological bases of circadian lighting, neuromodulation of visual perception, and emotional responses to virtual reality experiences. In 2018, he was appointed the chair of Lux Pacifica as a successor of Professor Warren Julian.

Invited Speaker Presentations

A Roadmap for Implementation of Human Centric Lighting

Dr Douglas Steel
NeuroSense, Utah, USA

Abstract
The current wave of lighting sales driven by energy savings will be rapidly eclipsed by sales driven by light effects on the health and wellbeing of occupants of the spaces being lit. The technology to deliver these beneficial effects of lighting has arrived. Lights, controls, sensors, and IoT platforms can be readily sourced.

The majority of research on light effects on human responses and health consider Circadian responses and patterns. These have proved to be difficult to implement in real world settings. There are a number of other addressable neurological and psychological health conditions that also respond to light exposure that are non-Circadian. In many cases these are much easier to study, have clearly established measurable outcome indicators, and can be implemented in practice without requiring a medical degree. I will discuss some of these conditions, describe what is known about their causes, and discuss how light can be used to address them.

The field of Human Centric Lighting is no different from any other maturing technology platform. Scientific knowledge gives way to practical applications in the field through a process of Scientific Translation. Starting with published scientific literature, commercial applications and associated business models have to be developed and tested. With respect to HCL, lighting companies and suppliers have struggled to figure out the business side of the equation. The second half of this presentation will consider different business strategies for developing and marketing healthy lighting solutions for wellness and therapeutic uses, taking inspiration from the Pharmaceutical and Consumer Health industries. Factors to be discussed will include identification of customers and high-value target markets; new supply chain and distribution channels; novel approaches to specification, commissioning, and pricing; and methods for assessing the effectiveness of HCL installations.

Biography
Doug Steel, Ph.D. is a Translational Scientist with NeuroSense, a medical technology and health management consultancy developing novel light exposure therapies for neurological conditions including PTSD, sensory processing disorders, migraine headache, depression, and emotional and stress-related conditions. He focuses on translating scientific research into successful business ventures. He is also a serial entrepreneur, having founded or co-founded and managed 6 technology start-up companies over the past 17 years in a number of life science areas. He is a member of the IES-NA Science Advisory Panel. Dr. Steel received his PhD in Biomedical Sciences from Columbia University Medical School.

How Things are connected in the strangest ways

Dr Emrah Baki Ulas
University of Technology Sydney, NSW

Abstract
From nature to technology, evolution to destruction and reality to illusions; this presentation is an inspiring journey about how light has a connection with everything around us.

Composed from a wide range of topics that are inspirational and informational to lighting design, and with a few random but big questions to ask and attempt to answer, this talk will offer new theoretical and practical knowledge. Presented in a holistic framework and with humour, we will unveil many magical facts about lighting which go unnoticed.

If you ever wondered “how Edison saved the whale?”, “how colour-blind can see better” and many more…

This entertaining and informing talk will reveal unusual and unknown connections between ‘things’ of all sort and ‘light’; beyond our day-to-day design practice, to show the richness of the world of light and lighting in history, cosmos, nature, technology, art, science and in every corner of life.

Join this unique, memorable and enlightening storytelling, with an inspiring public speaker, thought-provoking content and captivating imagery and esoteric humour.

Biography
Dr Emrah Baki Ulas is an established lighting designer and public speaker. As an advocate of research and innovation in design, he strives for a stronger integration of theory and philosophy into design practice and seeks to challenge the status-quo of lighting in architecture, engineering and design.
As an associate of Steensen Varming, Emrah has a range of responsibilities including design leadership in regular liaison with the internal and external collaborators. Emrah is also an academic at the University of Technology Sydney. His work has been published internationally and has earned many accolades and recognitions.

Panel Presentations

Industry and Standards Panel
Friday 22 November 2019, 1.30pm – 2.15pm, Room B

Moderator: Tim Shotbolt, Light & the Biosphere

David Lewis, DLLD Television Sports Lighting Consultant
David Bird, 2B Designed
Robert Hamilton, Webb Australia Group
Tracy Bronlund, Aesthetics Lighting

Energy Efficiency Panel
Friday 22 November 2019, 2.15pm – 3.00pm, Room B

Moderators: Tim Shotbolt, Light & the Biosphere

Adele Lock, Mint Lighting Design
John Ford, Relume Consulting Pty Ltd
Scott Forbes, Rubidium Lighting
Barry Gull, Affiliation

Concurrent Presentations

Concurrent Session 1, 10:45am - 12:15pm, Thursday 21 Novemeber 2019, Clarendon Room A, Human-Centric Lighting in Focus

Understanding and Interpreting Photometric Files

Jennifer Jaques

Lighting Application Sciences

Abstract
Attendees will learn about photometric testing and how a photometric file is created along with the different types of photometric files. They'll learn about types of photometry, the difference between absolute and relative photometry, and near field and far field photometry. Each keyword line of an IES file will be analysed to learn its importance to the IES file and what it should (or shouldn't include). Comparisons will be shown between Eulumdat, IES, and simulated files.

Lighting: Human-Centred Design with Radiation

Tim Shotbolt

Light and the Biosphere, NSW

Abstract
Lighting design is human centred design by basic definition. Illuminance, luminance and the appearance of surfaces all relate to the sensitivity of the human visual system. Instruments such as illuminance meters etc are created to mimic that sensitivity with a peak at 555 nanometres and falling to zero at 380 and 780 nanometres depending whether photopic or scotopic vision. Most biota on Earth have different sensitivities and sensitivity ranges to radiation than humans, with greater sensitivities in both the blue and red parts of the visible spectrum as well as sensitivities in the ultra-violet and infra-red regions as well as sensitivities to magnetic fields.
Humans rely on the biosphere for survival. Using a human-centred approach to design and development has the potential for "… substantial economic and social benefits for users, employers and suppliers…, …increasing … productivity … and … operational efficiency…increasing accessibility, … improving user experience" and "reducing discomfort and stress". Contribution to sustainability objectives is likely to be limited to potential energy savings only rather than the potential effects of outdoor lighting on biota and the potential for species and habitat loss.
In Australia, in a period slightly over a century, artificial outdoor lighting has proliferated with the invention of new technologies. Electric lighting has developed from a handful of luminaires to many hundreds of thousands of outdoor luminaires for road lighting, sports lighting, landscape lighting, architectural and building façade lighting, signage and display lighting as well as festival lighting.
Every enhancement has been for the benefit of mankind but with photographs from orbiting space vehicles, that rapid development and the potential for environmental effects is alarmingly obvious. The purpose of this brief paper is to suggest long-term survival of our biosphere, and therefore human comfort, sustainability objectives must expand from simple consideration of energy consumption objectives.

A feasibility study of using ocular metrics as indicators for assessing glare in an office setting

Gillian Isoardi

Light Naturally, QLD

Abstract
Ameliorating office worker satisfaction and productivity in workplaces through daylighting cannot be achieved unless the consequent visual discomfort and glare are minimized. However, due to the subjective nature of discomfort sensation, there has been some uncertainty as to the accuracy of discomfort glare predictive models. In this research, involuntary physiological responses, as an alternative approach to subjective glare ratings, have been studied. Ocular and pupillary metrics were investigated as feasible indicators of visual discomfort sensations. For this investigation, an experiment was carried out in a real office for three different scenarios: low, medium, and high glare probability. Participants were asked to perform simulated office tasks, while an eye-tracker recorded the ocular and pupil data. Mean pupil diameter, pupillary unrest, fixation rate/ duration, and blink rate/amplitude, were investigated.
The results showed significant differences between the high and low discomfort groups across most of the dependent variables, with blink amplitude having the largest effect size suggesting this variable may be a reliable indicator in the presence of glare. There were also statistically significant correlations between subjective glare evaluations and the pupillary unrest and mean pupil diameter.

IoT-based PHM Framework for LED Lighting Systems

Shan N Lee, Vineetha Kalavally, Chee Pin Tan, Vishnu Monn

Monash University, Malaysia

Abstract
LED lights have been displacing current technologies such as fluorescent lights for the past several years due to the reduction in costs. Additionally, advancements in lighting controls and developments in the internet of things (IoT) have enabled a new, lucrative business opportunity, which is lighting as a service (LaaS). LaaS providers sell illumination as a service, by handling the luminaires and hardware, guaranteeing a certain uptime and light output to customers. This is a value proposition to clients too, as they can finance it via power savings from the retrofits and leave the management of lights to a more experienced party. When the system is in operation, LaaS providers have an obligation to ensure minimum illumination targets are met. This entails maintenance, such as replacing failed luminaires.

LaaS providers are responsible for tens of thousands of luminaires, spread across different use cases and conditions, so there exists an opportunity to use big data to make servicing more efficient. A practical IoT enabled prognostics and monitoring (PHM) framework for LED lighting systems is presented in this work. The prognostics algorithm utilizes windowing and regression analysis to ascertain whether a luminaire will fail in the near future. This system collects data on luminaire operating conditions and generates reports from prognostics algorithms to enable LaaS providers to perform maintenance periodically by acting on failure warnings, rather than replacing lights when they fail. This leads to fewer maintenance staff needing to be employed, reducing human effort and increasing operational efficiency. Lighting uptime is also maximized.

On top of reducing the operating costs of LaaS providers, the IoT infrastructure and framework also facilitates the transition to sustainable buildings and cities—by allowing smart sensors to easily piggyback on the power and networking backbone that will be required for such a system.

Spatial Optimization of a Multispectral Illumination Source

Sanush Abeysekera[1], Vineetha Kalavally[1], Ye Chow Kuang[2], Melanie Ooi[3]

[1]*Monash University, Malaysia*
[2]*University of Waikati, NZ*
[3]*Unitec Institute of Technology, NZ*

Abstract
For more than a century, the primary (and only) purpose of indoor light design was to provide ample illumination to enable human activity at dusk. However the discovery of the significant impact of non-visual effects of light has propelled human centric light design to the forefront of lighting technology research. New advances in the field has introduced circadian tuneable light to improve employee productivity, lighting designed to help the aging or the visually impaired, and for medical therapy to control the circadian rhythm of patients. While a majority of research on light concentrates on the emulation of desired spectral characteristics during illumination, less attention is paid to illumination uniformity and color mixing accuracy. In our work, we present a design method to rapidly create an LED luminaire with a highly uniform illumination and color distribution.

In most cases, tuneable luminaires are manufactured with multiple LED color channels. The desired output spectral characteristics are obtained by color mixing. In this research, we present a formulation using a genetic algorithm (GA) to optimize the LED placement for a multi-channel luminaire to obtain highly uniform illumination and color distribution. The results are validated against both existing methods of evolutionary optimization and an analytical approach that extends the work originally done by Moreno et al. on spatial optimization of LEDs. Monte Carlo raytracing simulations performed on LED distributions obtained by the proposed method shows an illumination uniformity above 0.8 which exceeds the uniformity requirement recommended by the European Standard of lighting for indoor work places. This work is intended to improve the illumination distribution and color mixing accuracy of circadian tuneable light and potentially replace the need for free-form lenses, mixing chambers, and diffusion film to improve uniformity.

Spectral optimization of a commercialised multi-channel SSL luminaire with tunable circadian impact

Rachel Saw[1], Vineetha Kalavally[1], Chee Pin Tan[1], Andrew Phillips[2], Alexandre Schaeffer[1], Sean Cain[2]

[1]*Monash University, Malaysia*
[2]*Monash University, VIC*

Abstract
In this prolific era when humans are attuned to function past dusk, it necessitates the invention of indoor lighting to allow our society to perform their tasks during the absence of natural light. Previously, the main emphasis on lighting technology was on visual quality and energy efficiency. However, while these lighting technologies were able to achieve impressive visual quality and permit remarkable energy savings, none considered the effects of light on the human biological state. As our society becomes aware of the potential biological effects of light, it is only natural that the focus of indoor lighting now shifts towards being human-centric as opposed to merely emphasizing the visual quality and energy efficiency. Thus, there exists a need for the design of luminaires which allow tunable circadian impact while delivering high visual and energy performance to potentially realize healthy circadian entrainment in humans.

With spectrally-tunable luminaires, it is necessary to optimize for both visual and non-visual qualities as there exist trade-offs between spectral properties such as luminous efficacy with color quality and circadian impact. Most spectral optimization works revolve around selected LED channels, theoretical LED parameters or limited consideration factors for the luminaire design. In this work, we present the spectral optimization for the circadian-tunable LED channel design as a multi-objective optimization problem, in an industrialized sense by accounting for the optimal number of LED channels and the optimized LED parameters for wide circadian impact tunability based on commercially available LED parameters. We also included theoretical and commercialised LED parameter combinations for various number of LED channels to achieve light spectra of a certain circadian impact while still satisfying high quality white light constraints and optimized for energy efficiency. This would contribute to the field of scientific research to investigate the effect of circadian content in light on biological systems.

Concurrent Session 3, 1:15pm - 2:20pm, Thursday 21 Novemeber 2019, Clarendon Room A, Health, Wellbeing and Light

Human Centric Lighting for Night Shift Workers

Bow Miss Jaruwangsanti

Design by Bow, NSW

Abstract
My interest in this topic started in early 2016 when I used tuneable white lights for a staff lounge in an RSL club where there are rotating shifts throughout the day and night. Then last year, in 2018 I had a chance to work on a prison project leading me to some research on lighting for inmates, night shift workers, and healthcare facility. As I was working on this project, I worked long hours and slept few hours a night for many weeks. Since then, my health was getting worse and I was diagnosed with autoimmune disease which made me realise how important sleep and the circadian rhythms are for our quality of life.
There are many studies and research that I found indicating that long-term night shift work is linked to chronic diseases, physical and mental illness. People who work night shifts often don't sleep enough, and suffer from long-term sleep deprivation. One of the problems could be that when a person works at night, the light exposure suppresses melatonin and disrupts the body's circadian rhythms.
We've paid so much attention to good lighting for workplace, but often we neglected those who work on a night shift. When it comes to an active workplace at night time, lighting should be designed and installed for shift workers to facilitate their adaptation to night work for their performance, safety and health especially in places like prisons, hospitals, emergency call centre where security and medical services are very high important and high alertness is demanded. Lighting systems should be designed to imitate daylight in order to affect a night shift workers' circadian system and adapt their circadian clock to the night shift, keeping them alert at night and to promote the secretion of melatonin during the day for their sleeping time.

Evaluation of Temporal Light Modulation (TLM) in LED light sources

Steven Coyne[1], Gillian Isoardi[1], David Boughey[2]

[1]*Light Naturally, QLD*
[2]*Department of Environment and Energy, ACT*

Abstract
Temporal variations in light output from a light source (known as Temporal Light Modulation or TLM) have known visual and non-visual effects on people. The phenomena first received attention with the dominance of magnetic-ballasted linear fluorescent lighting; which were then resolved by the advancement to high-frequency electronic ballasts. Now with the widespread adoption of LED sources for general illumination, this topic has returned to the forefront of research and product development due to the wide range of LED driver architectures utilised and their associated TLM.
The effects on people from TLM (known as Temporal Light Artefacts or TLAs), range from the distraction of visible flicker, to low-grade health ailments such as eyestrain, and reduced task performance – through to critical health concerns like migraines, photosensitive seizures and autistic behaviour. Susceptibility to negative health effects depends on the frequency and intensity modulation of the light. Individual factors are significant as well, with some groups vulnerable to specific forms of TLA. However, threshold values linking lighting variables to physiological impacts are not yet clearly defined for some of these possible health effects.
This presentation reviews existing research, summarising the biological effects of temporal light modulation within the context of human centric focus on lighting. Following from this is an analysis of measurements made across a range of lighting products for their potential to create adverse environmental health impacts. Underpinning this material is a critical appraisal of the metrics used to evaluate TLA that are supported by various standards bodies and industry organisations. Given their longevity, LED products installed today could be in service for many decades; therefore, serious consideration must be given to this topic to avoid potential, long-term health and productivity issues and their costly remediation.

Concurrent Session 4, 1:15pm - 2:20pm, Thursday 21 Novemeber 2019, Clarendon Room D, Latest in Lighting Standards

Why Light Pollution must be a part of the conversation

Landon Bannister

Southern Lighting and Distribution, TAS

Abstract
The ramifications of light pollution on our planet are now well established. The number of published papers dealing with light pollution and its negative effects on ecosystems and wildlife continues to grow rapidly as the scientific community further uncover the myriad of consequences resulting from our human need for artificial light at night. When we add in the known links to circadian disruption, the estimated energy waste, and the simple fact that the majority of our children will grow up without access to the wonders of a starry night above, then it is little wonder the dark sky movement is gaining so much momentum.
However, when we look at where this momentum is being generated it raises some serious questions. The fight against light pollution is strongly promoted from the fields of biology, medical sciences, astronomy, conservation, philosophy and even tourism. Rarely though do we ever hear of the lighting community joining in the fight. Some of us are aware of it, we may even talk about it, but as a collective profession that is ultimately responsible for much of the problem, we have to ask why we haven't been taking the issue more seriously? Perhaps it is because we are concerned around the commercial implications? Will promoting dark sky friendly installations ultimately lead to a diminished market for what we do?

The intention of this talk is to not only alleviate these concerns but to explore the reasons why lighting that protects our dark sky heritage makes sense. We will investigate how the objectives and ambitions of those fighting light pollution are closely aligned to our goals as lighting professionals and, ultimately, that delivering good outcomes for our night time environments can be achieved without adding to the problem of light pollution.

AS/NZS4282:2019 - Signs and Facades

Scott Forbes

Rubidium Light

Abstract
A brief introduction of the requirements of AS4282 pertaining to illuminated surfaces.
A case study presentation. Discussion with audience about interpretation and application.

Concurrent Session 5, 11am - 12:30pm, Friday 22 Novemeber 2019, Clarendon Room A, Future of Lighting

Circa, a wearable spectral sensor to measure light exposure impacting the human circadian system

Anas Mohamed[1], Vineetha Kalavally[2], Chee Pin Tan[1], Sean Cain[2], Suleman Kham[1], Andrew Phillips[2]

[1]*Monash University, Malaysia*
[2]*Monash University, VIC*

Abstract
Circa is a wearable spectral sensor for visible spectroscopy, optimized to measure light exposure affecting the human circadian system. It is the first of its class, capable of measuring the spectral power density of a light source and allows for the calculation of several quantities of light corresponding to the human circadian system. The human circadian system is a biological system that controls several rhythmic functions that occur in the human body. Recent research into the field of circadian chronobiology has revealed that the human circadian system is sensitive to the intensity and the wavelength of light. As such, researchers in the field are highly in need of a wearable spectral sensor that can be used to measure the spectral properties of light. It is possible to calculate several measures of light quantification specific to the circadian system from the spectra of light. One such measure is the response of the five photoreceptors in the human eye. The circa is spectrally calibrated to provide such calculations in a comprehensive app-integrated package, with IoT implementation. The sensor's spatial response, dynamic range and resolution is optimized to represent the human eye, such that it can be used as a reliable tool for the study of the human circadian system and to implement procedures to correct circadian misalignments. This paper presents the design of a wearable wireless spectral sensor capable of measuring the spectral power density of light in the visible range, store the data on board, and calculate the response of the five photo receptors in the human eye along with Photopic lux.

Influence of LED-based assistive lighting on the autonomous mobility of low vision people

Vineetha Kalavally[1], Pichayada Katemake[2], Anukul Radsamsong[2], Eric Dinet[3], Alain Tremeau[3], Wee Heng Choong[1], Ye Chow Kuang[1]

[1]*Monash University, Malaysia*
[2]*Chulalongkorn University, Thailand*
[3]*Université Jean Moulin Lyon, France*

Abstract
Visual impairment degrades the human visual system leading to a dramatic reduction of mobility in daily life. Light influences visual perception as well as visual performance and a huge number of works have been devoted to this topic for normal vision [1,2]. However, the influence of light is not the same in the case of individuals with visual impairments [3]. Some studies have focused on the problem of lighting in interior spaces where older people and visually impaired individuals can live, work or perform activities [4,5]. However, very few papers have addressed the impact of light on the mobility performance of low vision people.

This paper presents novel approaches to assess the impact of LED-based light settings on the mobility of individuals with low vision as a potential alternative to conventional mobility aids. By conducting three separate experiments, each involving a mobility walk and a kitchen activity with participants comprising of elderly, low vision subjects, and normal vision subjects wearing low-vision simulation glasses, the authors evaluate the effects of illuminance, correlated color temperature, object edge enhancement using lights and spectral distribution of light on the mobility of people with low vision. Impact of these light settings on the mobility of low vision subjects with blurry vision, central scotoma, tunnel vision and cataract are presented.

It is a significant finding that illuminance level and CCT choices or their combinations do not offer any mobility enhancement for most low vision variants. With regards to fine motor activities, the kitchen activities in these experiments revealed that spot lighting in addition to edge and contour lighting is helpful. Additionally, manipulating the spectrum of the light to accentuate contrast provides statistically significant improvements in mobility for those with cataract.

Visual comfort in green office buildings: using field studies to inform design

Veronica Garcia-Hansen[1], Alicia Allan[1], Gillian Isoardi[2], Simon S Smith[3], Duncan Richards[4], J Bell[1], Ayman Wagdy[1], Kieu Pham[1]

[1]*Queensland University of Technology, QLD*
[2]*Light Naturally, QLD*
[3]*University of Queensland, QLD*
[4]*AECOM Australia, QLD*

Abstract
Visual discomfort can be a significant problem in typical green commercial buildings in subtropical climates in Australia. Recent research found almost 50% of office workers in such environments suffering discomfort from glare. Discomfort from glare can act as both a cognitive stressor and a distraction that affects worker performance, and has been identified as potentially doubling energy consumption in green buildings when occupants apply ad hoc interventions to improve their comfort. Evidence shows a clear mismatch between the design intent and the actual operational outcomes that leads to negative consequences for wellbeing and building energy performance.

This presentation details the results of a large field study assessing visual comfort and building design factors for long-term occupants of green buildings in Brisbane, Australia. This work progresses our understanding of the relationship between visual comfort, the luminous environment (resulting from building design and new lighting technologies) and office workers' wellbeing. These results provide new, evidence-based knowledge and methods to support the design of green buildings that fulfil the design intent while improving operational effectiveness. Properly matching the built environment with occupants' needs and behaviours will improve energy efficiency and provide healthier working environments for office workers.

Concurrent Session 6, 11am - 12:30pm, Friday 22 Novemeber 2019, Clarendon Room D, Energy Effciency

Real Time and Weather Modelling of Daylight Availability in Complex Transport Structures: reduces Illumination and Electricity Capex & Opex by 50%

Richard Morrison

Light in Design by Jenarick Consulting, QLD

Abstract
Most electricity is generated with fossil fuels. Modern Transport Infrastructure demands a significant commitment to electricity generation by providing illumination for public safety. This public lighting is a large consumer of electricity due to it running all night on streets, and twenty-four hours per day in underpasses and tunnels.

Harvesting daylight is an established paradigm for replacing electric lighting to improve energy conservation and sustainability in the building industry. By utilising techniques developed over the last five years the author has produced a novel method of analysis of daylight availability in transport tunnels and underpasses. The methodology studies available daylight across a full year to establish the minimum average harvestable illuminance available for replacing electric lighting. In three case histories the author demonstrates that the method can reduce Capex and Opex in transport lighting commitments by up to 50%. The technique is able to be adapted to any geography on the planet and predicted returns on investment (ROI) are different for every geographic location.

The metrics developed relate directly to performance metrics in Roads and Tunnel Lighting Standards. Furthermore, the Daylight Harvesting Techniques deliver compliant illumination designs for the structures to enable public and driver safety while also documenting savings on carbon emissions, greenhouse gases, maintenance costs across structure life that far out way the overall cost of both the consultancy and the light fitting installation

Update on Regulation of Lighting Products under the Greenhouse and Energy Minimum Standards Act

David Boughey

Department of Environment and Energy, ACT

Abstract
A range of lighting products are regulated for energy efficiency and related parameters under the Greenhouse and Energy Minimum Standards Act (GEMS Act). In 2009, the Government phased-out a range of inefficient tungsten lamps which is estimated to have saved around 2.4 terawatt-hours (TWh) of electricity each year. On 20 April 2018, Council of Australian Governments Energy Council agreed to further improve lighting energy efficiency regulation by phasing out inefficient halogen lamps in Australia and introducing minimum energy performance standards for LED lamps in Australia and New Zealand in line with European Union (EU) standards.

This decision is expected to deliver around $1.4 billion in benefits to households and businesses, through savings on their electricity bills and reduced light bulb replacement costs. This presentation will give an overview of progress on these new initiatives including scope and timing. The presentation will also outline the GEMS Regulator's approach to monitoring, enforcement and compliance under the GEMS Act, and, highlight some of the compliance related issues faced by the GEMS Regulator.

Every Building Counts Introducing a Practical Plan to Reduce Emissions in the Built Environment

Sandra Qian

Green Building Council Australia

Abstract
Australia's buildings account for over 50 percent of our national electricity use, and almost a quarter of the national emissions output. To help the sector reach its full potential and support the transition to a low emissions economy, the Green Building Council and Property Council of Australia recently launched Every Building Counts: A Practical Plan for Emissions Reduction in the Built Environment. The plan is targeted at policy makers at the three levels of government, and set outs out 75 recommendations covering residential , commercial and public buildings taken from a comprehensive view of global and local policies. Together, these recommendations form an ambitious strategy for improving the performance of our buildings, showing how industry and government can work together to unlock a low carbon built environment.

Concurrent Session 7, 1:30pm - 3:00pm, Friday 22 Novemeber 2019, Clarendon Room A, Technology Lighting Way

Study of Unified Glare Rating of LED luminaires with diffusers

Dariusz Kacprzak

University of Auckland, NZ

Abstract
LEDs are intensive light sources. Many manufacturers' of LED luminaires face challenges related to glare control. The glare can be normally controlled by shielding, diffusing, dimming, use of internal reflections or use of lenses, etc… This paper presents study of glare related to LED luminaires with one and more diffusers.

There are several different methods of evaluation and quantification of discomfort glare. These methods are briefly presented in this paper. However the most commonly glare calculation technique is the Unified Glare Rating UGR. Australian and New Zealand standards AS/NZS 1680 present recommended glare values for particular spaces and lighting applications. These values are addressed by the lighting designers as well as the luminaires' manufacturers.

The value of UGR is mainly calculated by evaluating the luminance of the luminaire and the luminance of the background in particular directions.

Al the luminance correspond to the luminous intensity per area (cd/m2). Thus the values of UGRs depend on the luminaire area, but more accurate on the area of light emitting surfaces (f.e. diffusers).

This paper presents results on UGR study addressing accurate representation of light emitting surfaces - diffusers. Various luminaires were analysed, and their glare UGR values were calculated. The surface area of the diffusers were adjusted to accurately represent the mechanical structure of the luminaires. It was concluded that the glare values significantly change when the width and the length is accurately used in photometric models. Thus the values of UGR initially assumed to be about 19 could in fact increase up to 24. The significant glare increase, caused by accurate representation of the diffusers' area, could often result in loss of compliance with local glare standards and regulations.

The study was carried with the use of DIALux software.

Performance of LED Lighting Systems in the Presence of Load Control Ripple Injection Signalling

Sean Elphick

Australian Power Quality & Reliability Centre, University of Wollongong, NSW

Abstract
There has recently been a substantial number of customer complaints received by electricity distribution network service providers (DNSPs) concerning performance issues, particularly visible flicker, associated with domestic LED lighting systems (LED lamp/driver/dimmer combinations). Investigations has generally verified that lamp flickering occurs during periods where load control ripple injection signals are present in lighting circuits controlled by dimmers. DNSPs have used load control ripple injection signalling since the 1960s to control loads such as off-peak electric storage hot water heaters as well as street lighting. Preliminary investigations have shown performance issues even when ripple injection load control signal magnitudes are within DNSP networks standards and wider internationally accepted compatibility levels.

In 2017, in response to concerns raised by stakeholders, the Department of Environment and Energy commissioned the University of Wollongong to prepare a test procedure to evaluate the immunity of LED lighting system in the presence of ripple injection signalling voltages. This test procedure identified a significant number of variables (e.g. signal frequency, magnitude) related to ripple injection signalling that required evaluation in order to determine the immunity of any LED lighting system to ripple injection signalling voltages. The high number of identified variables resulted in a test regime which required a very high number of tests be conducted in order to confirm LED lighting system immunity. The purpose of the work described in this paper was to investigate the sensitivity of LED lighting systems to each of the variables identified in the original test procedure in order to determine if the number of variables, and as a consequence the total number of tests, to assure proper LED lighting system performance in the presence of ripple injection signalling could be reduced. The sensitivity analysis has been undertaken by assessment of four LED lighting systems for a significant number of variables.

A Whole New Level of Real-Time Light Simulation and Design Communication Tools

Christopher Blewitt and Carl Grey

Migenius Pty Ltd, VIC
Graylight

Abstract
Over the last 5 years there have been huge advances in the field of high speed and physically accurate computer visualisation systems. Continuous and massive investment in many converging streams of related technology development have been brought together to satisfy the exploding demand to display, within seconds, detailed configurations derived from extremely large and ever-expanding data sets.

A significant proportion of this high-speed data visualisation can only be achieved by utilising a combination of real-world lighting sources, physically accurate light transport simulation and 'BSDF' material definitions. This high-speed process needs to deliver large volumes of accurate photo-quality imagery, where any human operator input is simply not possible, instead totally relying on automated process algorithms using real-world lighting design principles.

As a result, out of all of this development, the lighting and design industry has become one of the major beneficiaries, with a new set of tools where complex lighting and design scenarios can now be thoroughly developed, explored and communicated using either local or cloud-based processing resources and all of this in real-time.

With these developments, the lighting industry now becomes an even more relevant component of the design and documentation process, where accurate photo-quality image output can be quickly created allowing all project team members and stakeholders to equally grasp and explore the precise differences between each of the proposed lighting and design solutions.

In this presentation and as a leading developer in this field, we will firstly expand on the circumstances surrounding these advances and then demonstrate 'live' many of the components of this new generation of speed and capability which will include the following subject areas: Complex and Real-time Light Transport simulation, Caustic Sampling, Al De-noising, MDL Material Definitions (BSDF), Variable Source Colour Temperatures, Measured Sun/Sky systems, Cloud Based processing systems and Stereo VR production.

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Feature Events

Pre-Conference Workshop

Date: Wednesday 20 September 2019
Venue: Garden Rooms, Level 1 Crown Towers, Crown Melbourne, 8 Whiteman Street, Southbank VIC
Time: 9.00am - 5.00pm

Speakers: Dr Mark S. Rea, Professor of Architecture and Cognitive Sciences, Rensselaer Polytechnic Institute

Dr Mariana G. Figueiro, Director of the Lighting Research Center (LRC) and Professor of Architecture at Rensselaer Polytechnic Institute

Welcome Drinks

Date: Thursday 21 November 2019
Venue: Exhibition Area, Clarendon Foyer, Melbourne Convention & Exhibition Centre
Time: 5:45pm - 6:45pm

Join us for the official welcome drinks of the IESANZ 2019 Conference! Network with friends and colleagues over a casual drink in the IESANZ Exhibition Hall Area, Clarendon Foyer. .

City Lights Tour

Date: Thursday 21 November 2019
Meeting Point: European Bar, 120 Exhibition Street, Melbourne
Time: 7:30pm

City of Melbourne lighting aims to enhance people's experience of the city after dark, while ensuring responsible energy use. This tour will take you through 6 different city landmarks. It is recommended you wear comfortable walking shoes and bring a coat in the event of inclement weather.

IESANZ Awards & Gala Dinner

Date: Friday 22 November 2019
Venue: RACV City Club, 501 Bourke Street, Melbourne
Time: 6:30pm - Midnight
Dress code: After 5pm

Celebrate the winners of the IESANZ International Awards and IESANZ VIC/TAS Chapter Awards at the inaugural IESANZ Awards & Gala Dinner to be held at the exclusive RACV City Club.

Take in the beautiful panoramic views over Melbourne and Port Phillip Bay, whilst indulging in drinks and a delectable three-course dinner.

This luxurious night of networking is an ideal way to stay in the loop with the most innovative lighting projects, products, services and people in the country!

Circadian Light without compromise

OSIN SkyBlue® technology offers true circadian stimulus while maintaining natural colour.

See it for yourself at the OSIN stand during the breaks.

OSIN
human light

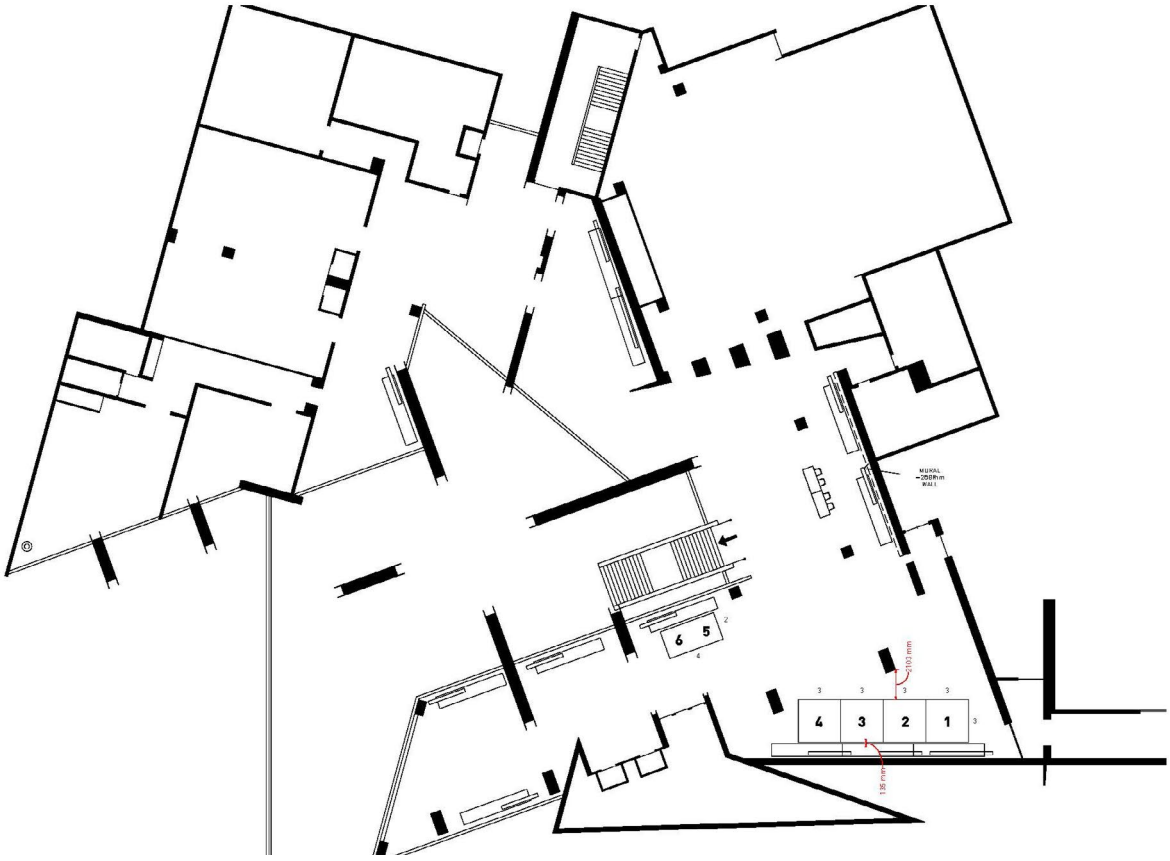
Exhibition

The conference exhibition will be located in the Clarendon Auditorium Foyer on Level 2 of the Melbourne Exhibition Centre (MCEC).

The exhibition will be open Thursday, 21 November 2019 from 10:15am – 7:00pm and on Friday, 22 November 2019 from 10:30am to 3.30pm.

Key

Exhibitor	Booth
Zumtobel	**1**
OSIN	**2**
Arealux	**3**
Pierlite	**4**
Signify	**5+6**



ies
The Lighting Society

Illuminating Engineering Society of Australia and New Zealand presents

IESANZ short Training Course Lighting Program for 2020:

‘Introduction to Light’ (2 Days)

Sydney – 17th & 18th February, 2020
Melbourne – 27th & 28th February, 2020
Adelaide – 2nd & 3rd March, 2020
Perth – 16th & 17th March, 2020
Brisbane – 26th & 27th March, 2020
Auckland – 7th and 8th May, 2020

Course Aims:

This course aims to provide participants new to the Industry to be suitably informed of the basic lighting concepts to enable them to understand and communicate these concepts to others. It equips participants with a knowledge of terminology and energy efficient lighting practices.

‘The Basics of Lighting Design’ (2 days)

Sydney – 2nd and 3rd March, 2020
Melbourne – 18th and 19th March, 2020
Adelaide – 23rd and 24th March, 2020
Brisbane – 12th and 13th May, 2020
Auckland – 25th and 26th June, 2020
Perth – 20th and 21st July, 2020

Course Aims:

This course is designed to expand on knowledge of light and the basics of its designed application. After satisfactory completion of this course, the attendee should feel confident discussing good lighting design at a basic level with industry participants plus an ability to work in a Lighting design role under expert supervision.

- Both courses are worth 12 CPD points each.
- A Certificate of Completion will be issued at the end of both Courses.
- In-house delivery of either of these courses is available to any organisation (subject to minimum numbers being achieved).

Further information can be found on the IESANZ website at www.iesanz.org look under EDUCATION and LIGHTING COURSES or contact the Course Coordinator, Susan Wall at susan.wall@iesanz.org

Putting people at the centre of lighting solutions

eaglelightingaustralia

Cherish the light

Respect the darkness

RS TECHNOLOGY
Reduced Spill light

Sportpark Marco van Basten,
Utrecht Netherlands

The urbanisation of society leads to more housing in the close proximity of outdoor sports accommodations. Due to this, light spill regulations become more important and more demanding.

AAA-LUX developed the RS technology. It keeps the light within the targeted zone, while maintaining an optimum uniformity. At the same time it limits spill light to the direct surrounding area to an absolute minimum.

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SMART. FLEXIBLE. LED.

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Small luminaire
Low weight & windage
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Wireless dimming
Remote monitoring
Smart City

10 year LED sportfield lighting.
First in the world 2009
with full retro-fit

AAA-LUX Australia

Distributer website:
WWW.AREALUX.COM.AU

Contact AREALUX
P: 1300 222 589

General Information

Registration Desk

On arrival, delegates are asked to make their way to the registration desk.

The registration desk will be located on the Level 2 Foyer of the Melbourne Exhibition Centre in the Clarendon Auditorium Foyer. Staff at the registration desk will be available at the following times:

- 06:00-19:00 Thursday, 21 November 2019
- 07:30-17:30 Friday, 22 November 2019

Name Badges

Delegate name badges will be issued at the registration desk upon your arrival. For security purposes, the name badge must be worn at all times during the conference. A person will not be granted entry to the conference if their name badge is not visible.

Presenter Instructions

- Presentations must be provided on a USB (memory stick) with the file in a PowerPoint PC format.
- Speakers will upload their PPT presentations on arrival at the Registration Desk.
- Please see Registration Desk staff for assistance.
- Please do not bring your own computer. There will be no time to swap computers over between presentations.
- Audio-visual technical support will be available on the day.

Transport

SkyBus

SkyBus is an airport express transport service that departs from Melbourne Airport (Tullamarine) and will take passengers directly to Southern Cross Station in the Melbourne CBD (corner of Collins and Spencer Streets). You can catch the SkyBus outside the front of Terminal 1 (T1), Terminal 3 (T3) and Terminal 4 (T4). SkyBus ticket booths are located at all terminals or alternatively, you can pre-book your ticket at **www.skybus.com.au/melbourne-city-express/fares** . Tickets are approximately $19.00 one way.

Taxi

Silver Top Taxi provides taxi services throughout Melbourne. Taxis are available outside Tullamarine airport or can be booked directly by dialing 131 008 or visiting **www.silvertop.com.au** . Taxis are approximately $50.00 from the airport to the Melbourne CBD.

Myki

You will need a valid myki ticket to travel on public transport in Melbourne. You can purchase and put money on a myki card from the ticket office window at train stations (e.g. Southern Cross Station, Flinders Street Station, Melbourne Central Station) as well as all 7-Eleven stores and participating newsagents and vendors in the city. Cards can also be refilled at myki machines located at all train stations, major tram stops, and bus interchanges. For further information, call 1800 800 007 or visit **www.ptv.vic.gov.au**

Free Tram Zone

It is important to note that the Free Tram Zone in Swanston Street ceases at Melbourne Central Station. All stops within the zone are clearly marked and tram drivers will make regular announcements when approaching zone boundaries. Outside of these areas, you must tap on and off when you change modes of transport to ensure you have a valid ticket. For further information, call 1800 800 007 or visit **www.ptv.vic.gov.au**

Train

The closest train stations to the Conference Venue is Southern Cross Station.

Tram

Tram numbers 96, 112 and 109 travel down Spencer/Clarendon Streets and stop opposite the Clarendon Street entrance of the Melbourne Exhibition Centre. Tram numbers 48 and 70 stop at the end of Flinders Street.

Bus

Many bus lines offer services connecting to train and tram services listed above. For details of connecting services in your area, call 1800 800 007 or visit **www.ptv.vic.gov.au**

Parking

There are two nearby options for parking: Wilsons Parking: Entrance off Normanby Road (1060 undercover parking spaces) and South Wharf Retail Car Park: Entrance off Normanby Road (550 Open air parking spaces). If you prefer the flexibility of street parking, the City of Melbourne offers more than 3000 parking bays throughout the central business district. Please be aware that these parking bays are subject to enforced parking restrictions.

Insurance

Registration fees do not include insurance of any kind. We strongly recommend that, at the time of booking your travel, you take out a travel insurance policy. This policy should take into account loss of deposit through cancellation, medical insurance, loss or damage to personal property, and financial loss incurred through disruption to accommodation or travel arrangements due to business failures, strikes, or other industrial action. IESANZ and the IESANZ Organising Committee cannot take responsibility for any participant failing to arrange their own insurance. Insurance must be purchased in your country of origin.

Disclaimer

IESANZ and the IESANZ Organising Committee will not accept liability for damages of any nature sustained by participants or loss or damage to their personal property as a result of the conference or related events. Neither IESANZ or the IESANZ Organising Committee are responsible for any loss or damage as a result of alteration to the program, cancellations or postponement of the conference due to unforeseen occurrence or any other event that results in staging of the conference being impractical or impossible. Delegates are encouraged to take out their own insurance as necessary to cover potential losses.

Program Changes

The IESANZ Organising Committee reserves the right to amend or make changes to this program.

CONTACT US

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