Joint Conference

17th International Symposium on the Science and Technology of Lighting (LS:17)

&

11th International Conference on Energy Efficiency in Domestic Appliances and Lighting (EEDAL'21)

June 1st – 3rd, 2022

Université Toulouse III – Paul Sabatier campus

Toulouse, France

EEDAL : LS:17

11th Energy Efficiency in Domestic Appliances and Lighting

17th International Symposium on Science and Technology of Lighting

17th LS

Session by session

Contributed papers Abstract Booklet

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Sessions at a glance

Wednesday June 1st, 2022

Session 1.03 - Afternoon

UV technologies & Applications

Session slot #	Paper number	Title	Presenter	Institution (Country)	
1.03.01	383609	Optical Light Source Model for UVC LEDs with Aid of Fluorescent Plate	Yang Tsunghsun	National Central University [Taiwan] (Taiwan), National Yang Ming Chiao Tung University (Taiwan)	**June 1st 14:00-15:40**
1.03.02	389999	Far UV-C Microplasma Flat Light Source: A Novel Tool Inactivating Airborne Pathogens	Park Sung-Jin	Eden Park Illumination, Inc. (United States), University of Illinois (United States)	
1.03.03	383406	Simulation based design of an UVC-LED emitter for disinfection of high-touch environmental surfaces	Mally Thorsten	Fraunhofer Institute of Optronics, System Technologies and Image Exploitation IOSB (Germany), Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology (FEP) (Germany)	
1.03.04	385163	Effectiveness of UV light on disinfecting SARS-CoV-2 and the field test using a UV irradiator in actual environment	Ide Nagisa	Toshiba Lighting & Technology Corp. (Japan), Yamaguchi Univ. (Japan)	

Environmetal Impacts & Life Cycle Assesment

Session slot #	Paper number	Title	Presenter	Institution (Country)	
1.03.05	400727	A generic approach to assessing lighting designs for horticultural applications: Part I - HID and LED lightsources	Bertin Kévin	Lumière et Matière (France), UCL Institute for Environmental Design and Engineering (United Kingdom), Ceravision Limited (United Kingdom)	**June 1st 16:05-18:10**
1.03.06	400730	A generic approach to assessing lighting designs for horticultural applications: Part II – Life Cycle Assessment	Bertin Kévin	Lumière et Matière (France), UCL Institute for Environmental Design and Engineering (United Kingdom), Ceravision Unlimited (United Kingdom)	
1.03.07	390070	EU ecodesign requirements for waste handling of lighting: perspectives from France and Sweden	Annika Jägerbrand	Halmstad University (Sweden)	
1.03.08	389598	New solution to prevent issues related to Volatile Organic Compounds in Sealed LED systems and in Packaged Laser Diodes	Corazza Alessio	SAES Getters (Italy)	
1.03.09	400279	Investigating the methods and health outcomes of research studies on light pollution and human physiology and behaviour: a systematic review	Nilsson Tengelin Maria	RISE Research Institutes of Sweden, Halmstad University (Sweden)	

Session 1.04 - Afternoon

Lighting Systems Design

Session slot #	Paper number	Title	Presenter	Institution (Country)	
1.04.01	383648	LED Spectrum with Optimal CRI of Various CCTs	Yang Tsunghsun	National Central University [Taiwan] (Taiwan), National Yang Ming Chiao Tung University (Taiwan)	**June 1st 14:00-15:40**
1.04.02	394659	Development of Linear LED Filament Lamps for Professional Lighting Applications	Hooker James	Sylvania Lighting NV (Belgium)	
1.04.03	383605	Design of Headlamp as Utilizing mini-LED Matrix Emitter	Yang Tsunghsun	National Central University [Taiwan] (Taiwan), National Yang Ming Chiao Tung University (Taiwan), National Taiwan University of Science and Technology (Taiwan)	
1.04.04	383494	A Multi Channel LED Luminaire with Bluethooth Control for Optimal Retail Lighting	Ahmadian Tazehmahaleh Kaveh	ESAT-WaveCore/Light&Lighting Laboratory KU LEUVEN (Belgium)	

Street & Tunnel Lighting				
Session slot #	**Paper number**	**Title**	**Presenter**	**Institution (Country)**
1.04.05	392616	The Role of Adaptive Lighting in Street Lighting Applications	Skandali Christina	School of Applied Arts and Sustainable Design, Hellenic Open University, Patra, Greece (Greece)
1.04.06	382955	Design of an adaptive lighting system able to consider the evolution of pavement reflection properties according to their moisture state	Greffier Florian	Cerema (France), Cerema (France), Comatelec Schréder S.A.S. (France), Cerema (France), Limoges Métropole (France)
1.04.07	386298	Strategies to decrease energy consumption in tunnel lighting: the feasible compromise between Safety and Sustainability	Peña-García Antonio	University of Granada [Granada] (Spain)
1.04.08	389004	Visibility Improvement of Fallen Objects and Lighting Energy Saving in Tunnels by Narrow Light Distribution Pro-Beam	Ikeda Yoshihisa	Ehime University (Japan), West Nippon Expressway Engineering Shikoku Company Limited (Japan)
1.04.09	389005	Investigation of the optical factor to determine the visibility of fallen objects in the tunnel by multiple regression analysis	Ikeda Yoshihisa	Ehime University (Japan), West Nippon Expressway Engineering Shikoku Company Limited (Japan)

Thursday June 2nd, 2022

Session 2.03 - Morning

Innovative Light Sources					
Session slot #	**Paper number**	**Title**	**Presenter**	**Institution (Country)**	
2.03.01	Keynote	Photoluminescence Enhancement of organic dye in thin film by metal layer and electrospun nanofibers	Ozaki Ryotaro	Ehime University (Japan)	**June 2nd 8:30-10:10**
2.03.02	396293	OLED Aging Detection through Voltage Noise Characterization under Constant Current	Elhalaoui Mustapha	Laboratoire Plasma et Conversion d'Energie [Toulouse] (France), Optics and Photonics Laboratory, Abdelmalek Essaadi University (Morocco)	
2.03.03	389896	oCVD PEDOT, an innovative material for OLEDs	Breig Benjamin	Laboratoire de Génie Chimique (France), Lumière et Matière (France), Laboratoire de Génie Chimique (France), Centre interuniversitaire de recherche et díngenierie des matériaux (France)	
2.03.04	383121	Novel Laser-Diode Based White Light Source with Increased Radiant flux	Rondelez Nick	Technologie campus Gent - KU Leuven (Belgium)	

Thermal Management					
Session slot #	**Paper number**	**Title**	**Presenter**	**Institution (Country)**	
2.03.05	391329	Thermally resolved electrical and spectral measurements and characterization of 420 nm and 450 nm LED filaments	Geens Rudy	Sylvania Lighting NV (Belgium)	**June 2nd 10:45-12:25**
2.03.06	392026	Numerical and experimental visualization of natural convection around a LED dissipator	Araoud Zouhour	Laboratory of Studies of Ionized Gases and Reactive Media, University of Monastir, Monastir, Tunisia	
2.03.07	391537	Effect of chip spacing on thermal and optical behavior of circular multi-chip LEDs package	Ben Abdelmlek Khaoula	Laboratory of studies of ionized and reactif media(EMIR) (Tunisia), Lumière et Matière (France)	
2.03.08	386688	Thermal modeling of a thermoelectric module on the temperature of a high-power LED	Ben Halima Ahlem	ben halima (Tunisia)	

	Phosphors				
Session slot #	**Paper number**	**Title**	**Presenter**	**Institution (Country)**	
2.03.09	382566	Study of the color-changing technology using multi-layer phosphors coupled with multi-LED excitation source using near-UV LED and purple LED	Sato Yuji	Department of Electrical and Electronic Engineering, Kanagawa Institute of Technology (Japan), Department of Home Appliance Engineering, Kanagawa Institute of Technology (Japan), Mitsubishi electrical lighting corporation (Japan)	**June 2nd 14:00-15:40**
2.03.10	396691	Nanophosphors, a catalyst for micro-LED technology development	Martin Pierre	Université Clermont Auvergne (France)	
2.03.11	389779	Highly-efficient LEDs by Combining Traditional Phosphors with InP/ZnSe Red Quantum Dots: Impact of Quantum Efficiency	Karadza Bega	KULeuven (Belgium)	
2.03.12	394576	White light generation by coupling blue laser diode and phosphor film	Kyrginas Dimitrios	Laboratoire Plasma et Conversion d'Energie (France), Laboratoire Plasma et Conversion d'Energie [Toulouse] (France), Institut de Chimie de Clermont-Ferrand - Clermont Auvergne (France), Institut de Chimie de Clermont-Ferrand - Clermont Auvergne (France)	

	Horiculture & Pisciculture Applications				
Session slot #	**Paper number**	**Title**	**Presenter**	**Institution (Country)**	
2.03.13	383333	Horticulture LEDs in Soybean Outdoor Light Supplementation - a Case Study	Vegner Igor	Universidade Federal de Santa Maria (Brazil)	**June 2nd 16:05-18:10**
2.03.14	389673	Genetic Algorithm Model for Plants Growth Based on Photosynthesis-Active Spectrum	Lopez Claudio	UC Davis (United States)	
2.03.15	388702	Influence of a variety of light parameters on biomass production and energy efficiency of Spirulina	Li Wenqi, Liu Muqing	Institute of Future Lighting, Academy for Engineering and Technology, Fudan University (China), Institute for Electric Light Sources, Fudan University (China)	
2.03.16	389665	How innovative light design can improve microalgae production	Trivellin Nicola	Department of Industrial Engineering [Padova] (Italy)	
2.03.17	389385	Light Propagation for Underwater LED as Fish Attraction Lamp	Dagang Ahmad Nazri	Ahmad Nazri Dagang (Malaysia)	

	Human Centric Lighting				
Session slot #	**Paper number**	**Title**	**Presenter**	**Institution (Country)**	
2.04.01	348133	Human Centric Lighting for the benefit of the elderly	Guerry Estelle	Laboratoire Plasma et Conversion d'Energie [Toulouse] (LAPLACE) (France), Laboratoire Plasma et Conversion d'Energie [Toulouse] (118 Route de Narbonne 31062 TOULOUSE CEDEX 9 France), Laboratoire LARA-SEPPIA (France)	**June 2nd 8:30-10:10**
2.04.02	391612	Light quality, color perception and emotions in the interior space.	Mekki Olfa	MEKKI Olfa (Tunisia)	
2.04.03	383131	Fundamental spectral boundaries of circadian tunability under different Duv constraints	Cerpentier Jeroen	KULeuven (Belgium)	
2.04.04	355278	Preference Lighting Model: Generalization of lighting preferences for individual users	Klir Stefan	Laboratory of Lighting Technology - Technical University of Darmstadt (TU Darmstadt) (Germany)	

SSL Market & Performances					
Session slot #	**Paper number**	**Title**	**Presenter**	**Institution (Country)**	
2.04.05	EEDAL 37	The unspoken challenge for linear fluorescent retrofits - and a solution	Shounak Roy, Krames Michael	Seaborough Research (USA)	**June 2nd 10:45-12:25**
2.04.06	EEDAL 25	Performance from SSL Lamps used in the Brazilian Residential Sector	Calixto Elvo	University of Sao Paulo (Brazil)	
2.04.07	EEDAL 55	What case studies reveal about the impacts/benefits of minimum and high-level performance targets on LED lighting markets	Mike Scholand	IEA 4E-SSL Annex	
2.04.08					

Session 2.04 – Afternoon

Light Quality, TLA and Drivers					
Session slot #	**Paper number**	**Title**	**Presenter**	**Institution (Country)**	
2.04.09	**Keynote**	Contemporary issues with temporal light modulation of lighting systems	Martinsons Christophe	CSTB - Centre Scientifique et Technique du Bâtiment (France)	**June 2nd 14:00-15:40**
2.04.10	389611	Implementation and Preliminary Verification of an Alternatvie Flicker Observer Model	Kukacka Leos	Technical University of Liberec (Czech Republic), Lumière et Matière (France)	
2.04.11	383569	Design and Implementation of LEDs Boost Driver for street lighting system	Mrabet Brahim	Prince Sattam Bin Abdul-Aziz University (Saudi Arabia), LAboratoire PLasma et Conversion dÉnergie (France)	
2.04.12	389199	Lighting quality and work performance based on glazing types and dynamic LED Lighting	Kose Fatma	Z.Tuğçe Kazanasmaz (Turkey), H.Engin Duran (Turkey), Gökmen Tayfur (Turkey)	

Discharge Light Sources Technology					
Session slot #	**Paper number**	**Title**	**Presenter**	**Institution (Country)**	
2.04.13	383393	Hybrid discharge for low consumption, mercury-free fluorescent lamps	Gutierrez Quentin	Laboratoire de Physique Subatomique et de Cosmologie (France), Institut Pprime (France)	**June 2nd 16:05-18:10**
2.04.14	383788	Electrical behavior of an excimer lamp excited by an Argon-based dielectric barrier discharge	Caillier Bruno	Diagnostic des Plasmas Hors Equilibres (France), Laboratoire de physique des couches minces et matériaux pour l'électronique, Oran1 (Algeria)	
2.04.15	354867	Modeling of Ultrahigh-Pressure Short-Arc Xenon Discharge Plasma	Timofeev Nikolai	Saint Petersburg University (Russia)	
2.04.16	383339	Experimental investigation of the electrical and optical properties of a DBD photon source in a Ne/Xe mixture.	Caillier Bruno	Diagnostic des Plasmas Hors Equilibres (France), Laboratoire de Physique des Plasmas, des Matériaux Conducteurs et leur Application, USTO-MB (Algeria)	
2.04.17	375336	General Considerations for Pulsed Power Circuit Topologies for Gas Lasers	Grover Harpreet	University of Toronto (Canada), UNIVERSITY OF TORONTO (Canada)	

Session 2.05 – Morning

	The way to the future, Markets & Training				
Session slot #	**Paper number**	**Title**	**Presenter**	**Institution (Country)**	
2.05.01	EEDAL 35	Update on the Advances of Lighting Systems Technology – The way towards Lighting 4.0 era	Zissis Georges	Hellenic Open University (Greece)	**June 2nd 8:30-10:10**
2.05.02	399163	Addressing Skills Needs of Lighting Professionals	Borotis Spiros	Université Toulouse LAPLACE (France)	
2.05.03	EEDAL 69	Next-Gen LEDs: Valuing New Features in the Market and Implications for R&D, ROI, Pricing, and Savings	Skumatz Lisa	SERA Skumatz Economic Research Associates, Inc (USA)	
2.05.04					

Session 2.05 – Afternoon

	Light Perception				
Session slot #	**Paper number**	**Title**	**Presenter**	**Institution (Country)**	
2.05.05	389805	Visual, non-visual and psychological effects of light on the textile and clothing factory workers	Bouzgarrou Lamia	Faculty of Medicine of Monastir -Tunisia (Tunisia)	**June 2nd 14:00-15:40**
2.05.06	386961	LED Device of Psychophysiological Express Diagnostics of Human Functional States	Aladov Andrei	Laboratory of Optoelectronic Instruments Submicron Heterostructures for Microelectronics Research and Engineering Center of Russian Academy of Sciences (Russia)	
2.05.07	383474	Impact of personalized lighting on the psychophysical state of a human	Svetlana Roslyakova	ITMO University (Russia)	
2.05.08	355240	The method for determining colour-matching functions of the physiological system based on the statistical approach	Rybina Viktoriia	VNISI Russian Lighting Research Institute named after S.I. Vavilov (Russia), National Research University, Moscow Power Engineering Institute (Russia)	

	Heritage & Museum Lighting				
Session slot #	**Paper number**	**Title**	**Presenter**	**Institution (Country)**	
2.05.09	392414	Visual and non-visual architectural thinking : 21st Century lighting design new theoretical contents	Caratti-Zarytkiewicz Richard	RICHARD CARATTI-ZARYTKIEWICZ (France)	**June 2nd 16:05-18:10**
2.05.10	388648	Embodied Cognition and Lighting in Museums	Gobbato Viviana	Viviana GOBBATO, Université Sorbonne Nouvelle and Université Paris Cité, CNRS, CERLIS, F-75006 Paris (France)	
2.05.11	383396	User Preference of White Light for Nepalese Heritage Site	Bista Aayush	Center for Electric Power Engineering, DoEEE, Kathmandu University (Nepal), Department of Electrical Engineering and Automation, Aalto University (Finland), LAPLACE (France), CLEES, Jigme Namgyel Engineering College (Bhutan)	
2.05.12	383405	Analysis and optimisation of lighting arrangement for typical Pagoda architecture of Nepal accounting the effect of light pollution	Bista Diwakar	Center for Electric Power Engineering, DoEEE, Kathmandu University (Nepal)	
2.05.13	388421	"LED-HBES" High Efficiency Lighting Systems: a Case Study of an University Historical Building	Martirano Luigi	Sapienza - University of Rome (Italy)	

Session 3.03 – Morning

Glare					
Session slot #	**Paper number**	**Title**	**Presenter**	**Institution (Country)**	**June 3rd 8:30-10:10**
3.03.01	382080	Discomfort glare in motion	Villa Céline	Université Gustave Eiffel/COSYS/PICS-L (France)	
3.03.02	382708	Applying the Unified Glare Rating for a non-uniform residential luminaire	Spieringhs Rik	Light&Lighting Laboratory, KU Leuven (Belgium)	
3.03.03	389269	Daylight glare occurrence and verification of prediction models under various solar radiation control technologies	Takanori Kabaki	Tokyo University of Science [Campus Noda] (Japan), YKK AP Inc. (Japan), Satoh Energy Research (Japan), National Institute for Land and Infrastructure Management, MLIT (Japan)	
3.03.04	389804	Model for discomfort glare evaluation reflected visual characteristics by using distribution over a retina of incident luminous flux on a receptive field	Hara Naoya, Kazuto Takase	Kansai University (Japan)	

Light Sensing & Measurement					
Session slot #	**Paper number**	**Title**	**Presenter**	**Institution (Country)**	**June 3rd 10:45-12:25**
3.03.05	383063	Combining Optical and Electronic simulation models for the assessment of Visible Light Positioning Systems	Zahiri Rad Saman, Weiss Andreas	MATERIALS – Institute for Surface Technologies and Photonics, JOANNEUM RESEARCH Forschungsgesellschaft mbH (Austria), Institute of Microwave and Photonic Engineering; Technical University Graz (Austria)	
3.03.06	382369	Sit-to-stand and stand-to-sit activities recognition by Visible Light Sensing	Salem Ziad	MATERIALS – Institute for Surface Technologies and Photonics, JOANNEUM RESEARCH Forschungsgesellschaft mbH (Austria)	
3.03.07	383290	Measurement of the light vector and the illumination-distribution solid using Raspberry Pi	Krüger Jan	Jan Krüger (Germany)	
3.03.08	388392	Case study – Modelling of Visible Light Communication on Luminous Intensity Distribution Curve of LED Low Beam Car Headlamps	Novak Tomas	VSB - Technical University of Ostrava (Czech Republic), Hella Autotechnik Nova (Czech Republic)	

Session 3.02 – Afternoon

Metrology & Vision					
Session slot #	**Paper number**	**Title**	**Presenter**	**Institution (Country)**	**June 3rd 14:00-15:15**
3.02.09	382678	Road BRDF Construction From Measured R-Tables	Boucher Vincent	Light and Lighting Team (France), Technical Direction (France)	
3.02.10	355143	Characteristics of brightness perception with two light sources presented to peripheral vision	Takahashi Hiroshi	Kanagawa Institute of Technology (Japan)	
3.02.11	389807	Relationship between Solid Angle, Eccentric Angle, Background Luminance and BCD Luminance for a Large-Area Light Source	Kazuto Takase	Kansai University (Japan)	

Session 3.03 – Afternoon

Smart Lighting & Visual Communications					
Session slot #	**Paper number**	**Title**	**Presenter**	**Institution (Country)**	**June 3rd 14:00-15:15**
3.03.09	382442	Smart lighting and digital sobriety	Foucras Bruno	The Shift Project (France)	
3.03.10	389254	Towards a Digital Twin for Smart Street Lighting systems Using a Virtual Reality interface	Piovano Luca	CEDINT - Universidad Politécnica de Madrid (Spain)	
3.03.11	383338	Color-mixed white light LEDs and visible light communication integration: benefits, perspectives, and challenges	Dalla Costa Marco	Universidade Federal de Santa Maria (Brazil)	

Presenters at a glance

Session slot: 1.03.01

Optical Light Source Model for UVC LEDs with Aid of Fluorescent Plate

Presenter: Yang Tsunghsun, National Central University Taiwan)

Abstract:
This paper presents the mid-field model for an ultraviolet C light emitting diode (UVC LED) of wavelength around 275 nm by comparison of the 2-dimension (2-D) gray-level image captured from a mono-CMOS sensor and simulated irradiance pattern. Owing to UVC light, we propose using a fluorescent film to absorb UVC light and re-emit visible light so that the 2-D image could be captured. The analysis and calibration to obtain accurate gray level of image are performed. Finally, we achieve the mid-field model with high accuracy. Furthermore, this model is also applied for dome lens design and then compares the performance with fabricated samples in measurement to expertise its validity.

Session slot: 1.03.02

Far UV-C Microplasma Flat Light Source: A Novel Tool Inactivating Airborne Pathogens

Presenter: Park Sung-Jin, Eden Park Illumination, Inc. (United States)

Abstract:
In this paper, a far UV-C microplasma flat lamp with its center emission wavelength at 222 nm will be introduced for its performance to prevent airborne transmission of the virus by continuous viral density reduction in an occupied indoor space. At a controlled UV fluence, specified by UV TLVs guidelines from the both ACGIH (American Conference of Governmental Industrial Hygienists) and ICNIRP (International Commission on Non-Ionizing Radiation Protection), the microplasma lamps demonstrated technical (and scientific) advantages over conventional techniques in inactivating various infectious pathogens, including various coronaviruses including SARS-CoV2 (COVID-19) virus. Details concerning the lamp characteristics, application studies, and prospects of the preventive uses of these microplasma far UV-C tiles in both pandemic and post-pandemic eras will be discussed.

Session slot: 1.03.03

Simulation based design of an UVC-LED emitter for disinfection of high-touch environmental surfaces

Presenter: Mally Thorsten, Fraunhofer Institute of Optronics, System Technologies and Image Exploitation IOSB (Germany)

Abstract:
Healthcare-associated infections (HAIs) are a serious problem. Many studies showed that high-touch environmental surfaces can take part in the transmission of HAIs. Helping to reduce these transmissions an UVC-LED emitter is developed, which can be carried by an autonomous robotic platform. It can disinfect environmental surfaces within a clinical environment with UV-C light. The performance of the device was experimentally tested with two pathogens Escherichia coli (E. coli) and Bacillus subtilis (B. subtilis) spores. A 3-5 log reduction can be achieved within 4 s irradiation time. Further investigations are made by simulation typical environmental surfaces. In this study we aim on the disinfection of contamination hotspots like light switches and door handles. On the light switch surface it can reach a dose of almost 400 J/m² within 4 s. The door handle is more challenging due to its geometry. To improve the irradiation of the backside a foil of sintered PTFE can be attached to the door surface to increase the reflectivity. With the PTFE attached a 3-4 log reduction can be achieved for E. coli and B. subtilis spores.

Session slot: 1.03.04

Effectiveness of UV light on disinfecting SARS-CoV-2 and the field test using a UV irradiator in actual environment

Presenter: Ide Nagisa, Toshiba Lighting & Technology Corp. (Japan)

Abstract:
Ultraviolet (UV) disinfection technology has been attracting attention as one of the countermeasures against infectious diseases. We investigated the inactivation efficacies against SARS-CoV-2 in laboratory experiments with the light sources of three wavelengths: an excimer lamp (222 nm), a low-pressure mercury lamp (254 nm) and an LED (280 nm). It was confirmed that 99.999% or more of SARS-CoV-2 were inactivated with less than 20 mJ/cm2 of all light sources. An excimer lamp mounted UV irradiator, which can irradiate even when people are present, was installed in an actual environment to confirm the disinfection effectiveness. Compared with the conditions without UV irradiation, the UV-irradiated conditions resulted in a 76-90% reduction in colonies of viable bacteria.

Session slot: 1.03.05

A generic approach to assessing lighting designs for horticultural applications: Part I - HID and LED lightsources

Presenter: Bertin Kévin, LAPLACE, Toulouse 3 University (France)

Abstract:
Lighting designs for a typically-sized large scale commercial greenhouse are presented for various generic HID and LED sources. The designs are analysed by a detailed comparison of the calculated irradiances in selected wavelength bands. The extensive range of parameters needed to complete these analyses highlights the shortage of readily available quantitative information currently available from the lighting industry. The detailed methodology is intended to promote co-operation between commercial growers and the lighting industry.

Session slot: 1.03.06

A generic approach to assessing lighting designs for horticultural applications: Part II – Life Cycle Assessment

Presenter: Bertin Kévin, LAPLACE, Toulouse 3 University (France),

Abstract:
Following the emergence of different horticultural installations around the world, many questions have been raised about the environmental impacts they may generate. In order to assess these impacts, a Life Cycle Assessment (LCA) of different horticultural lighting systems, High Pressure Sodium (HPS), Metal Halide (MH), and Light-emitting diode (LED), was conducted. The authors propose two different approaches in the definition of the functional unit: one is expressed as the product of the photosynthetic photon flux density (PPFD) ($\mu mol.s^{-1}.m^{-2}$) and time, and the other is expressed as the product of the irradiance ($W.m^{-2}$) and time. The results show that the potential impacts are largely dominated by the use phase which favours the systems with the lowest energy consumption, however when looking specifically at the irradiance over a wavelength range, some lamps, depending on their SPDs, have lower potential impacts despite higher overall energy consumption.

Session slot: 1.03.07

EU ecodesign requirements for waste handling of lighting: perspectives from France and Sweden

Presenter: Annika Jägerbrand, Högskolan I Halmstad (Sweden); Merschbrock Christoph, Halmstad University (Sweden), Norwegian University of Science and Technology (Norway)

Abstract:
Abstract—Circular economy is becoming an important topic for lighting design, research, and industry. Recent legislation, like the EUs ecodesign regulation, have established circularity, reparability, and recyclability as requirements for industry. This article investigates what happens at the end-of-life stages of lighting products through questionnaires and interviews conducted with experts in Sweden and France. The focus is to understand the impact of the new EU requirements on industrial practice in France and Sweden. Moreover, the article provides ideas for practical improvement of both product recyclability and waste handling of luminaires and light sources.

Session slot: 1.03.08

New solution to prevent issues related to Volatile Organic Compounds in Sealed LED systems and in Packaged Laser Diodes

Presenter: Corazza Alessio, SAES Getters (Italy)

Abstract:
Volatile Organic Compounds (VOCs) can cause problems in LED lamps and in opto-electronic devices during their operative service life. In particular, it is already known that in sealed LED bulbs and in laser diodes where an intense radiation flux is present, dark spots on emitting areas can be created as a consequence of pyrolysis of carbonaceous gaseous species within the package. In this work we describe an advanced solution suitable to avoid VOCs-induced degradation in hermetically sealed devices; the solution is based on a composition that combines synergic actions of both getter and gas dispensing materials. We illustrate the effectiveness of the new solution in real operating conditions, extending the device service life from few hundred hours to several thousand hours.

Session slot: 1.03.09

Investigating the methods and health outcomes of research studies on light pollution and human physiology and behaviour: a systematic review

Presenter: Nilsson Tengelin Maria, RISE Research Institutes of Sweden, Halmstad University (Sweden)

Abstract:
Light at night (LAN) enables humans to extend their lifestyle and exploration, cultivates economic growth, and increases the perception of safety. On the other hand, LAN has been connected to adverse health outcomes, such as circadian disruption, mood effects, and increased breast cancer incidence risk in humans. Studies investigating health outcomes of LAN utilize a variety of methods sometimes resulting in conflicting outcomes. We conducted a systematic review focusing on the experimental methods and health outcomes of LAN studies. While most studies found a negative impact of LAN on human health, lighting conditions were not adequately reported or controlled in many cases. Recommendations are provided for future research studies investigating LAN effects on human health outcomes.

Session slot: 1.04.01

LED Spectrum with Optimal CRI of Various CCTs

Presenter: Yang Tsunghsun, National Central University (Taiwan)

Abstract:
In this work, we have successfully obtained the optimal LED spectra for the highest CRI of any CCT. By developing an empirical spectral function to describe the LED spectra with high accuracy and optimizing the empirical spectral function with a specified merit function, the optimal LED spectrum can be easily evaluated. Therefore, a series of the optimal LED spectra for the highest CRI of various CCTs is concluded.

Session slot: 1.04.02

Development of Linear LED Filament Lamps for Professional Lighting Applications

Presenter: Hooker James, Sylvania Lighting NV (Belgium)

Abstract:
LED Filaments in gas-cooled envelopes have been widely embraced for residential lighting, in particular as retrofits for incandescent lamps. Despite their impressively high efficacy and omnidirectional light distribution, they have so far failed to penetrate professional lighting applications. This paper presents a novel design of linear LED filament lamp which enables a dramatic increase in luminous flux. It also builds on the unique 360° light distribution pattern to create a highly versatile light source offering a number of advantages for commercial lighting applications.

Session slot: 1.04.03

Design of Headlamp as Utilizing mini-LED Matrix Emitter

Presenter: Yang Tsunghsun, National Central University (Taiwan)

Abstract:
In this paper, we propose and demonstrate that a 5x6 GaN-based mini-LED matrix projects the vehicle low beam and high beam by a single reflector with 68 segments. The design of the reflector is based on light wave technology in considering etendue from the light source across the segments. The group of the segments with smaller etendue from the LED dies in the bottom 2 rows are used to project low beams. When the other LED dies are turned on, the reflector will project light upward and form the high beam. The selection of the turn-on LED dies in the mini-LED matrix can adjust the width of the illumination pattern so that an adaptive low/high beam can be performed. Besides, to extend the functionality of the headlamp module, we propose to dispense IR phosphor on LED dies in the high-beam zone of the GaN-based mini-LED matrix. Thus, the vehicle can emit IR high beam, which can be imaged through a camera and incorporated with machine vision for an autonomous vehicle without using a complicated adaptive headlight to avoid glare.

Session slot: 1.04.04

A Multi Channel LED Luminaire with Bluethooth Control for Optimal Retail Lighting

Presenter: Ahmadian Tazehmahaleh Kaveh, ESAT-WaveCore/Light&Lighting Laboratory KU LEUVEN (Belgium),

Abstract:
Multichannel LED luminaires can generate tunable illumination spectra, which creates new opportunities for designers of professional lighting applications, such as retail and museum. One of such opportunities is to select an optimal illumination spectrum depending on the desired Correlated Color temperature (CCT), the target illuminance

and the object to be illuminated (object-oriented approach). A Bluetooth Low Energy (BLE) controlled tunable six-channel LED light source is designed and constructed. A Python code, adopting a genetic algorithm (GA) is developed to compensate for the shifts in the LED spectra due to a variation of the junction temperature. Validation measurements of the optical output of the luminaire confirm the validity of the concept. A smartphone application has been developed to provide the end user the opportunity to select the desired light spectrum in three ways: a predefined setting for a particular familiar object determined based on the outcome of psychophysical experiments, a selection of the desired CCT and color rendering properties of the spectrum or a free choice where the user can modify the intensity of each channel to achieve the desired object appearance.

Session slot: *1.04.05*

The Role of Adaptive Lighting in Street Lighting Applications

Presenter: Skandali Christina, School of Applied Arts and Sustainable Design, Hellenic Open University, Patras, Greece (Greece)

Abstract:
The advent of LEDs in street lighting applications and the corresponding technological evolution during the last decades has given the opportunity to societies to create a more sustainable lighting environment. However, in most cases, up to now, in upgrading the infrastructures of the national roads, the assessment of street lighting tenders is limited at meeting the lighting design criteria as proposed by European Norms such as luminance, uniformity, threshold increment and the edge of illuminance ratio. As the candidate companies achieve the lighting requirements the next stage of the evaluation is the financial. None of the existing energy indexes, environmental criteria or the benefit of the adaptive lighting is examined. The aim of this study is to indicate the effect of adaptive lighting in luminaire selection in street lighting applications. The outcome shows that the dimming procedure can affect significantly the results of selection of the optimal luminaire in every street lighting case. The real function between the light output and the consumed power differs remarkably when luminaires are dimmed and the adaptive lighting is selected in curfew hours as until now this function is considered faulty as linear. This difference can change the evaluation procedure and the classification of the luminaires in a light tender.

Session slot: *1.04.06*

Design of an adaptive lighting system able to consider the evolution of pavement reflection properties according to their moisture state

Presenter: Greffier Florian, Cerema (France)

Abstract:
The optimization of road lighting installations is nowadays mainly considered from the point of view of reducing energy costs by using the advantages of LED technology when designing or renovating lighting installations. Knowing the actual reflection properties of the road to be illuminated enables further optimization but these are too often not measured. Moreover, the evolution of these properties according to the surface state of the road (dry, moist, wet, soaked) is never considered. This paper proposes a methodology to design an adaptive lighting system that takes into account the optical properties of the pavement according to the weather conditions in order to optimize the visibility offered to users. This methodology is based on numerous simulations of potential pavement surface states. By comparing the developed adaptive lighting system with a conventional lighting system, it is shown that the overall optimization of the lighting operation is achieved both on photometric and on energy aspects.

Session slot: 1.04.07

Strategies to decrease energy consumption in tunnel lighting: the feasible compromise between Safety and Sustainability

Presenter: Peña-García Antonio, University of Granada [Granada] (Spain)

Abstract:
The especial characteristics of tunnels make them critical infrastructures in terms of driving complexness and expensive lighting from all the perspectives: economic impact, consumption of energy and raw materials, environmental pollution, dangerous maintenance etc. The search of equilibrium between safety and sustainable lighting has been a matter of concern for years. Although the last decade has been especially fruitful in terms of proposals, there is still a long way ahead until the implementation of the most accurate ones in each case becomes a routine. This work presents and analyzes the current proposals, the tools to evaluate them, their degree of implementation and the forecasts for the next years.

Session slot: 1.04.08

Visibility Improvement of Fallen Objects and Lighting Energy Saving in Tunnels by Narrow Light Distribution Pro-Beam

Presenter: Ikeda Yoshihisa, Ehime University (Japan)

Abstract:
To reduce traffic accidents caused by fallen objects in expressway tunnels, the authors investigated the visibility of fallen objects in a 1/24 scale model of tunnels by changing the lighting conditions in the tunnel. As a result, narrow light distribution pro-beam lighting with collimator lenses with a lighting distribution angle of 30 degrees for tunnel lighting achieved higher visibility of fallen objects. Moreover, the power consumption was reduced by 25 % compared to conventional symmetrical lighting at a road surface luminance of 4.05 cd/m^2.

Session slot: 1.04.09

Investigation of the optical factor to determine the visibility of fallen objects in the tunnel by multiple regression analysis

Presenter: Ikeda Yoshihisa, Ehime University (Japan), West Nippon Expressway Engineering Shikoku Company Limited (Japan)

Abstract:
To secure the driver's visual environment has the priority in tunnel lighting design. The visibilities of preceding vehicles and on-road obstacles are the essential factors in tunnel lighting, determining the safety in the visual environment. In this study, the authors verified the visibility improvement effect of the Pro-beam lighting in the expressway tunnel. The authors investigated the necessary luminance ratio of objects and background road surface to recognize the objects in a tunnel. The authors also investigated the other lighting factors (including the equivalent veiling luminance and illuminance) and the relationship between these lighting factors and visibility.

Session slot: 2.03.01

KEYNOTE
Photoluminescence Enhancement of organic dye in thin film by metal layer and electrospun nanofibers

Presenter: Ozaki Ryotaro, Ehime University (Japan)

Abstract:
Nanofiber is a nanostructured material whose diameter is several tens to several hundreds of nanometers. Electrospinning is widely used for manufacturing nanofibers, wherein fibers are formed by filling a syringe with a polymer solution and applying a high voltage to the needle tip. One-dimensionally aligned or randomly aligned nanofibers can be easily obtained by changing collector electrodes in electrospinning setup. In this study, we demonstrate photoluminescence enhancement of dye-doped polymer films using metal layer and electrospun nanofibers. Enhanced emissions from the polymer films on a planar aluminum layer have been observed which can be explained by interference. The photoluminescence intensity of the sample also gradually increases during nanofiber electrospinning. The emission enhancement by nanofibers is brought about by improving the excitation efficiency and light extraction caused by light scattering.

Session slot: 2.03.02

OLED Aging Detection through Voltage Noise Characterization under Constant Current

Presenter: Elhalaoui Mustapha, LAPLACE, Toulouse 3 Univesity (France)

Abstract:
The degradation mechanisms of Organic Light Emitting Diodes (OLED) light sources are not yet fully understood. Several researchers have studied these mechanisms using different methods, such as I-V and impedance characteristics as well as photometric and colorimetric parameters. In this paper, emphasis is put on aging detection using simple, field applicable and non-obstructive approaches. More specifically, the voltage noise during continuous operations at the nominal current is investigated. The statistical properties of this parameter shift with aging. This shift was studied on a small sample set, yet it permitted to discriminate correctly between new and aged OLEDs. A number of estimators were evaluated, all possessing the same ability to detect aging signature.

Session slot: 2.03.03

oCVD PEDOT, an innovative material for OLEDs

Presenter: Breig Benjamin, Laboratoire de Génie Chimique, Institut National Polytechnique (France)

Abstract:
PEDOT:PSS is a benchmark material for hole injection/transport in organic electronic devices. However, the addition of PSS additives to solubilize it, also induce an increase of acidity and potential solvent relaxation into the device. Two factors highly detrimental to the life time of the OLED. The development of oxidative chemical vapor deposition (oCVD) offers the possibility to deposit thin films of pure PEDOT directly on the substrate. Thus avoiding any extra steps, such as using PSS. The oCVD requires a careful control and optimization of the reaction parameters. Among them, the most critical ones are the temperature of the substrate, the flow of the two reactants and their ratio one to the other and the time of deposition. Through an optimization of these parameters, a PEDOT thin film with a conductivity of 800 S/cm and a transparency over 85% at 550 nm was obtained. These performances makes PEDOT by oCVD competitive with commercial PEDOT:PSS. Hence, for the first time to our knowledge, an OLED with PEDOT by oCVD was made and demonstrated excellent electrical and luminance performances. Thus paving the way to a new method of deposition for PEDOT thin film, free of additives and solvents.

Session slot: 2.03.04

Novel Laser-Diode Based White Light Source with Increased Radiant flux

Presenter: Rondelez Nick, Technologie campus Gent - KU Leuven (Belgium)

Abstract:
Novel high-luminance light sources are being investigated for applications such as car headlights and street lighting. The availability of efficient and powerful blue laser diodes, makes it possible to realize phosphor converted white light sources with an extremely high source luminance. In this paper, we demonstrate a system with high-power laser diodes emitting up to 76 W, and a remote phosphor, of which the outcoupling efficiency is improved by 146% by addition of a sapphire half-ball lens. A theoretical limit of over 16000 lm is possible at a CCT of 4800 K.

Session slot: 2.03.05

Thermally resolved electrical and spectral measurements and characterization of 420 nm and 450 nm LED filaments

Presenter: Geens Rudy, Sylvania Lighting NV (Belgium)

Abstract:
This paper presents a novel methodology for measuring LED filament characteristics as a function of junction temperature and current. It is shown that the current-voltage characteristics of the LED emitters used in the filaments follow a modified Schottky relation. The Schottky parameters are derived and discussed. Using the ABC method, the measurement results are used to analyze the contributions of the different recombination processes of the LED emitters.

Session slot: 2.03.06

Numerical and experimental visualization of natural convection around a LED dissipator

Presenter: Araoud Zouhour, Laboratory of Studies of Ionized Gases and Reactive Media, University of Monastir (Tunisia)

Abstract:
Thermal management of light-emitting diodes (LEDs) for lighting is essential to ensure better performance since 70–85% of its injected power is converted into heat. To increase the heat transfer rate, a heat sink is used to facilitate the natural convection heat transfer phenomenon. Thus, visualization of thermal flow around its heat sink is a powerful technique for developing conceptual models.
In this paper, we compare the numerical results found by simulation with Comsol Multiphysics® using a rectangular heat sink with experimental visualization of the natural convection obtained by Schlieren imaging technique and then processed by Matlab®. Results show that this optical technique can be a promising technology to quantify thermal properties of the light source.

Session slot: 2.03.07

Effect of chip spacing on thermal and optical behavior of circular multi-chip LEDs package

Presenter: Ben Abdelmlek Khaoula, Laboratory of Studies of Ionized Gases and Reactive Media, University of Monastir (Tunisia)

Abstract:
Despite the continuous progress of its technology, thermal management ofLight Emitting Diode packages (LEDs) still the key of their good performances and long lifetime. In this paper, a numerical analysis of 45WLEDs arrayis developed using COMSOL Multiphysics®. The PCB LED Board and the heat sink have circular forms. Thirty-six chips are arranged on the PCB following three circles around a central one. The spacing between them is the studied parameter used to highlight its effect on thermal and optical properties of the package. Results show that junction temperature

decreases considerably when increasing the spacing from 1 to 12mm. However, it is found that smaller chips spacing causes a temperature difference between chips in the same package. Despite it does not affect strongly the light output,the temperature difference between chips causes a significant difference of chips lifetime in the same package, and causes a reduction of the amount of light produced when central chips fail.

Session slot: 2.03.08

Thermal modeling of a thermoelectric module on the temperature of a high-power LED

Presenter: Ben Halima Ahlem, Laboratory of Studies of Ionized Gases and Reactive Media, University of Monastir (Tunisia)

Abstract:
LED light sources have established themselves in the lighting world due to their long lifespan and high energy efficiency. Nevertheless, almost 70% of the injected power is converted in the form of heat. The transformation of this lost thermal energy into light must be accompanied by an overall increase in the efficiency of the system. A Peltier module placed in the heat flow produces current but generates additional thermal resistance which results in a drop in the light output of the LED. This preliminary study should make it possible to provide the necessary elements to demonstrate whether the ratio between the energy produced by such a system is greater than the efficiency losses generated.

Session slot: 2.03.09

Study of the color-changing technology using multi-layer phosphors coupled with multi-LED excitation source using near-UV LED and purple LED

Presenter: Sato Yuji, Department of Electrical and Electronic Engineering, Kanagawa Institute of Technology (Japan)

Abstract:
We investigated a light emission method for high color rendering LED lighting that can change its emission color using multiple near-UV LEDs with different peak wavelengths. In the multi-layer phosphor sample, the average color rendering index Ra = 89.02, the color fidelity index Rf = 92.08, and the color vividness index Rg = 100.05 were obtained by arranging the phosphors in the order of GbBRb from the side closest to the excitation source. Furthermore, by changing the ratio of the emission intensity of the near-UV LED and purple LED of the multi-chip type excitation source using the multi-layer type phosphor sample GbBRb, the color temperature could be adjusted over a range of about 500K from 3068K to 3532K.

Session slot: 2.03.10

Nanophosphors, a catalyst for micro-LED technology development

Presenter: Martin Pierre, Université Clermont Auvergne (France)

Abstract:
With high optical power densities and small dimensions (inferior to 100µm), micro-LEDs are considered as a major progress, opening new perspectives in smart displays conception, communication or medical fields. However, color conversion appears as a challenge that requires the development of efficient and stable nanophosphors. In this paper, a top-down approach to produce cerium doped yttrium aluminum garnet (YAG) nanocrystals (<50nm) through high energy ball milling is reported. Results show that

comminution is associated with a drop in optical performances and a partial amorphization of the particles. A grinding mechanism, based on the performed morphological and structural analysis, is proposed.

Session slot: 2.03.11

Highly-efficient LEDs by Combining Traditional Phosphors with InP/ZnSe Red Quantum Dots: Impact of Quantum Efficiency

Presenter: Karadza Bega, KU Leuven (Belgium)

Abstract:
We report efficient, high-CRI white LEDs with an on-chip color convertor coating based on red InP/ZnSe QDs and traditional green/yellow powder phosphors. Using InP/ZnSe QDs with a quantum yield of nearly 80% and a full width at half maximum of 45 nm, we demonstrate high spectral efficiency for white LEDs with very high CRI values. The white LED that we made has an efficacy of 132 lm/W, and color rendering indices of Ra ~ 90, R9 ~ 50 for CCT ~ 4000 K. Further, we show that this result would be significantly higher with a 'state-of-the-art' LED package, as the main losses are due to the non-optimal wall-plug efficiency of the blue LED chip and non-optimal recycling properties of the package used in this study. To make efficient LEDs it is also important to carefully choose a green powder phosphor that does not emit significantly in the red region, and that quantum dots are of high efficiency.

Session slot: 2.03.12

White light generation by coupling blue laser diode and phosphor film

Presenter: Kyrginas Dimitrios, LAPLACE, Toulouse 3 Univesrity (France)

Abstract:
YAG: Ce^{3+} phosphor encapsulated in a polyimide film is coupled with a blue laser diode of 450nm for the generation of white light. Colorimetric properties such as CCT and CRI are measured under different driving currents and operating temperatures of the laser diode. The aging of the material under laser irradiation is also studied.

Session slot: 2.03.13

Horticulture LEDs in Soybean Outdoor Light Supplementation - a Case Study

Presenter: Vegner Igor, Universidade Federal de Santa Maria (Brazil)

Abstract:
In the present paper, a case study of the use of horticultural LEDs in artificial light supplementation is presented. For that, the main system characteristics are presented, along with the concepts used on lighting systems projects. Plant response to light in different life stages are necessary to investigate in order to proper design of the lighting system. Using a 40W light engine with purple light, a combination of blue and red spectra, a proof of concept was installed in a soybean field. Preliminary results show increment in the flowering of crops.

Session slot: 2.03.14

Genetic Algorithm Model for Plants Growth Based on Photosynthesis-Active Spectrum

Presenter: Lopez Claudio, UC Davis (United States)

Abstract:
In this work, a Genetics Algorithm model was created and implemented to obtain the parameters to design a specific spectral power distribution by combining multiple monochromatic light sources. This model accurately optimized the individual SPD lamps' variables of a group of light sources that combined fit the desired spectral power distribution.

Session slot: 2.03.15

Influence of a variety of light parameters on biomass production and energy efficiency of Spirulina

Presenter: Li Wenqi, Liu Muqing, Institute of Future Lighting, Academy for Engineering and Technology, Institute for Electric Light Sources, Fudan University (China)

Abstract:
Cyanobacteria Spirulina is rich in nutrients and a variety of bioactive substances and is essential to the ecosystem and human production activity. The process of biomass production strongly depends on light. However, there is still a lack of comprehensive research on the influence that various parameters of light have on biomass production. Light-emitting diodes (LED) have low energy consumption and is flexible to control light parameter, which is difficult to achieve by conventional light sources. In this study, several scenarios illuminated by LED of different light intensities, wavelength and photoperiod were tested. It was found that the light saturation point of Spirulina was 540 μmol photons m^{-2} s^{-1} and the combination of 450~465 nm and 650~660 nm performed well in improving cell growth. It suggested that the light: dark cycle should be set to 12 h: 12 h in the process of Spirulina cultivation for substantial biomass accumulation. The influence of duty cycle and frequency of pulsed light (PL) on the Growth of Spirulina was tested and the results showed that the lower the frequency is (below 10 Hz), the lower the energy utilization efficiency for biomass accumulation will be obtained. Under low frequency, small duty cycles have a substantial inhibition effect and the growth process under PL of larger duty cycles was consistent with that under continuous light.

Session slot: 2.03.16

How innovative light design can improve microalgae production

Presenter: Trivellin Nicola, Department of Industrial Engineering (Italy)

Abstract:
With this work we report on the design of two lighting systems based on LEDs to increase the efficiency and efficacy of microalgae production. Two lighting units are designed, discussed and their performances in biomass production of Arthrospira Maxima are evaluated. The first light design is used to demonstrate that an accurate spectral tuning can improve the photosynthetic efficiency as opposed to white light. The second light source has been designed to achieve high intensity, short pulses of light and demonstrate that under pulsing light regime the photosynthetic efficiency can be further improved. In particular we will focus into matching the absorption spectra of the algae light by accurately mixing the emission spectra of different Light Emitting Diode (LED) sources. By using pulsating light sources it also possible to boost the efficiency of the system by better exploiting the photon absorption and conversion principle.

Session slot: 2.03.17

Light Propagation for Underwater LED as Fish Attraction Lamp

Presenter: Dagang Ahmad Nazri, Universiti Malaysia Terengganu (Malaysia)

Abstract:
Artificial light in fisheries has been one of the most advanced and successful methods to control fish behavior for capture purposes. This study was conducted to investigate the light propagation and efficiency of the LED fish attracting lamp compared to the traditional light sources like halogen lamps and incandescent light bulbs used fishing. Three colors of LED tubes as the LED fish attracting lamp prototype were constructed, and the optical and electrical characteristics of LEDs were determined. The LEDs tubes consumed electric power of 7.025 W (blue), 6.056 W (green), 3.022 W (red), the incandescent lamp 7.05 W, and the halogen lamp 150 W of electric power. The spectrometer results show that LEDs only emit light in a narrow range of wavelengths, but the light emitted from traditional light sources such as halogen and C4 incandescent dive lamps covered all wavelengths in visible spectrums and also non-visible spectrums. The results in pool measurement showed that the light emitted from the LED tubes was distributed evenly in all directions, and the effective illuminance distance ranged from 2 m to 4 m. The blue light attenuates coefficient value is 1.05 m^{-1}, 1.089 m^{-1} for the green light, and red light has the highest at 2.093 m-1. The performance of LEDs in this study shows that they can become a future underwater illuminance light and are worth investigating further.

Session 2.04 – June 2nd

Session slot: 2.04.01

Human Centric Lighting for the benefit of the elderly

Presenter: Guerry Estelle, Caumon Lorrain, LAPLACE, Toulouse 3 University, LARA-SEPPIA, Toulouse 2 University (France)

Abstract:
Age leads to a natural evolution of the circadian cycle. For the elderly some changes in chronotype can be observed. This leads to a decline in the quality of sleep and a state of daily sleep. It's actually a question of compensating the changes of the circadian cycle by the use of the light. It does a major role in its regulation. If blue light allows stimulation of brain activity, a yellow light can trigger a resting and a sleeping phase which recreate the benefit of the chromatic cycle of natural light. Accompanying the elderly in their daily lives, this dynamic compensates the evolution of their circadian rhythm. The study of dynamic LED lighting has made it possible to judge the potential of artificial lighting to reproduce the color and the cycle of natural light. This "Human Centric Lighting" becomes a factor for improving the elderly's pace of life to ensure a standard of living.

Session slot: 2.04.02

Light quality, color perception and emotions in the interior space.

Presenter: Mekki Olfa, Institut Supérieur d'Arts et Métiers de Sfax (Tunisia)

Abstract:
This work comes in a new reflection about the choice of color in the interior space. And how an interior designer can integrate a participative approach in his design process, in which a user can express an affective dimension. In this paper, we consider

the following hypothesis: the quality of light can influence spatial appreciation in real time. In an attempt to confirm this, we are treating space as an « eco-system » in which, each component is treated as a system in its own right. In this context, light is also a system that might be taken into account in the planification stage of an interior design process as an element allowing a better perception and a better acceptability of the physical environment. In fact, non-visual effects of light are a current scientific debate that is investigated not only by scientists in physics but also in other fields such as psychology, affective engineering and design. That's why as interior designers we show our interest to this subject.

Session slot: 2.04.03

Fundamental spectral boundaries of circadian tunability under different Duv constraints

Presenter: Cerpentier Jeroen, KULeuven (Belgium)

Abstract:
Human centric lighting (HCL) has seen an increase in interest over the last years. The CIE introduced the melanopic efficacy of luminous radiation (MELR), which summarizes the impact of light on melanopsin, a protein that strongly influences melatonin production. In a previous publication, the fundamental spectral limits of MELR in terms of correlated color temperature (CCT) and TM-30 color fidelity have been disclosed. In this paper we extend this study by investigating the spectral MELR boundaries under different Duv constraints. Using the same flexible parametrization for the emission spectrum, we optimize MELR in terms of CCT, and this for different tolerances. The results show that for lower CCT, more stringent constraints result in a significant reduction of the MELR tunability range, while the impact is significantly lower when the CCT increases.

Session slot: 2.04.04

Preference Lighting Model: Generalization of lighting preferences for individual users

Presenter: Klir Stefan, Laboratory of Lighting Technology, Technical University of Darmstadt (Germany)

Abstract:
Multi-channel LED luminaires are fundamental components of smart-lighting systems for a dynamical adjustment of the room and ambient light conditions. The lighting preference of an individual user can vary due to the variations of the environment and the physiological and psychological state of the user. Modeling these dynamic preferences and ranking light spectra accordingly helps the smart-lighting system to recommend optimal light spectra for the individual user. However, for such an approach, a lot of data must be collected and suitably interpreted. In this paper, we therefore present a novel Bayesian strategy to estimate the user preference dynamic with a mixture model of normal distributions. These user-specific time models can then be used to generate trajectories of already assessed light spectra with regard to the overall rating behavior of the individual user. The trajectories will eventually be used to create a network choice model that results in transition probabilities from a current spectrum to all connected spectra in order to identify those that may lead to increased user preference.

Session slot: 2.04.05

The unspoken challenge for linear fluorescent retrofits - and a solution

Presenter: Shounak Roy, Krames Michael, Seaborough Research (USA)

Abstract:
The performances of commercially available LED fluorescent-tube replacement lamps are analyzed with respect to “real world” electronic ballasts, as ascertained through field recovery from job sites throughout northern Europe in 2018-2020. Results show a wide variation in power draw which not only thwarts the energy saving aspects of the LED retrofit solution but also poses a potential safety risk. A novel driver topology is introduced which is shown to avoid these problems. A prototype lamp incorporating this driver technology is shown to deliver safe and predictable energy savings, showing a path towards guaranteeing the expected return on investment in, and positive environmental impact of, solid state lighting.

Session slot: 2.04.06

Performance from SSL Lamps used in the Brazilian Residential Sector

Presenter: Calixto Elvo, Martinez Melero Jose Carlos, University of Sao Paulo (Brazil)

Abstract:
The conventional incandescent lamp was banned from the market in Brazil. Currently the user with an Edison type lamp holder has the following options: the single base fluorescent lamp and the solid state lighting technology (SSL: WLEDi). Very short lifetime has been reported from local users to the screw base WLEDi (inorganic white LED) lamp. Data of lamp failure and light output depreciation were collected during a long-term experiment with WLEDi lamps purchased at the Brazilian market. The long-term experiment result showed agreement with users' position. The present article considered aspects related to SSL electric lamp technology (WLEDi) sold in developing countries, like its electrical and radiometric characteristics, include discussion about plastic waste implications at the end of product life, that is a non-energy benefits topic. Results from the second experiment, based on prescriptions from available standards and conducted at the Institute of Energy and Environment-IEE/USP lab., with a broader sample of WLEDi E-27 bulbs, acquired at the Brazilian market are presented and discussed. The samples were expanded, both in brands types and in the number of lamps. The sample formation considered two classes of products named world and local brand, price, nominal electrical power (4.5 W to 40 W), nominal correlated color temperature (Tcp, 3000 K to 6500 K). The methodology intend to consider measuring data for initial characteristics like light output, relevant electric parameters including harmonics, Tcp, Duv, IRC, spectrum power distribution (SPD), lamp IR image (temperatures) and results from experiments accessed from others labs./countries. Incandescent lamps intended to be used as reference to check the Ulbricht sphere calibration and equipment response during the period of the experiment. The initial part of the experiment is being conducted under 127 V, the lower nominal voltage value displayed on the product package. The second part of the experiment will be conducted under 220 V, generally the other nominal voltage value. The sample stabilization time before instrument reading is expected to occur within a period not less than 55 minutes (for electric and photometric parameters). Discussions are made on: the current stabilization sample procedure, this period is considered too long; about what has been called "burn-in" typical period, with focus on the SSL technology; and the sufficient period of time that WLEDi lamp need to run under nominal voltage set before each measurement procedure can start. A short literature review about these fundamentals concepts is presented and discussed.

Session slot: 2.04.07

What case studies reveal about the impacts/benefits of minimum and high-level performance targets on LED lighting markets

Presenter: Mike Scholand, International Energy Agency, 4E-SSL Annex

Abstract:
The transition from traditional technology to light-emitting diode (LED)-based lighting products is achieving significant energy-savings. The rapid improvement in the efficacy of LED products is having a huge impact on the range in performance of LED lighting products. To maintain the drive for the development and adoption of energy efficient products a combination of push (mandatory Minimum Energy Performance Standards (MEPS)) and pull (voluntary High Efficiency Performance Standards (HEPS) in the form of labels, subsidy schemes, government procurement) strategies/programs can be employed. The International Energy Agency, Energy Efficient End-use Equipment, Solid State Lighting (IEA 4E SSL) Annex was launched in July 2010 as a joint initiative of governments of several countries working together to address challenges with SSL technologies. The SSL Annex acts as advisor to the governments of member countries concerning the performance and quality of solid-state lighting. In that context, the Annex has developed voluntary quality and performance requirements with several performance levels based on market and product analysis, to address the needs of various programs and priorities for a country or region. In relation to the lower performance end of the market, data from MEPS-type performance and labelling programs for LED products prove these programs are effective at removing the lowest performing products from the market – resulting in an overall improvement in product efficacy compared with broader unregulated market data. At the upper performance end of the market, implementing HEPS levels for LED products to be used in white certificate or energy efficiency programs (with periodic review of those levels) ensures that the best performing, recently developed products are utilised. With ongoing efficacy improvements in the LED market, renewal of registered product is important to ensure that incentive programs are stimulating the uptake of highest performing products. This paper demonstrates the impacts and benefits of this “push-pull” approach using the analysis of detailed case studies from countries participating in the IEA-4E SSL Annex, as well as references to programs in other countries.

Session slot: 2.04.09

KEYNOTE
Contemporary issues with temporal light modulation of lighting systems

Presenter: Martinsons Christophe, CSTB - Centre Scientifique et Technique du Bâtiment (France)

Abstract:
Temporal light modulation (TLM) is defined as a temporal change in luminous or color quantities of a light source, resulting from an unsteady power supply. Research studies published during the past decade helped define new metrics describing well-known visual effects of TLM such as direct flicker and the stroboscopic effect. Other acute visual artifacts induced by TLM such as color breakup and the phantom array effect are still under investigation by several teams of researchers aiming to better understand their occurrence and visibility, especially when viewing modern types of LED modules and power supplies, used for instance in automotive lighting and in color-tunable decorative or entertainment lighting. Health effects associated with the exposure to TLM were initially revealed by research carried out using fluorescent tubes from the 1960s up to the 1990s. With the advent of solid-state lighting, high levels of temporal light modulation and new types of waveforms exhibited by some LED lamps and luminaires have generated concerns among users and regulators, thereby motivating new research efforts to elucidate their impacts on humans. This talk will review the existing knowledge and the pending research questions about the temporal light modulation of lighting systems and its effects on humans.

Session slot: 2.04.10

Implementation and Preliminary Verification of an Alternatvie Flicker Observer Model

Presenter: Kukacka Leos, Technical University of Liberec (Czech Republic)

Abstract:
This paper studies an algorithm for determining the flicker severity of luminous flux produced by artificial lighting systems. The algorithm is defined in time domain and constitutes an alternative to the widely used flicker observer model (light flickermeter) known as IEC Technical Report 61547-1:2015. The paper describes and discusses a few aspects related to the implementation of the algorithm. An alternative filter definition is suggested. Finally, the algorithm is compared in simulation with the standard observer model using several properly chosen tests.

Session slot: 2.04.11

Design and Implementation of LEDs Boost Driver for street lighting system

Presenter: Mrabet Brahim, Prince Sattam Bin Abdul-Aziz University (Saudi Arabia)

Abstract:
LED systems play an important role in general purpose lighting. Nowadays, LEDs become a commonly used solid-state lighting source in street lighting systems. They must be used with power electronics technology to ensure the performance requirements and to avoid additional power losses. For indoor use, internal drivers are included in. For outdoor use, external drivers with certain fixtures are required for LEDs operation. In both cases, the LED driver is now typically the most expensive element in a solid-state lighting (SSL) product. In street lighting, LED lighting systems have better characteristics than conventional lighting systems such as energy saving, long life spans and color rendering. This work aims to analyze and design a DC-DC boost driver with voltage regulation for 50 W LED street lighting system. In addition, simulation using Matlab and LTspice is performed and experimental implementation is conducted.

Session slot: 2.04.12

Lighting quality and work performance based on glazing types and dynamic LED Lighting

Presenter: Kose Fatma, Department of Architecture, Izmir Institute of Technology (Turkey)

Abstract:
The combination of daylight characteristics and LED lighting quantities determine the visual environment in offices. Office workers' health and work performance can be influenced under lighting conditions. This study is an experimental one containing lighting measurements in two offices, subjective performance tests and questionnaires to find out how work performance, lighting preferences and satisfaction about lighting quality modify in terms of various glass types and dynamic LED lighting quantities. Glass types have strong impacts on contrast tests on paper and luminance which are corresponding to work performance. Regarding lighting quality, it is in strong relation between the homogeneity of light, the impression of artificial light and the perception objects' textures and colour, contrast balance between paper and the surrounding. When the glass has been modified in offices, we observe that participants preferred to change the CT setting of LED by remote control, and in relation to that the eye level illuminance and SPDs showed significant changes. So, findings depicted the importance of the choice of glass types in relation to LED lighting settings in terms of above variables.

Session slot: 2.04.13

Hybrid discharge for low consumption, mercury-free fluorescent lamps

Presenter: Gutierrez Quentin, Laboratoire de Physique Subatomique et de Cosmologie, Institut Pprime (France)

Abstract:
In order to improve significantly the performance of fluorescent discharges in lighting applications, the concept of hybrid positive columns, which combines a direct current DC positive-column and a microwave plasma source at the cathode surface is introduced. The compatibility of such discharges with UV emitters like S_2 instead of mercury for the elaboration of a new fluorescent lamp is reported here.

Session slot: 2.04.14

Electrical behavior of an excimer lamp excited by an Argon-based dielectric barrier discharge

Presenter: Caillier Bruno, Laboratoire Diagnostic des Plasmas Hors Equilibres (France)

Abstract:
UV light sources are becoming more important in the biomedical field, among these sources; we find lamps excited by dielectric barrier discharge. The work consists on electrical study of an argon-filled DBD plane excimer lamp powered by a sinusoidal-shaped voltage source. The aim is to obtain a uniform light source with better efficiency. In this work, we used a simulation model where the DBD was taken under fixed pressure and temperature conditions (1 bar, 400 K), the electrodes are circular in shape with a radius of 5cm, the gap is 1mm, the applied voltage varies from 5 kV and the frequency from 10 - 70 kHz. A kinetic and electrical study have been made, the kinetic diagram as well as the results of the current intensity and the total capacitive power deposition will be presented.

Session slot: 2.04.15

Modeling of Ultrahigh-Pressure Short-Arc Xenon Discharge Plasma

Presenter: Timofeev Nikolai, Saint Petersburg University (Russia)

Abstract:
Short-arc xenon lamps of high and super-high pressure are used where it is necessary to obtain a radiation spectrum that is as close as possible to the solar one, and where the radiation source should be in fact point-like. High- and ultrahigh-pressure discharges in rare gases have been studied quite extensively. However, some aspects have not been investigated. This concerns above all the possible presence of electrode material atoms in the discharge and their effect on plasma properties. As a rule, light sources of this type have thoriated tungsten cathodes. Strong heating of the cathode may lead to evaporation of thorium atoms into the discharge gap that can undoubtedly affect plasma characteristics. The present study is aimed at the development of the model of the short-arc xenon discharge plasma at a high (ultrahigh) pressure including the influence of thorium atoms on the plasma properties. Calculations made really demonstrate a strong effect of emission of thorium into the discharge volume on plasma characteristics: electric field strength, plasma temperature, composition of ions.

Session slot: 2.04.16

Experimental investigation of the electrical and optical properties of a DBD photon source in a Ne/Xe mixture.

Presenter: Caillier Bruno, Laboratoire Diagnostic des Plasmas Hors Equilibres (France)

Abstract:
Dielectric barrier discharge (DBD) excited lamps have been widely used in UV and VUV ultraviolet light source applications. The work consists in making a study of the electrical and optical characteristics for the realization of a UV photon source. The lamp used is a flat DBD lamp filled with a 50/50% Ne/Xe mixture supplied by two types of excitation sources: a rectangular pulsed voltage and a sinusoidal voltage at a frequency of 20 kHz. The aim is to get a uniform light source with a better efficiency. For increasing applied voltages, the rise in pressure is accompanied by an elevation in luminance. This augmentation in pressure has a visible effect on the efficiency, thus related to the VUV production efficiency of the discharge. In this work, electrical (current and voltage measurements) and optical (luminance and luminous efficacy) studies were performed to characterize a dielectric barrier discharge (DBD) flat lamp. Comparing the results obtained on the luminous efficiency and luminance of the lamp excited by the two types of signals (sinusoidal and pulsed), the results clearly show that the pulsed signal improves considerably the luminous uniformity of the lamp.

Session slot: 2.04.17

General Considerations for Pulsed Power Circuit Topologies for Gas Lasers

Presenter: Grover Harpreet, University of Toronto (Canada)

Abstract:
Gas lasers, in particular excimer lasers, find widespread use in the lithography of semiconductor chips, high resolution imaging and other diffraction limited applications due to their short wavelengths in the UV band. State-of-the-art lithography of modern computer chips employ CO_2 gas lasers for facilitating EUV radiation at 13nm. Some of the prime challenges involved in designing these gas laser systems is their short discharge stability, low efficiency and short radiative (upper state) lifetimes. These challenges result in tight constraints on the pulsed power circuits that power these gas lasers. This paper presents the pulsed power circuit requirements, design challenges and a summary of existing pulsed power circuit topologies that can be used to power gas lasers.

Session slot: 2.05.01

Update on the Advances of Lighting Systems Technology – The way towards Lighting 4.0 era

Presenter: Zissis Georges, LAPLACE, University Toulouse 3, (France)

Abstract:
Historically speaking, past century's research and development focused on single energy efficacy enhancement. Today Solid-State Light sources-based systems market penetration rate is the order of 40-45% and growing. This work, based on the compilation of more than 160 recent documents, gives an update of on the status of lighting technology. The only massive adoption of SSLs during the next years can contribute to harness electricity use for lighting, up to 4% additional by 2030 and save up to 500 Mtn of greenhouse gas emissions in a year. But "rebound effect" can seriously blur this prediction. One potential solution to avoid that negative effect consists on switching to the SSL2 concept – Sustainable Smart Lighting (SSL) systems based on Solid State Lighting (SSL) devices. Smart human-centric lighting driven by the "appliance efficiency" integrating the quality of light. This just means that next gen lighting systems should provide the "Right Light" with the best efficiency and quality, when and where it is needed.

Session slot: 2.05.02

Addressing Skills Needs of Lighting Professionals

Presenter: Borotis Spiros, Hellenic Open University (Greece)

Abstract:
The proliferation of contemporary technologies, as well as the need to cover specific topics on lighting, green, entrepreneurship and horizontal needs, have created serious training needs for lighting professionals. These professionals are typically working adults, already working in the lighting or neighboring sectors that have to be re-skilled or up-skilled so as to become or to remain knowledgeable and competitive in the lighting volatile landscape. In this regard, the ECOSLIGHT project designed and is currently implementing a staged training approach including introductory online learning, followed by blended (online, face-to-face) and work based learning on specific job role profiles it has identified.

Session slot: 2.05.03

Next-Gen LEDs: Valuing New Features in the Market and Implications for R&D, ROI, Pricing, and Savings

Presenter: Skumatz Lisa, SERA Skumatz Economic Research Associates, Inc (USA)

Abstract:
The vast majority of existing non-energy benefits (NEB, also called non-energy impact) studies that investigated lighting products are based on old, non-led technology. This new study fills the gap and goes beyond. It examines the NEBs associated with next generation / advanced LEDs, and in particular, the value of their various visual and non-visual effects, and environmental effects. This study used three different measurement approaches to develop specific NEB dollar values for advanced LED technologies that include a variety of feature improvements above standard LED measures. The three methods allowed triangulation of values for these near-term and later-market LED technologies. The detailed NEB surveys and specialized NEB-measurement approaches were used to develop estimates of the one-time and annual benefits from features including: glare, flicker, color rendition, dynamic lighting, and improved outdoor lighting color and other features. We studied advanced LED technologies in three markets – residential, commercial, and streetlighting.These results were used to examine the NEB values and used the values to explore extra customer value associated with individual features and combinations of advanced LED features to the various decision-makers in each market. These values were used to explore the pricing flexibility associated with each feature – and given that we also had the cost of producing LEDs with these features, we were able to explore R&D ROIs. Finally, the NEBs and associated pricing was used to drive models forecasting future

market shares of various lighting technologies. The results guide R&D directions for these and features, illustrate the value associated with individual features and groups of features, and informs pricing for new lighting technologies, which may indicate pricing can be value-based and not just price-based, aiding profitability of the technology

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Session slot: 2.05.05

Visual, non-visual and psychological effects of light on the textile and clothing factory workers

Presenter: Bouzgarrou Lamia, Faculty of Medicine of Monastir (Tunisia)

Abstract:
Lighting is one of the most important characteristics of the working environment in the textile and clothing industry. Indeed, for this occupation which requires dexterity and precision, a non-normative lighting environment is associated with product quality defects and negative impacts on the workers' well-being, physical and mental health. We conducted an interventional field study, in one of the largest fully exporting clothing factories in the center of Tunisia. We built a representative sample of the workers' population affected to the six workshops in which visual constrain is the most important (number of samples = 250). We investigate the lighting environment in each workshop. An analysis of visual and extra-visual symptoms at the end of the working day and psychological symptoms over the last four worked weeks was conducted with the sample. Subsequently, an intervention on lighting environment was carried out in each workshop, in accordance with the normative recommendations according to the task carried out. The intervention was succeeded by a reassessment of physical and psychological symptoms carried out six weeks after the intervention. We concluded that no workshop had normative lighting for workstations before the intervention phase. This concern was especially important for works affected to the embroidery workshop and to the machine sewing stations in the garment shop. At the end of the working day, frequent sensation of eye burns was reported by 90, 4% of workers, tingling eyes by 40% of them, blurred vision by 54% of them and visual fatigue by 48% of workers. Moreover, 40% of the subjects had difficulties with watching screens and television and 30% of them had trouble reading (newspaper, books ...). Headaches, musculoskeletal neck pain, fatigue were the most reported non-visual symptoms. Behavioral disturbances such as irritability and an angry mood have been reported among 2/3 of the subjects in question. After lighting intervention; a decrease of 70.04% visual symptoms and 16% of non-visual ones was noted.The greater the initial deviation from the recommended normes in the workshop was, the more significant the regression of symptoms was. Following the lighting intervention with keeping other factors constant, fifty percent of participants rated working environment earlier almost satisfactory to satisfactory. Further results will be reported at the conference.

Session slot: 2.05.06

LED Device of Psychophysiological Express Diagnostics of Human Functional States

Presenter: Aladov Andrei, Laboratory of Optoelectronic Instruments Submicron Heterostructures for Microelectronics Research and Engineering Center of Russian Academy of Sciences (Russia)

Abstract:
The design and operation of a small-sized LED-based device for psychophysiological express diagnostics of functional states is considered. Diagnostics of functional states is carried out using dihaploscopic techniques for measuring the critical frequency of flicker fusion. The construction of the device includes a tablet computer with software for select, configure and run tests and a virtual reality glasses with LED matrix forming the color and shape of the test signal.

Session slot: 2.05.07

Impact of personalized lighting on the psychophysical state of a human

Presenter: Svetlana Roslyakova, ITMO University (Russia)

Abstract:
Dynamic preset and personalized lighting modes can positively affect the psychophysiological state of office workers. This study compared different approaches to changing the correlated color temperature (preset and selectable). The study analyzed the influence of lighting on the components of human fatigue: mood, activity, well-being, sleep, performance and subjective well-being. The analysis of the experimental data revealed preferences for color temperatures depending on the type of human daily activities. A high degree of influence of the quantity and quality of sleep on the psychophysiological state was revealed. An increase in mood and a decrease in fatigue were observed with personalized lighting. Purely individual dependencies were revealed between the personalized lighting mode and working performance together with mental productivity. The study results show that lighting systems based on individual preferences, in general, have positive effect on the psychophysiological state of the user, providing a quality night's sleep.

Session slot: 2.05.08

The method for determining colour-matching functions of the physiological system based on the statistical approach

Presenter: Rybina Viktoriia, VNISI Russian Lighting Research Institute named after S.I. Vavilov (Russia)

Abstract:
Using the statistical theory of the human threshold color vision, the authors have suggested the method how to determine the colour-matching functions of the physiological L-, M- and S-cone system. To implement the developed method, the authors have constructed the experimental research installation that gives the opportunity to determine the threshold characteristics of the visual system during the observation of monochromatic objects against colored backgrounds.

Session slot: 2.05.09

Visual and non-visual architectural thinking : 21st Century lighting design new theoretical contents

Presenter: Caratti-Zarytkiewicz Richard, A.C.E.-Association des Concepteurs lumière et éclairagistes (France)

Abstract:
Lighting design as a discipline is now reaching adult's age in terms of theoretical thinking as much as a decisive starting point for a new dimension in lighting design teaching. Houser et al, in Human-centric lighting: Myth, magic or metaphor? Lighting Research and Technology, after an accurate analysis, confirm that the primary function of lighting design is the setting up of a reflection process about the visual and non-visual human functions within the architectural project. This duty also happens to be supported by the definition CIE proposes of the integrative lighting. From both these visual and non-visual points of view, the aim of lighting design is to build up and manage the conditions or the human wellbeing, just like architecture does. But the parallel with architecture now goes further because right as Renaissance did for architecture, 21st century is about to bring lighting design most of its theoretical inspiration, giving lighting new instruments to go up on a higher step in terms of the comprehension of the visual and non-visual matters. Consequently, language of light gets enriched by semiotic elements, coming from neurosciences and neuroaesthetics, sciences of behavior, history of art and architecture. Visual studies, the 20th Century born field of investigation also appears to be a pertinent instrument to inventory and categorize the historical, psychological, philosophical, scientific, artistic, environmental, socio-cultural and functional aspects of our vision and visuality within a lighting design-oriented perspective.

Session slot: 2.05.10

Embodied Cognition and Lighting in Museums

Presenter: Gobbato Viviana, Dept. of Arts and Medias, Université Sorbonne Nouvelle and Université Paris Cité, CNRS, CERLIS, (France)

Abstract:
This study questions the effects of a lighting scenario designed as a mediation device for Raoul Dufy's painting La Fée Électricité (1937) within the Museum of Modern Art in Paris (MAM). It discusses the visitor's experience from the REMIND theoretical research program to understand how lighting influences visitors' cognitive, emotional and sensory experience (embodied cognition). Results allow to consider new possibilities related with lighting and other “sensorial” devices. This could contribute to theorizing a “sensorial” field of museum studies, and to develop adapted devices.

Session slot: 2.05.11

User Preference of White Light for Nepalese Heritage Site

Presenter: Bista Aayush, Center for Electric Power Engineering, DoEEE, Kathmandu University (Nepal); Centre for Lighting & Energy Efficiency Studies (CLEES), Jigme Namgyel Engineering College (Bhutan)

Abstract:
The rapid improvement in the performance of Light Emitting Diode (LED) in recent years has enabled LED based light sources replacing traditional light sources in many applications. Moreover, LED light sources have greater flexibility in spectral design than conventional light sources, offering more dynamic and flexible ways to change the light source chromaticity and colour quality. However, flexibility in spectral variation has brought challenges in the quantification of light source colour quality using existing colour quality metrics such as CCT and CRI, necessitating the development of alternative and supplementary metrics. The Duv is defined as the perpendicular distance of u,v chromaticity coordinates from the Planckian locus in CIE-1960. In this study, ten different spectrums of LED light source were created having different Duv values at two different correlated colour temperatures. A subjective preference analysis was done to observe the user rating on naturalness and their preference of the objects used in cultural and heritage sites. Twenty observers participated in the study to define their perception of the light source. The illuminated test objects were construction materials from a 15th century UNESCO world heritage site of Nepal. This experimentation gives the user acceptance level of white light and helps to optimize the white light sources for cultural and heritage sites of Nepal.

Session slot: 2.05.12

Analysis and optimisation of lighting arrangement for typical Pagoda architecture of Nepal accounting the effect of light pollution

Presenter: Bista Diwakar, Center for Electric Power Engineering, DoEEE, Kathmandu University (Nepal); Centre for Lighting & Energy Efficiency Studies (CLEES), Jigme Namgyel Engineering College (Bhutan)

Abstract:
Heritage sites and monuments of Nepal are recognised globally and are of immense importance to the local and worldwide audience. The intervention of modern electric lighting in these structures should be carried out without conceding cultural values, visual perception, and traditional outlook. On the contrary, in most of the sites, there are no lighting or unscientific lighting interventions that are inappropriate, unsurpassed, exaggerated, and unpleasant. Lighting installation and luminaire placement intended to enhance the visual ambience, the natural appearance of artefacts, and ornamentation are not realised in most cases. Current practices provide inadequate and inappropriate light and generally have an adverse impact on beauty and originality. Such an arrangement does not influence highlighting the architecture but instead creates spill light, glare, over-illumination, uneven illumination, and many other factors contributing to light pollution. The study considers lighting design for a temple following typical Nepalese pagoda architecture and for realistic performance evaluation, different lighting scenarios are simulated by creating a three-dimensional model in DIALux. The recommendations for luminaire selection and placement are made to offer better illuminance and illuminance uniformity, lighting effects, low glare, and low light pollution.

"LED-HBES" High Efficiency Lighting Systems: a Case Study of an University Historical Building

Presenter: Martirano Luigi, Sapienza - University of Rome (Italy)

Abstract:
The adoption of LED modules, now a well-established choice in any type of lighting design, combined with an appropriate home and building electronic system (HBES) for the control and the automation, allows to reach high energy efficiency and at the same time ensures excellent lighting comfort. The suggested approach, called "LED-HBES", consists in the combination of a LED system integrated with a HBES control system. The authors suggest a criterion based on the oversizing of the installations in terms of flux emitted, and at the same way, the adoption of a constant illuminance smart control regulated by an HBES, able to guarantee the optimal quantity of light in each part of the building and reduce the actual electric power consumed. The article focuses its attention by proposing a case study of a historic university building in which the LED-HBES model was applied. The energy performance sees a net improvement of more than 50%, moreover, the integration of a SCADA monitoring and supervision system ensures a consistency in performance throughout the life of the system, with maintenance and replacement appropriate to keep the lighting indexes always at nominal values.

Session slot: *3.02.09*

Road BRDF Construction From Measured R-Tables

Presenter: Boucher Vincent, Light and Lighting Team, Cerema/DTerOuest (France)

Abstract:
Two r-table extrapolation methods are presented. One based on the evolution of the brightness as a function of the observation angle α and the other based on the addition of correlated variables, the relative angles. The evaluation of these methods uses a reference BRDF and the Normalized Root Mean Square Deviation as a metric. The method exhibiting less errors is applied to experimental data, r-tables measured at 6 observation angles. It allows to reconstruct the sample BRDF. Integrated in a numerical lighting simulation, BRDF leads to luminance calculation from the observer's position to the horizon.

Session slot: *3.02.10*

Characteristics of brightness perception with two light sources presented to peripheral vision

Presenter: Takahashi Hiroshi, Kanagawa Institute of Technology (Japan)

Abstract:
The degree of brightness in a full space as perceived by humans, and the consideration of a sense of brightness within a space, can be expected to serve as an index for the design of an agreeably illuminated space. Even though there have been significant amounts of research performed on brightness perception, investigations have not yet extended to the characteristics of brightness perception by multiple light sources directed to peripheral vision. The purpose of this study is to clarify the characteristics of brightness perception when two light sources are presented to the area of peripheral vision. The experiment was conducted using an adjustment method in a darkened room. A display was used to present a matching light and a test light. The matching light was presented at the center of the display, and the test light was presented at various angles from the center of the display. The results were suggested that the brightness sensitivity with increasing eccentricity increases and the brightness sensitivity is high for the vertical downward direction but is low for the 45° and 135° directions.

Session slot: *3.02.11*

Relationship between Solid Angle, Eccentric Angle, Background Luminance and BCD Luminance for a Large-Area Light Source

Presenter: Kazuto Takase, Kansai University (Japan)

Abstract:
UGR, DGP, PGSV, which is a general discomfort-glare index, are limited to the specific range assumed in the process of developing them. Because it is necessary to reflect human visual characteristics to universally predict the rating of discomfort glare according to visual science, it is necessary to understand the effects of visual characteristics on discomfort glare. In this study, which was conducted to systematically investigate visual characteristics in the visual field of discomfort glare, he effects of various solid angles and eccentric angles on the borderline between comfort and discomfort (BCD) (1) luminance of discomfort glare in two types of background luminance were experimentally investigated.

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Session slot: 3.03.01

Discomfort glare in motion

Presenter: Villa Céline, Université Gustave Eiffel/COSYS/PICS-L (France)

Abstract:
This study investigates the relation between static and dynamic discomfort glare, as experienced by drivers, in a laboratory experiment with a panel of 32 participants. It provides a model to estimate an overall glare level from successive static glare levels. This model integrates a temporal decay of the glare level memory.

Session slot: 3.03.02

Applying the Unified Glare Rating for a non-uniform residential luminaire

Presenter: Spieringhs Rik, Light&Lighting Laboratory, KU Leuven (Belgium)

Abstract:
The Unified Glare Rating (UGR) and the modified version (UGR') have been developed for a luminaire in a typical indoor environment. In this paper, the application of these metrics is explored for an outdoor residential luminaire with a non-uniform spatial luminance distribution. The luminaire was characterized in a large near field goniometer (NFG) and luminance images were created at four angles specified in the CIE 232:2019 document. Some practical issues of applying the UGR' for a non-uniform residential luminaire are discussed, such as selecting the luminous area, the blurring parameter and the background luminance.

Session slot: 3.03.03

Daylight glare occurrence and verification of prediction models under various solar radiation control technologies

Presenter: Takanori Kabaki, Tokyo University of Science (Japan),

Abstract:
We grasped the actual situation of daylight glare occurrence when various solar radiation control technologies were introduced and verified the widely-used prediction models, DGP and PGSV, for daylight glare. Many respondents felt that the window surface was glaring and uncomfortable, especially when the exterior light shelf was used on sunny days in winter. Differences in the explanatory power of DGP and PGSV model were observed between summer and winter, among methods for detecting glare sources, and among different solar radiation control technologies.

Session slot: 3.03.04

Model for discomfort glare evaluation reflected visual characteristics by using distribution over a retina of incident luminous flux on a receptive field

Presenter: Hara Naoya, Kazuto Takase , Department of Architecture, Kansai University (Japan)

Abstract:
As a discomfort glare evaluation method that can directly evaluate discomfort glare with respect to the luminance distribution in the visual field and reflect visual characteristics, a model for predicting discomfort glare based on the luminous flux distribution in the receptive field over a retina was shown.

Session slot: 3.03.05

Combining Optical and Electronic simulation models for the assessment of Visible Light Positioning Systems

Presenter: Zahiri Rad Saman, Weiss Andreas, MATERIALS – Institute for Surface Technologies and Photonics, JOANNEUM RESEARCH Forschungsgesellschaft mbH (Austria)

Abstract:
Research activities to establish precise and reliable Indoor Positioning Systems (IPS) have significantly gained momentum in the recent years. Visible Light Positioning (VLP), an approach to establish a positioning system by utilizing the spectrum of the visible light that is emitted from one or multiple light sources and received at a photosensitive device, has shown to be a promising candidate for the fulfillment of this task. Still, despite the huge progress in improving the basic technology, some discrepancies between the achievable accuracies reported in simulation based studies and real world implementations become aware. This is because in the simulations the effects of the electronic components necessary for a real world implementation are often simplified or even not considered at all. In this study, we propose an approach of an electronic receiver design methodology that is combining raytracing for the simulation of the optical channel with simulations of electronic circuits in Simulink/Simscape. By interfacing these two domains, a system level assessment of applications in the field of Visible Light Positioning can be realized. In addition, we demonstrate in an exemplary implementation how the electronic design can be optimized utilizing the method of fingerprinting.

Session slot: 3.03.06

Sit-to-stand and stand-to-sit activities recognition by Visible Light Sensing

Presenter: Salem Ziad, MATERIALS – Institute for Surface Technologies and Photonics, JOANNEUM RESEARCH Forschungsgesellschaft mbH (Austria)

Abstract:
Monitoring and analyzing the basic human daily life activities will help enhancing the life qualities of both healthy and physically handicapped persons. The recognition of sit-to-stand and stand-to-sit transitions is a complex task due to the intricate movements in such a transition. This work proposes a novel method, for the detection of sit-to-stand and stand-to-sit transitions in addition to walk and no-walk activities. In contrast to previous methods for sit-to-stand and stand-to-sit transition determination, our solution does not require complex time- or frequency-domain based algorithms, but relies on fusing sensor data from an inertial measurement unit and an RGB photodiode that detects the lighting characteristics at different positions of a room. By utilizing a low complex decision tree algorithm the activity recognition can be performed in a resource-efficient way. The applicability of our approach was tested in two different scenarios.

Session slot: 3.03.07

Measurement of the light vector and the illumination-distribution solid using Raspberry Pi

Presenter: Krüger Jan, Department of Lighting and Multimedia
TÜV SÜD Product Service GmbH (Germany)

Abstract:
Currently, measuring devices for the detection of light direction and directionality of light are rarely available. On the other hand, light direction and shadow characteristics are important quality criteria in the field of lighting. Against this background an open-

source measurement device will be presented which can measure the light vector and illumination-distribution solid [1] at a fixed point in space. Furthermore, evaluations of diffuseness and directionality can be derived from the measured data. In this paper an old concept from 1885 is taken up and brought to present time as an open-source project.

Session slot: 3.03.08

Case study – Modelling of Visible Light Communication on Luminous Intensity Distribution Curve of LED Low Beam Car Headlamps

Presenter: Novak Tomas, VSB - Technical University of Ostrava (Czech Republic)

Abstract:
The issues addressed in this paper is focused around the possibilities of using VLC (Visible Light Communication) in the automotive industry. This case study addresses the range of low beams car headlights in terms of the usability of the modulated signal on the distributed luminous flux. The paper discusses the Luminous Intensity Distribution Curves (LIDC) of LED low beams car headlights in a car due to the possibility of modulating LED (Light-Emitting Diode) light sources with high modulation frequencies. Due to the conversion between the communication parameters and the lighting units, a laboratory measurement of the passing LED lamp was performed. From the laboratory measurements, the limits of VLC usability were determined for various illuminance generated by low beams car headlights. At the same time, the LIDCs of these low beams car headlights were obtained so that they could be implemented in lighting software and simulated situations in which these luminaires reached the limits required for the use of VLC technology for standardly available photodetectors. Only the direct component of the luminous flux will be evaluated in the article, because the actual photodetectors do not allow the use of the reflected component due to attenuation (path losses of the transmission channel) or interference. This direct component will be evaluated from both a horizontal and a vertical VLC photodetector location.

Session slot: 3.03.09

Smart lighting and digital sobriety

Presenter: Foucras Bruno, The Shift Project (France)

Abstract:
Information technology, nowadays central and essential in all aspects of society, has a crucial role to play in the low carbon transition of our economies. Connected services, commonly named “Smart”, are thus not purely virtual tools, but are also physical and material mediums, even if we do not directly perceive their materiality through the actions they enable. Especially the devices and the infrastructures require energy and material to be manufactured and then obviously when they are used. On the other side, many digital tools help to optimize processes and to minimize energy consumption and the related carbon emissions. As lighting systems are everywhere in developed countries, both in cities and buildings, they are considered to be the ideal gateway to the Smart City and the Smart Building. In October 2020, the Shift Project, a French think tank, published the report Deploy digital sobriety [1], in which he tried to assess the energy relevance of connected technologies. A methodological framework was built, illustrated by case studies (mainly around connected lighting).

Session slot: 3.03.10

Towards a Digital Twin for Smart Street Lighting systems Using a Virtual Reality interface

Presenter: Piovano Luca, Guillermo del Campo Jiménez CEDINT - Universidad Politécnica de Madrid (Spain)

Abstract:
The smart management of the public lighting infrastructure is essential to reduce energy consumption without negatively affecting the quality of life of citizens. The corresponding decision-making process needs tools and approaches to steer stakeholders' strategies based on clear evidence and data. By introducing Virtual Reality in the context of the Digital Twin framework, it is possible to mirror a system in real-time and at scale through a realistic and controlled reproduction of the real environment and its functionalities. Interactivity, immersion, and visualization techniques are expected to bring more understandability and replicability in the management and design of street lighting policies. In this paper, a Digital Twin solution for monitoring the performance of the outdoor lighting installations at a university campus is proposed. Through a Virtual Reality replica of the campus, current lighting management services are introduced to showcase the advantages of the approach.

Session slot: 3.03.11

Color-mixed white light LEDs and visible light communication integration: benefits, perspectives, and challenges

Presenter: Dalla Costa Marco, Universidade Federal de Santa Maria (Brazil)

Abstract:
This paper presents an analysis between color-mixed LEDs (CM-LEDs) and phosphor-coated LEDs (PC-LEDs) in a joint illumination and visible light communication (VLC) system. The advantages, challenges, and perspectives of using CM-LEDs for general lighting are presented, as well as the possibilities and challenges of these devices used for communication. Finally, this paper focuses on the future trends in this topic and the perspectives of researching in this area.