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Lighting Technologies
For Lighting Industry and Lighting Design

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For Lighting Industry and Lighting Design

Keynote Speaker

Dietmar Zembrot
CTO
Trilux

CHAPTER A

LpS LECTURES – LIGHTING INDUSTRY

Standards Driving Business

When Circular Economy Meets the Lighting Industry (LCA)

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Abstract

The Repro-light ("Re-usable and re-configurable parts for sustainable LED-based lighting systems") is a European research project that aspires to successfully initiate a transformation in the European LED lighting industry by the year 2020. This project harnesses innovative production technologies (industry 4.0) and materials to design a modular luminaire architecture with a smart production scheme as part of a circular economy, a reconfigurable customised LED luminaire, the 'Luminaire of the Future'. When dealing with lightings, it is important to remark that great efforts have been done in the past to reduce the energy consumption during their use phase. However, because LED lightings have a specific material composition, with electronic boards and LED spots, their environmental benefit should be carefully considered. The Circular Economy approach seems to be more adequate to provide a complete view of the environmental burdens caused by electric and electronic devices starting with identifying and improving the materials used for manufacturing these products, and determining their failure rates and potential replaceability to elongate their useful life. For this purpose, this research includes an assessment of the lighting components using Life Cycle Assessment (LCA) methodology as per the ISO 14044 standard, paying special attention to both Climate Change and Resource Depletion impact categories. The objective of this LCA is two-fold. On one side, determining which components of a specific linear LED lighting contribute the most to the selected environmental impacts and on the other side, determining how the design of the lighting can be improved by using a modular design that reduces the overall environmental impact across all lifecycle stages. Results have shown how the electronic components, control and electronic boards contribute the most to all the selected impact categories. Furthermore, this study has included a review of potential polymers that can be 3D printed and may replace PMMA for the optical element in the linear lighting. This change is expected to bring environmental benefits in the overall environmental profile of the lighting and the objective is to introduce additive manufacturing technology into the production lines. In addition to this LCA, a more exhaustive analysis has been carried out with the aim of determining the most suitable configurations to meet industry lighting regulations with a reduced environmental impact. The LCA has explored different scenarios combining number of linear lightings, number of LED modules, durability, power consumption combining natural light in different geographic scenarios, dimensions of the control gear, and the possibility of removing internal wirings. A dimmable and modular lighting product with innovative manufacturing techniques following Industry 4.0 guidelines has been assessed. This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 768780. More information on www.repro-light.eu.

Author's CV

Deidre WOLFF, MSc

Deidre Wolff is working as part of the Energy Systems Analytics team at Catalonia Institute for Energy Research (IREC) as a Project Engineer. She is currently in the final stage of her PhD research at Technological University Dublin in Life Cycle Assessment (LCA) with a focus on uncertainty analysis. She further has a Bachelor of Science in Chemistry from Simon Fraser University in Canada and a Master of Science in Sustainable Energy and Green Technologies from University College Dublin.

Organisation

The Catalonia Institute for Energy Research (IREC)

The Catalonia Institute for Energy Research (IREC) was founded to contribute to more sustainable energy use and consumption in the future. Economic competitiveness and maximum energy security are both taken into consideration.

The IREC makes its contribution through advances in science and technology. The research requires a long-term vision to identify future energy challenges. However, the Institute also develops technology that enables companies to implement immediate innovative solutions.

The project is closely linked to the Catalan, Spanish and international economic system. Therefore, its institutional and business sponsors have joined forces to a singular and significant extent to attain a common objective: the creation of value by boosting scientific knowledge and technology development in the energy sector; a sector that has global consequences. As a result, IREC works in an international arena and has become a leading institute in several areas.

Ecodesign Directive and Energy Labelling Regulation - A Detailed Impact Overview

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Abstract

New EU rules on ecodesign and energy labelling for lighting products will probably be published in Summer 2019 and introduce significant changes for the lighting industry, from the phase out of conventional technologies to increased performance and environmental requirements for lighting products. With increasing world-wide demand for more efficient products to reduce energy and resource consumption, the Ecodesign Directive has a been a major driving force behind the transition to LEDs over the past years. More recently EU Ecodesign policy has steered away from purely energy-efficiency to address the wider environmental impact of a product, and now includes requirements such as materials efficiency, reparability and replaceability of components and the product's end of life. LightingEurope will provide guidance to the market to understand and apply the requirements to their products as of September 2021 and the actions to be taken to strengthen the enforcement of these rules. The presentation will detail the main requirements of the new ecodesign and energy labelling laws, including what products affected, removability requirements, timelines, exemptions, tolerances, endurance testing, information and reporting requirements. It will also highlight some pending issues that will need to be addressed once the final law is published.

Author's CV

Elena SCARONI

Elena Scaroni joined LightingEurope as Policy Director in September 2016 and is responsible for policies related to Circular Economy and the transition to LED. She has led the advocacy work on behalf of the European Lighting Industry in the legislative debate between the European Commission, the Member States and the European Parliament on the latest Ecodesign Regulation for light sources. Prior to LightingEurope, Elena worked for 8-years at the European Institutional Affairs of Enel, a multinational energy company for electricity and gas. She was responsible for the relations with the European Parliament on policies related to environment, climate, energy, consumers and Corporate Social Responsibility. Elena started her career as an Advisor on International Cooperation for Development, at the Italian Red Cross in Rome and in Kenya for the NGO "Ibo Italia" (the Italian branch of the International Building Organization). Elena studied in Rome and Paris, holds a master's degree in law and is specialised in European Affairs.

Organisation

LightingEurope

LightingEurope is the industry association that represents the lighting industry in Europe. We are the voice of more than 1000 lighting companies who employ more than 100000 people over Europe. Our daily mission is to advocate and defend the lighting industry in Brussels while reconciling it with ongoing EU policy aims. In doing so, we are dedicated to promoting efficient lighting practices for the benefit of the global environment, human comfort and the health and safety of consumers. Our unique strength resides in bringing together leading industry actors with local and European policy experts in so called Working Groups (WG). These WGs are essential in our mission as they crystalize and often merge different viewpoints on burning lighting industry issues, hence paving the way for concrete policy steps. Their output allows us to operate at the frontline of EU policy-making. Our WGs are nothing short of real entry points to the Brussels arena and merit your full participation!

Latest Zhaga Updates - Interoperability, Smart Lighting

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Abstract

Zhaga is an open, global, industry consortium that standardizes the interfaces of components of LED luminaires, including LED light engines, LED modules, LED arrays, holders, electronic control gear (LED drivers) and sensor and connectivity modules. It does so to drive out unnecessary interface variations and to provide proper separation of concerns to facilitate the interaction between different (branches of) industries. In 2018, Zhaga has started operating under a widened scope. This allows the organization to address all interfaces, explicitly including those for smart components, such as sensors and communication modules. Next, the new mission focuses on interoperability to allow the upgrading and servicing of LED luminaires. Interoperability is a step up in ambition for Zhaga and requires that all aspects of the interface are included, not mechanical aspects only. These renewed principles will bring Zhaga closer to a new set of stakeholders from sensor, communication to services industries. In this paper, we review the Zhaga progress since the 2018 LpS. Next to covering all that happens between writing this abstract and the 2019 LpS, we will at least cover the following topics: Book 18 ed. 2, which will specify a smart luminaire interface between the luminaire and its driver to an external sensor or connectivity module. This interface simplifies the addition of communication/sensor nodes to LED luminaires with plug-and play interoperability. The mechanical aspect of the connectivity interface, to position the module on the luminaire, was already specified in Book 18 ed.1. In Book 18 ed.2 also the power and control aspects will be specified, referencing new specifications from the Digital Illumination Interface Alliance (DiiA). The specification will be accompanied by a certification program which is currently in development by Zhaga and the Digital Illumination Interface Alliance (DiiA). This joint program will certify luminaires and components and guarantees interoperability to the market. Zhaga Book 20; which follows up Book 18 for indoor and which will enable similar capabilities for future-proofed indoor luminaires for smart buildings. There are many uses supported by the introduction of a standard for smart and serviceable indoor luminaires which include, the ability to save energy through occupancy sensing and timings, ambient light level detection, wireless commissioning, lux level management, asset management via people tracking, secure local wireless data networks and lighting control and programming drivers. These benefits will be well received in public environments such as retail and hospitality application areas. Book 21, which brings the successful linear modules described in Book 7 to a higher level of interoperability, a.o. via the specification of a connector.

Author's CV

Dee DENTENEER, PhD

Dee Denteneer is Secretary General of the Zhaga Consortium. Dee has held positions at the University of Utrecht, the Statistical Office of the Netherlands, and Philips Research. He has a PhD in mathematics, and a background in wireless connectivity, lighting, project and program management, and finance. Currently, he is Director of Standards at Philips Lighting, focussing on strategy and governance in industry alliances. Alongside of his position in the Zhaga Consortium, Dee is a member of the executive team, treasurer and chair of the Finance Committee of the ZigBee Alliance; Technical Working Group Chair of the Fairhair Alliance; and non-executive member of the Board of the Philips Pension Fund.

Organisation

The Zhaga Consortium

We are a global lighting-industry organization that aims to standardize components of LED luminaires, including LED light engines, LED modules, LED arrays, holders, electronic control gear (LED drivers) and connectivity fit systems.

Use of Zhaga specifications can provide benefits such as the ability to keep pace with rapid LED technology evolution, flexibility to respond to customer/market requirements, and improved supply-chain management. Zhaga is creating a set of Interface Specifications, known as Books, which define the conditions necessary for interchangeability. Each Book defines one or more components of an LED luminaire by means of the mechanical, photometric, electrical, thermal, and control interfaces of the component to its environment. Products based on several of the Zhaga Books are already in common use in the global lighting market. Zhaga continues to develop new specifications that reflect the needs of luminaire makers and other stakeholders. Zhaga members share their technical expertise in an open, cooperative manner. The consortium is market-oriented and works in the best interests of lighting-industry stakeholders.

Potentials of Digital Disruptions

Supply Chain Based Disruptive Business Revolution

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Abstract

Amazon, Zalando and Alibaba are impressively showing how Supply Chain driven Business Models are rapidly changing the game in Commerce of consumer goods. As soon as a GTIN (EAN) is known, the internet is likely to be the place to find the best offer in terms of supply.

High complexity in the 'engineered' Lighting Business was so far preventing similar competition levels and disruptions in the concerned industries. According to the author of this paper, Engineering Businesses and lighting Business in particular are the next field for disruptive developments in their business structures - and this not because of the LED-Technology driven disruption but because of a completely different setup of competing structures in the markets.

Swift Supply Chain Engineers are coupling Technical and Lighting Know-how with Competitive Sourcing, Project-, Data-, Lean Supply Chain- and Logistics Management and Execution. As a result the Quality and Reliability of Lighting and Engineering Projects will increase while the cost is reduced drastically. Technical characteristics and differences in LED-Products will definitely loose importance as they are becoming 'standard' for lighting. The customer simply will not take notice of the technical details but put focus on the 'orderly fulfilment' of the projects at minimal cost and risk exposure. From the customer point of view - with typically risk adverse behaviour - novelty in technology is even perceived as a hindering factor, while proven track of success with proven technology is wanted. With the entrance to the phase of 'post-peak-LED' project-management will outdo technological innovation by far.

This presentation will show how the ComuLux-Program was taking impact to the lighting market where traditional structures are breaking up and roles are redefined even in the public sector. ComuLux was nominated for the Swiss Logistics Award in 2018 and is being rolled out internationally in 2019. The next level of globalization starts now in spite of increasing efforts to hinder international competition with political and technical barriers to trade. The new competition will be even increasingly driven and accelerated by professional management of globalization issues in complex environment. Further concentration and even harsher competition will be the outcome for the lighting branch that will no longer control the markets with its traditional distribution pattern.

Author's CV

Stefan KREIDLER, Dr.

Awarded for „Advanced Economic Thinking", „Innovative Supply Chains" and for „Best Products". Stefan Kreidler develops and integrates Economic Theories with Management-Techniques, Products and Logistics. Based on profound theoretical and practical Knowledge and vast Experience he is mastering the Global Economy with all its aspects along with Competences in Supply-Chain, Technology- and Production-Management. A dense international Network and excellent Communication skills are completing his personality. * University of Zurich – Dr. oec. publ. (PhD), 1999 Supply Chain & Technology Management, Production, Behavioural Economy, Accounting & Controlling Doctoral Thesis: Economics of industrial Processing * University of Zurich – lic. oec. publ. (MA/MBA), 1995 Business Management, Economics & organizational Psychology Master-Thesis: „Euro-Logistics" (basis for the 2001 award) * College / Kantonsschule im Lee, Winterthur – High-school diploma Type C (Math./Science.), 1989

Organisation

Onlog

The onlog-Value-Chain will not just boost your international Sourcing and Distribution but also it will help you closing up new Resources and Markets and it will improve your Supply Chain's Transparency, Quality and Reliability. onlog provides your Enterprise with Professional Supply Chain Services and enables Outsourcing Corporate Supply Chain and Logistics Functions with fully integrated Processes and Structures.

LiFi Technology

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Abstract

LiFi-Technology allows the the usage of lighting spectrum for high bandwidth data transfer. The technology will not replace 5G or WiFi but rather smartly complement available solutions both business and technology wise. LiFi will enable the lighting industry both to play a new, disruptive role in communications as well as towards enterprises, covering vertical-specific end-to-end use cases. In order to achieve that, the lighting industry will need to evolve from hardware-attached business to service centric models and engage deeper into cooperation models with the broad IT, IoT & telecom industry.

Author's CV

Tomasz ZAREBA, Dr.

LinkedIn Profile

Organisation

Zumtobel Group Services

Zumtobel Group Services (ZGS) offers a service portfolio for the entire lighting sector. ZGS brings all the services of the Zumtobel Group together under one roof, helping us to redefine the connected lighting and services market. The Zumtobel Group is an international lighting group and a leading player in the lighting industry. With its internationally established Thorn, Tridonic and Zumtobel brands, as well as acdc and Zumtobel Group Services, the Zumtobel Group offers customers all around the world a full range of products and services.

Collective Intelligence in Lighting Control

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Abstract

With the adoption of the Bluetooth mesh standard, the lighting industry was introduced to the concept of decentralized lighting control. While not previously seen in lighting, technology-driven decentralization is already happening across multiple industries, transforming businesses and redefining the way we use services. From transportation and power generation to media and banking, we can see centralized structures challenged and gradually replaced by decentralized solutions. It has become clear that decentralized systems are more resilient and adaptive. By eliminating middlemen, they simplify processes and reduce inefficiencies. Decentralization is increasingly being perceived as an inevitable milestone in the technological evolution of our society. And lighting controls need it, too. The traditional approach to lighting control involves sensors and fixtures reporting to a central controller. That controller is nothing but a computer running lighting control software. The software takes input signals from sensors and switches, adds local "logic" (schedules, setpoints, scenarios), and computes output signals that tell luminaires what lumen output they should be generating. But Bluetooth mesh puts a software controller into each luminaire. The luminaires themselves become intelligent and form a complete control system without the need for a central control box. The efficiencies of this architecture are intuitively obvious and mathematically provable, leading to increased reliability and better scalability. The system architecture is simplified, the single point of failure is gone, and the network load is much lower. Instead of waiting for commands from the central control unit, each luminaire carefully watches its environment, figuring out by itself how to contribute to one common goal - to provide optimal lighting conditions under the given circumstances. With such a decentralized authority structure, a lighting system starts acting like a single body driven by collective intelligence. Thousands of tiny interactions between components result in collective intelligence at the macroscopic level. This allows for achieving results that can't be achieved when these components are considered individually. There are countless examples of collectively intelligent systems in nature. By analyzing them, we can understand the advantages of decentralization even better. Colonies of ants work collectively, finding near-optimal paths to food sources despite the lack of a central authority. Considering their sizes, a central authority would be inefficient, and the transfer of information to and from the decision-maker would become a lengthy and sensitive process. Driven by collective intelligence, ant colonies are resilient, adaptive and can scale to impressive sizes. All of this is true for collectively intelligent mesh lighting networks. Also here, a central controller only generates problems. Removing it is a step forward in the evolution of lighting control. The concept of collective intelligence provides us with new insights for understanding how communication in wireless systems should be organized. But as we embrace it in lighting, we need to tailor it to our needs. I will discuss the enormous potential of collectively intelligent control systems, while exploring how we can deal with specific challenges that need to be addressed in the demanding lighting environment - such as the potential desynchronization of controller states.

Author's CV

Szymon SLUPIK, MSc

Serial entrepreneur with a strong engineering background. Today, he is a CTO and co-founder of Silvair, a company which enables manufacturers of LEDs, drivers, switches and sensors to make a smooth transition into the Internet of Things. As the CTO, Szymon is taking care of the product roadmap, as well as shaping the long-term technology strategy. He drove the development of Silvair Mesh, one of the first proprietary mesh solutions based on Bluetooth Smart, and soon became one of the leading contributors to the Bluetooth SIG's Mesh Working Group. Since 2016 Szymon has been chairing the Bluetooth Mesh Working Group.

Organisation

Silvair

Silvair is an American company with Polish roots that builds software solutions for the Internet of Things (IoT). Operating on the global market, Silvair is pursuing its strategic goal of becoming a leading supplier of modern technological tools for IoT applications. Currently, the company is focusing on developing a technology for lighting manufacturers and providers of intelligent building management systems. It offers the Silvair Lighting Firmware, as well as digital tools based on the Bluetooth mesh standard that allow for building the Silvair Platform.

Silvair's product range includes firmware for smart lighting components manufactured by third-party companies. In addition, the company provides tools for configuring, controlling and managing the lighting infrastructure, as well as tools for analyzing and using the data collected by sensors installed as part of lighting systems:

Silvair Firmware is software that can be installed by lighting manufacturers in their components. It allows devices to wirelessly communicate with each other. This in turn enables autonomous control over the intensity and color temperature of light, while also making it possible to collect data on the ways the space and devices themselves are used. Silvair's firmware is offered to manufacturers of lighting components, including drivers, sensors, fixture controllers, switches, etc.

Silvair Platform is a technology and service platform developed by the company. It includes digital tools for commissioning, configuring and managing smart lighting networks, as well as an infrastructure enabling the company to provide a range of innovative services, e.g. the ones related to property management. These services will be associated with the collection, processing and visualization of data generated by sensor-driven smart lighting networks. They will be provided remotely through a dedicated website and cloud-based solutions.

User Centric Lighting – Studies & Surveys

A European Workplace Lighting Survey

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Abstract

European lighting industry is moving towards a more sustainable and competitive future. Companies are harnessing innovative technologies and new materials to design new solutions, trying to improve human's everyday life and wellbeing. However, one of the key aspects into this new context is to integrate the User Centred Design approach into the design processes. Including the user perspective into the design process, will ensure that innovative lighting designs fulfil the real needs of users. As part of the European Commission's Horizon 2020 work programme, the REPRO-LIGHT project (Re-usable and re-configurable parts for sustainable LED based lighting systems) aspires to successfully initiate a transformation in the European LED lighting industry, by creating the 'Luminaire of the Future'. In this European project, a specific step-by-step design process is followed, providing a different set of tools for each design phase that enable user participation during the whole process. The lecture presents how the REPRO-LIGHT project is taking into account the user needs and requirements to set the future of luminaire. On the one hand, how the project has implemented a co-creation strategy is shown, based on 5 different user workshops with different stakeholders. On other hand, the results of a lighting related questionnaire are presented. REPRO-LIGHT has carried out a survey where more than 1100 people across Europe rated their work lighting environment and were asked to consider their working environment's lighting and what changes they would like to see that could improve their productivity, mood, and performance. The obtained result from the questionnaire clearly indicated that lighting in working environments, both industrial spaces and in offices, should be changed and that people are now ready for the next large steps in lighting transformation, i.e. personalized lighting.

Author's CV

Ganix LASA, PhD

Ganix Lasa is a lecturer and researcher in the Design Innovation Center (DBZ) of Mondragon University (Spain). He obtained his first degree in Industrial Design and Product Development Engineering at Mondragon University. He hold an MSc in Design Engineering from Polytechnic University of Valencia (UPV) and PhD degree in User Experience Evaluation at Mondragon University in 2015. Since then, Dr. Lasa is carrying out several research projects with a User Centred Design approach, mainly related to interaction design and product development. He is author of several scientific articles referring technology of interaction design, user experience and product development.

Organisation

Mondragon University

Mondragon University (officially in Basque: Mondragon Unibertsitatea, MU) is a non-profit cooperative private university in the Basque Country, officially established and recognised in 1997, whose primary aim is the transformation of society through the comprehensive education of persons and the generation and transfer of knowledge. It is part of Mondragon Corporation with whom it shares the values and principles which have made it possible to be active agents in the development of a more just and sustainable society. Its main campus is in Mondragón, Gipuzkoa.

Now a days, it has 5500 students, studding degrees , master's and doctoral programs, in addition, around 6500 professionals update their knowledge through courses, advanced courses...

An Interactive Approach to the Optimization of Public Space Lighting with Resident's Participation

Boris A. PORTNOV, PhD, DSc, Prof.
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Co-Author(s): Inna Nissenbaum, PhD, E&E (Eng) IBN labs ltd CO., Chairman of the Israel Lighting Association) and Tammy Trop (PhD, University of Haifa)

Abstract

Public space lighting (PSL) plays a vital role in promoting wellbeing and personal safety in urban areas. If insufficient, PSL may adversely affect the perception of comfort and personal safety in urban areas, while, if excessive and misdirected, it may lead to unnecessary energy waste, increase greenhouse gas emissions, and pose non-negligible threats to the nocturnal environment and human health. At present, PSL is designed according to universal technical standards. As a result, little is known whether the outcome, albeit technically efficient, fully reflects the perceptions of illumination quality and comfort by different groups of users in different temporal and urban settings. The main goals of the study, which methodology and preliminary results are discussed in this paper, are: (1) to develop and test an interactive user-oriented approach, according to which urban observers use a specially designed smartphone application to report their perceptions of PSL attributes; (2) to reveal users' perceptions of PSL's quality and comfort in different urban settings; (3) to identify how locational, temporal, and individual factors influence users' PSL perceptions; (4) to compare users' perceptions of PSL quality and comfort with objective field measurements of light attributes, and (5) to develop an empirical model, linking measured PSL's attributes with its perceived quality and comfort. The study, jointly funded by Israel Science Foundation, Israel Ministry of Science and Technology and Ministry of Science and Technology of the PR of China, is carried out in four phases: 1) identification of suitable survey sites, using night-time satellite images, local detailed planning schemes and field observations; 2) in-situ instrumental measurements of PSL attributes in the selected sites; 3) structured assessments of different parameters of PSL by specially trained groups of observers using interactive internet technologies; and, 4) conjoining field measurements and users' evaluations into an empirical model, linking the measured and perceived attributes of PSL. The project aims to contribute to better understanding of the way in which PSL attributes translate into users' perceptions of illumination quality and comfort, and the factors influencing these perceptions. The empirical model of the perceived PSL quality, which the study aims to develop, can be instrumental in redesigning PSL in a smart and sustainable manner, which would tailor outdoor

lighting design to users' needs, while improving service quality and urban residents' satisfactions.

Author's CV

Prof. Portnov holds PhD (1st Russian Doctoral Degree) in Urban and Regional Planning from the Central Research Institute of Town planning (1987; Moscow, USSR) and D.Sc. (2nd Russian doctoral degree) in Urban and Regional Planning from the Moscow Architectural Institute (1994). Since 2012, he holds the position of a Full Professor at the Department of Natural Resources and Environmental Management, University of Haifa (tenured). Prof. Portnov chairs the Departmental PhD Committee. Research interest of Prof. Portnov include Geographic Information Systems (GIS); Urban and Regional Planning; Real Estate Valuation and Management; Spatial data analysis, Population Geography, and Environmental Epidemiology. Prof. Portnov authored or edited (alone and with others) 7 books and 160+ refereed articles and book chapters.

Research Interests

Geographic information systems, Urban Planning, Population Geography, Real estate valuation and management

Research topics

Environmental risk assessment Geographic information systems in environmental studies Green building Modifying behavior for energy saving Environmental and health effects of light pollution

Teaching

Geographic information systems (GIS) in environmental research 3-Dimentional environmental modelling Geo-statistical analysis Urban environment Sustainable development Regional and business location

Research in progress

2018-2021 Modelling the Perceived Quality of Public Space Lighting: An Interactive User-Oriented Approach (PI) – Funded by Israel Science Foundation (ISF) (with T. Trop)

2019-2020, Optimizing Public Space Lighting in Cities with Residents' Participation :A Step towards Smart and Sustainable Urban Areas in China and Israel – Funded jointly by Israel Ministry of Science and Technology and Ministry of Science and Technology of PR of China, PI (Co-PIs: T.Trop (UoH), Prof. Ming Liu (Dalian University of Technology, PRC) and Prof. Weili Jiao, Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, PRC) .

Organisation

University of Haifa

Over 18,000 students from a wide range of ethnic and socio-economic backgrounds are enrolled at the University of Haifa, the largest comprehensive research university in northern Israel, and the most pluralistic institution of higher education in the country. Founded in 1963, the University of Haifa received full academic accreditation in 1972 and, since then, has created and developed a world-class academic institution that is dedicated to academic and research excellence. Through an accelerated growth strategy, the University has established Israel's first "Multiversity" – a multi-campus institution that promotes extensive interdisciplinary studies and partnerships. The Multiversity is designed improve access to higher education in the North, better prepare students for a dynamic job market and serve as a catalyst for economic expansion and strengthening Israel's northern region.

As a thriving academic center, the University comprises six faculties, 56 departments, eight schools and 69 research centers and institutes. The University has gained an international reputation in a variety of fields, including public health, security studies, holocaust research, cancer research, neurosciences, bioinformatics, marine sciences, education and epigenetics. The University also offers 16 international graduate programs taught in English language and a Study Abroad program.

The University's distinctive mission is to foster academic excellence in an atmosphere of tolerance and multiculturalism. Our faculty and student population is unique in its composition. Here, Jews, Arabs, Druze, Haredi and secular students, new immigrants, and military and security personnel come together to study, teach and learn.

Driven by unusual crossings between fields of research and social responsibility we create a new environment, a better community, and a better Israeli society.

Dynamic LED Public Lighting Solutions: Citizen Perceptions and Evaluations

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France

Abstract

The recent arrival of LED lighting technology on the public lighting market, linked with developments in built-in digital innovations, presents solutions to the current questions asked by managers of street lighting systems about the operation and renewal of the equipment: in what way(s) can the energy bill be reduced? Can the lighting system become a way to collect data from public space? How can the new lighting technologies be perceived by individuals? Simultaneously, some manufacturers are developing products to vary the light intensity in real-time or in a scheduled way, which is considered as relevant to better regulate the energy consumption. However, within the current paradigm of static public lighting equipment, the dynamic public lighting technologies raise two questions: what perceptions do they trigger in the users of nocturnal public spaces (Haans & de Kort, 2012, Boomsma & Steg, 2014), and, in terms of uses and time (Gwiazdzinski, 2014), how can the relevant territories be identified to implement this type of technology? In Nantes, the Interactive Data Light experiment tackles these questions with an experimental system of ten lights set up under real conditions in public space. Equipped with air-quality, decibel, temperature, humidity, electricity consumption and motion sensors, they aim to study the technical and technological ability of a lamp post to capture environmental data and measure real energy savings between a traditional light, identified here as a 150W high pressure sodium lamp, and a LED light with intensity variation, calibrated in our case between 15W (standby mode) and 45W (active mode). Lastly, this project intends to study the acceptability of dynamic public lighting by the users, thanks to a series of surveys carried out on the field. With a questionnaire, the users will give their opinion on two aspects: intensity levels (standby and active modes) and variation speed between the two intensities (quick or slow increase, dimming after a long or short time). Technologically, the results of this experiment allowed to identify a series of obstacles on the integration of sensors in a lamp post: what systems to transfer data, what storage, how to represent the data, for what? Ultimately, the evaluation protocol with citizens allowed to note perceptions of nocturnal ambiance that are relative to the different parameters of the light (visibility, feeling of comfort, of safety) and enabled exchanges with them on nocturnal territories where dynamic systems could be relevant. Furthermore, this allowed for the integration of the citizen as a proper contributor to the public lighting renovation process, with his ability to provide data on the uses and temporalities of the territories he visits. With this collaboration, we note the prospect of involving citizens in the processes of adapting lighting equipment to real situated nocturnal needs, and we open the discussion on the repetition of this evaluation form on a bigger scale.

Author's CV

Nicolas HOUEL, PhD Student

Nicolas Houel is an architect and a lighting designer. He is currently a researcher in night-time urban studies at CRENAU, which belongs to the AAU Laboratory (UMR CNRS 1563, Nantes). Since 2014, he has been leading Skedanoz, a nocturnal cultural mediation project, and has accompanied public and private projects regarding the study of architectural, urban and landscape lighting. He also carries out experiments and evaluation projects in terms of public lighting (Interactive Data Light, 2016 – 2018). After assuming the position of teacher in studio and in digital representation tools (ESMA Nantes, 2014 – 2017), he is now involved in the Master's curriculum at the Graduate School of Architecture of Nantes, where he is in charge of classes on lighting culture. He has been working along with the city of Nantes since 2017, to help them with the implementation of their Public lighting equipment scheme, considered as a management and renovation tool for the lighting stock of the metropolis' 24 municipalities.

Organisation

AAU Laboratory

The Urban Architecture Nantes Research Centre (CRENAU) is the AAU Laboratory's team based in Nantes. CRENAU was created in January 2015 from the merger of two laboratories at ENSA Nantes:

CERMA, Research methodology in Architecture Centre, created in 1971 and specialised in the built environment's methodological and numerical approaches. LAUA, Languages, Urban Actions, Alterities laboratory, founded in 1991 and specialised in the urban building and forms of urbanities' socio-ethnographic approaches. Members of GERSA, (Stage Design in Architecture Research and Study Group), also joined CRENAU.

Research at CRENAU is part of the AAU Laboratory's scientific mission. In this context, it includes numerous themes related to architectural and urban ambiances, models, public territorial action instruments and policies, virtual and enhanced reality, maps and sensitive representations of the built environment, cities' adaptability to climate change, etc.

Through its history and composition, CRENAU has deployed expertise in a wide range of fields: architecture, urban planning and urbanism, sociology, anthropology, computer science, physics, history and arts. It welcomes numerous PhD students in these fields of study.

CRENAU members belong to the institutions supervising the AAU Laboratory i.e. ENSA Nantes, Centrale Nantes, CNRS as well as ENSA Paris-Malaquais and Nantes School of Art in agreement with ENSA Nantes.

Human Centric Lighting I–III

Critical Opinion on the Current Development Status of HCL Solutions

Wilfried POHL, Mag
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Bartenbach
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Austria

Abstract

The digital light source LED allows the efficient generation of dynamic light spectra and luminous intensity distributions and the implementation of new lighting designs for special visual, biological and emotional needs. The integration of additional sensor-technologies and the implementation of complex control algorithms will support the transformation of current lighting systems into smart and adaptive lighting solutions that will instantaneously react to environmental alterations and individual desires (personalized lighting).

Bartenbach is designing and realizing HCL installations for different applications in his daily business, thus gaining a lot of practical experience. But Bartenbach is also involved in research projects where the psychophysiological and health effects of such illuminations are investigated with scientific methods. An interdisciplinary team in the fields of medicine, perceptional psychology, physics and techniques is dealing with the basics of HCL (e.g. melatonin suppression, etc.) and is evaluating the scientific resilience.

On the basis of these many years of experience, a critical opinion on the current development status of HCL lighting solutions will be presented, covering scientific, photometric and lighting design aspects.

Answers to the following questions will be presented: • Who needs HCL lighting solutions? • Which non-visual effects are scientifically proven today? • How well can non-visual effects be predicted? • Which lighting designs represent HCL lighting solutions today? • What recommendations can we make today for an evidence-based HCL lighting solution?

Author's CV

Wilfried POHL, Mag

Studied mathematics and physics, started 1985 at Bartenbach, since 1998 Member of Managing Board and Director Research, dealing with artificial lighting, daylighting and building physics, visual perception and light and health. Leader of various international planning and R&D-projects in these fields. Lecturer at different universities, university teaching position at the Lighting Academy Bartenbach (a branch of the University of Innsbruck), several scientific papers and presentations, participation in international advisory boards.

Papers/Presentations: • Spectral Quality - Einfluss des Spektrums auf den Menschen; LICHT 2014, Den Haag • From Digital Lighting to Smart Lighting Smart Lighting; Smart Lighting Conference, Barcelona 2014 • Lighting with LEDs – More than just Illuminating Objects; LpR50, July

2015 • Licht und Technologie: Licht im Wandel; Architekturjournal wettbewerbe, Juli 2015 • Light and Health – newest research findings and its applications; LpS 2016 Bregenz • Energieeffizienz und Helligkeitseindruck im Verkauf; Licht 2016 Karlsruhe • Biodynamische Beleuchtung – Anwendungen und wissenschaftlicher Hintergrund; Licht 2016 Karlsruhe • HCL – Just a phrase?; Tagung Smart Lighting 2017, Hamburg • New daylight solutions for energy and health; Tagung Luxeuropa 2017 Ljubljana • LED-Beleuchtung – Demonstration der Chancen und Risiken; Kongress lighting technology, Essen 2017 • Trends in Lighting – Demo Quality; Kongress LpS 2017 Bregenz

Organisation

Bartenbach

"Not from the luminaire to the overall ambience but from the desired effect to the lighting concept using the findings in perception psychology. And then applying physics and photometry to arrive at the optimal luminaire type respectively lighting system." Prof. Dr. h.c. Ing. Christian Bartenbach

Lighting Beyond Light - What Should We Expect from Light in the Future and What do We Have to Trade in?

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Abstract

Around 10 years ago the LED as a standard light source for general lighting application was still questionable. During the last decade, the strong focus on efficacy increase and cost reduction, led to a status where all new developments are based on the semiconductor light sources. The high efficacies and low cost position opened the discussions of light quality: The color rendering has been improved significantly, we have human centric lighting and LEDs with light similar to sunlight are available. So what should we expect next from light for lighting? Very similar to the color rendering discussion, the scientific world is already very active for decades to study the impact of the spectral composition of light on human beings. There are undesirable but also beneficial effects known and documented. Now is the time to evaluate these findings, understand the impact on important metrics of the general lighting market: Efficacy and Cost and develop new systems based on the latest technologies of light generation with the target of providing a better light with less unwanted side effects. This paper will summarize and discuss several positive and negative effects of certain spectral compositions in respect to human beings. It will describe possible technological solutions and provide a comparison in respect of efficacy and effort. This could form a basis for further discussions on better light with additional considerations and aspects beyond the known light quality parameters.

LESSONS LEARNED • Learn about the impact of different spectral regions for human beings • Understand the possible positive and negative influence caused by different spectral compositions • Learn about the technologies to create and provide radiation in the respective wavelength ranges • Understand the potentials and challenges for different spectral compositions in their generation and combination

Author's CV

Alexander WILM, DI

Alexander Wilm is Senior Key Expert for illumination in the GL application engineering department at OSRAM Opto Semiconductors in Regensburg. He joined OSRAM OS in 2004 after graduating from the University of Applied Sciences in Regensburg with a diploma in Mechatronic Engineering. In his career he started with optics and system design for LED headlamps, flash lights and projectors. After being stationed in Singapore for 2 years he works as Application Engineer and Key Expert for SSL products and light quality. He is active in several expert associations for general lighting and driving the innovation in solid state lighting.

Organisation

OSRAM Opto Semiconductors

Osram Opto Semiconductors is one of the guiding lights both in technological development and in the manufacture of high-quality products. For nearly four decades, the high-tech company has been investing in research and developing new products on the technological cutting edge - enabling Osram Opto Semiconductors to set international standards in the fields of illumination, visualization and sensor technology. The expertise of Osram Opto Semiconductors extends from basic semiconductor technologies to individual customer applications. The company produces top-quality solutions in various fields such as sensor technology and laser systems. The product portfolio comprises high-performance light-emitting diodes (LEDs) – e.g. for automotive and general lighting applications – miniature LEDs for mobile devices, as well as infrared diodes (IRED), semiconductor lasers and detectors. The global player accords top priority to offering its customers professional and comprehensive support based on many years of well-founded expertise. With a focus on promoting future development, the company has been involved in high-caliber technology partnerships for many years, collaborating closely with partners from the commercial sector as well as with universities and colleges. Additionally, the high priority attached to ongoing internal development has spawned many innovations and optimized the product portfolio. All this makes Osram Opto Semiconductors one of the key players in the global opto-electronic semiconductor market today.

Impact of Solid-State Lighting on Health and Safety

James Norman BARDSLEY, PhD
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San Francisco Bay
California
USA

Abstract

Discussions of the impact of SSL on human health have often been focused on the Intrinsically Photoreceptive Retinal Ganglion Cells and the impact of blue light on the circadian system. Although many papers and articles have been published on these effects, there is still a need for more research to guide the development of SSL systems. The difficulty of performing and interpreting experiments will be illustrated. It seems likely that premature recommendations based on incomplete analyses by prestigious bodies have led to loss of life. This presentation will discuss the potential positive effects that could accrue from improved lighting and will focus on issues other than the circadian rhythm. Topics could include: • Eye fatigue and recommended amelioration o Case studies on myopia from China, Australia and elsewhere o Eye fatigue following brain damage • Seasonal Affective Disorder • Age-related Macular Degeneration o Photo-oxidative damage • Accident reduction on streets and roads o Influence of intensity, color and contrast • Fall reduction for the elderly o Case studies in senior care facilities • Improved lighting in underground mines o New lamps from US • Optimum lighting for medical diagnostics o Skin conditions o Medical displays • Surgical lighting o Theater lighting o Endoscopy • Disinfection using visible light and near UV o Preventing hospital acquired infections • Reduced air pollution – indoors and outdoors o Elimination of kerosene stoves • Wound healing o OLED and QLED patches • Treatment of neurological dysfunction. The choice of topics and the division of time will be designed to avoid duplication with other presentations.

Author's CV

James Norman BARDSLEY, PhD

As President of Bardsley Consulting, Dr. Bardsley advises industry, government and academia on flat panel displays, solid-state lighting and energy efficiency, with special emphasis on diffuse lighting and organic electronics.

Norman's current activities are focused upon diffuse lighting applications of OLEDs and LEDs, flexible substrates and printed electronics. He serves as a technical consultant for the US Department of Energy's Solid State Lighting Program. In this role he is a co-editor of their "R&D Program Plan", facilitates the OLED discussions at their technical workshops, and acts as an external monitor for R&D projects.

Dr, Bardsley also serves as Chief Analyst for the International Solid State Lighting Alliance (ISA), based in Beijing. Between 2013 and 2016, he was a keynote speaker at the China OLED Summit, the China International Summit on Smart Lighting and at the LED Forum of the Chinese Association for the Lighting Industry in Shanghai. His other invitations in this period included major conferences in Austria, Brazil, Germany, India, Korea, Netherlands, the UK and the US. His written contributions included the technical sections to the IDTechEx Reports on LED and OLED Lighting in 2013 and 2014.

Until 2006, Norman served as the Director of Display Technology for DisplaySearch. His responsibilities for DisplaySearch included

analysis of all technology aspects of the flat panel industry, including display design, manufacturing and performance. He wrote monthly reports on flat panel display (FPD) technology in the OLED Emitter and DisplaySearch Monitor, quarterly reviews of FPD technology development and annual reports on FPD technology and performance. More recently, Norman made major contributions to the Flexible Display Reports for DisplaySearch and the Flextech Alliance.

Dr. Bardsley was the Director of Roadmaps and Standards at the US Display Consortium (USDC) for ten years. In this capacity, he was responsible for monitoring trends, identifying technical challenges and uncovering business opportunities in the manufacture and application of electronic display technology. The focus of these activities was in emerging technologies, such as OLED and electronic paper displays. As part of his duties, Norman worked with the Electronic Display Industry Research of Korea in the development of an early version of the Korean National Roadmap for Flat Panel Displays.

Organisation

Bardsley Consulting

To support the development of solid state lighting as a prime example of increased energy efficiency and to help harness solar power and associated technologies in revitalizing the economies of rural communities in Malawi and elsewhere.

In Search of The Perfect Light

Stephen MASON, Dr.
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Sustainable Eye Health Pty Ltd
508/437 Bourke St, Surry Hills,
NSW 2010
Australia

Abstract

The discovery of passing an electric current through a semi-conductor and observing it to emit light in the early 20th Century began a journey of discovery in physics and engineering to the present day where highly efficient light-emitting-diodes can be processor-controlled and programmed to vary radiance and wavelengths as a function of time. This paper explores the parameters when considering the optimal light to support visual and systemic health, comfort and human performance.

Author's CV

Stephen MASON, Dr.

Dr. Mason graduated in Optometry from the University of New South Wales (UNSW) Australia in 1978. In private practice for more than thirty years, for the past decade, Dr Mason has concentrated his interests on the development of LED light that offers beneficial effects for health and visual performance for the human eye and visuo-sensory system. Dr. Mason has been a visiting lecturer at University of New South Wales, Sydney, Australia, and became a Fellow of the American Academy of Optometry in 1984. Dr Mason spends the greater part of his time in studying and conferring with colleagues in the LED lighting community to raise awareness of the importance to the eye health that we adopt best design attributes to illuminate the built environment.

Organisation

Sustainable Eye Health Pty Ltd

Sustainable Eye Health Pty Ltd is an Australian company committed to the development of new technology for the support of eye-health both throughout life and throughout the world. In the developed and developing world, as populations become more urbanised, our eyes are exposed to new and emerging threats to long term health. An immediate threat to our vision globally and a manifestation of this 'urbanisation', is that over the past 30-40 years, myopia ('near-sightedness') has increased 300% country to country on average. In some eastern Asian countries, 80% of high school graduates are myopic along with 95% of university graduates. Research conducted by the Brien Holden Vision Institute at the University of New South Wales in Sydney, Australia (2015) revealed that as current trending stands, by 2050, half the world's population will be myopic. For some, this can mean blindness in later years of life.
Sustainable Eye Health has developed a solution: Lightsafe (patent pending) is a novel form of processor controlled LED illumination, offering a significant reduction to the risk of myopia by strategic choices of wavelength, brightness and duration of exposure. Sustainable Eye Health has also developed innovative modifications to LED lighting that removes the risk of potentially long term retinal damage from 'high-energy-visible' light (HEV) incorporated in to its Lightsafe products. This addresses the so-called 'blue-light hazard' now more commonly being referred to in the literature as of potential long-term concern for eye health as we switch to LED lighting to save energy. HEV is typically found in LED lighting but can be safely removed to provide the same 'white

light' experience we enjoy for indoor illumination
but without hazardous HEV.

Energy and Quality Metrics in Melanopic Stimulus Evaluation for HCL

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Abstract

The estimation of the potential impact of general lighting in human health and wellbeing is a challenging field of science. A great progress has been done in the last 20 years with the discovery of the ipRGC (intrinsically photosensitive retinal ganglion cells), and the proposal of different functions of merit for their action spectra (such as the WELL Building Standard and the CIE S026:2018). These functions are focused on the melanopic stimulus of light sources/fixtures, rather than providing an indication of this stimulus in real environments. This is the main difference between light and lighting, that remains blurred for many stakeholders of the lighting industry. In LpS2017, we proposed a model for the estimation of the melanopic potential of lighting setups, that we refined in LpS2018. Our proposal was to evaluate the melanopic potential for lighting conditions at real environments such as the office/school workspace (that can be extended for other human environments such as the patient room at hospitals). We proposed a performance metric that considers the relationship between the photopic requirements and the melanopic impact at the eye. We have a dataset for this metric for conventional light sources (such as incandescent, fluorescent and blue pumped LEDs) together with the stimulus of full spectrum LED sources. We go one step further in our approach taking into consideration two relevant factors. The first one is the energy impact of the melanopic stimulus and how new approaches have to be considered to balance, during a whole temporal window (day, week, year), energy consumption against proper melanopic stimulus. It is not anymore about lumen/watt, it is about proper lighting for human health and wellbeing, without the constraint of current energy metrics. Our second contribution is a quality metric for the melanopic stimulus. Having a peak around 480nm, the expected contribution of the functions of merit of the ipRGC might be the same for different spectral power distributions (SPD). Together with the quantification of the stimulus, a measure of quality is critical. These two contributions will provide a broader perspective of real applications of lighting systems for HCL.

Author's CV

Octavio Luis PEREZ, PhD

Dr. Octavio L. Perez is a passionate professional, researcher and scholar who contributes to exploring, developing and bringing to the real world the benefits of light and lighting for human wellbeing and wellness, and ultimately health. He works internationally as an independent consultant, focused in translational research in human centric lighting (HCL), more precisely "affective lighting". Currently developing the HCL business intelligence for LLEDO Lighting in Madrid, Spain, he is also an adjunct researcher at Mount Sinai Hospital in NYC, NY, USA. Dr. Perez serves in several international technical committees and he is a WELL Building Standard Accredited Professional.

Organisation

Icahn School of Medicine at Mount Sinai Hospital NYC

The Icahn School of Medicine at Mount Sinai is an international leader in medical and scientific training, biomedical research, and patient care. It is the medical school for the Mount Sinai Health System, which includes eight hospital campuses, and has more than 5,000 faculty and nearly 2,000 students, residents and fellows. Our unwavering pursuit of intellectual exchange, breakthrough research, and multidisciplinary teamwork propels us ever forward in biomedical discoveries and advances. We pursue ideas that often challenge conventional wisdom to revolutionize the practice of medicine and produce dramatically better outcomes for patients. We make big, bold bets by investing in radical free thinkers and technology at the cutting edge.

Current State of Knowledge and the Levels of Various Non-visual Lighting Effects

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Abstract

Without the most original form of light, sunlight, there would be no life on this earth as we know it. The human body has synchronized its functions with sunlight for thousands of years and used its energy; light became a livelihood. Through our skin as well as via the retina, light acts on our body. Light provides visual information and contributes the synthesis of essential vitamins and messengers that control and influence numerous organic systems. Our metabolism and our skeletal system are dependent on sufficient sun exposure. Our neuropsychological abilities such as attention, concentration, and alertness adapt to current light exposure. Duration, intensity and spectral composition of our ambient light control our sleep-wake cycle, mood, and other body functions.

Light has already conquered several therapeutic domains. For example, people with skin diseases, newborns with icterus neonatorum as well as people with seasonal affective disorder (SAD) are now benefiting from special light therapies. So, by developing and installing room and ambient lighting, attention must not be paid exclusively to visual needs. Because of its biological effectiveness, light systems can have both beneficial and deleterious effects on human health. With Human Centric Lighting, the industry meets the growing awareness and knowledge of non-visual lighting effects and meets the requirements of a health-promoting room lighting.

In which form can this knowledge on Non Image Forming Light Effects (NIF) be incorporated into the lighting industry? Which general recommendations can be made and which subgroups can be classified that benefit particularly from HCL? The appropriate lighting scheme depends on the time of day and year as well as the social and individual needs of the individual or subgroup. Lighting solutions are increasingly being adapted individually and tailored to subgroups (e.g. shift workers).

This paper aims to provide a deeper insight into the current state of knowledge and the levels of various non-visual lighting effects as well as the conclusions derived therefrom for lighting concepts.

Author's CV

Lisa POHL, Dr. med.

Post-Graduate Training: 2013- present: In training for specialist doctor in psychiatric medicine. In training for professional psychotherapist in psychoanalytic therapy.

Education: 2013: Graduation as Dr. med. univ.; 2012: Final thesis at the Department of Neurobiology (Neurodegenerative Disease): "Multiple system atrophy in monocygotic twins - a case study"; 2007 – 2013: Medical University of Innsbruck; 1999 – 2007: Gymnasium Meinhardinum Stams (grammar school); 1996 – 1999: VS Silz (elementary school).

Professional Experience: Since 2017: Bartenbach Research: Non-Image-Forming Light Effects; 2013 – 2015: Clinic for Psychiatry and Psychotherapy Hall; 2015: University Hospital for Internal Medicine.

Organisation

Bartenbach

"Not from the luminaire to the overall ambience but from the desired effect to the lighting concept using the findings in perception psychology. And then applying physics and photometry to arrive at the optimal luminaire type respectively lighting system." Prof. Dr. h.c. Ing. Christian Bartenbach

Critical Evaluation of Adverse Effects of LED Light Sources

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Co-Author(s): Pohl Lisa, Pohl Wilfried

Abstract

The discussion about increased adverse effects of LED light sources occurs today both, in the light industry and in the general public. Emotional reporting in public press contributes significantly to this broad discourse. The purpose of the presentation is to give an objective, comprehensive evaluation of adverse light effects, especially LED light.

It is undisputed today that sunlight potentially has the greatest risk to human skin and eyes. In addition, increased risks result from artificial light sources with increased ultraviolet and infrared radiation. Such light sources are not used today in general lighting due to their potential photic hazards. Light sources, however, that mainly emit visible radiation and are widely used for lighting may also have negative effects on humans, especially if they generate high retinal radiation over an extended period of time.

In principle, it is known today that the amount of light, as well as its rapid temporal variation and the spectral composition of the light, are the decisive photometric causes for adverse light effects.

To estimate these adverse effects, various hazard models are used today. These models have the light spectrum, light intensity, exposure duration, the distribution of light in the visual field, and the temporal variation of the light intensity as input parameters. Furthermore, it is known that the daytime of light exposure plays a decisive role in the area of non-visual light effects.

All hazard models have in common that they make short-term effects predictable. Long-term adverse effects have so far been studied insufficiently and are thus largely unknown. In general, many models assume that natural avoidance behavior (e.g., blinking, gaze, wearing sunglasses) ensures that potentially dangerous light sources do not exhibit their potential for long-term harm. Furthermore, it is known that specific groups are at increased risks (e.g., people with a lack of avoidance behavior, with increased photosensitivity or with damaged or immature ocular medium) and therefore need special protection.

What special risks do LED bulbs generate? Basically, it can be stated that there is no increased risk due to the light spectrum of the LED alone. On the other hand, LED light sources today are ubiquitously applied due to their energy efficiency, longevity, good controllability, and small form factor (see, e.g., displays, children's toys), but the emitted radiation is often less well controlled (see, e.g., light pollution in nocturnal urban space). Especially with a direct view into the LED light source (due to its high luminance) or with a very short distance between the human eyes and the light source, hazardous effects are more likely. Finally, it should be noted that the driving of LEDs (i.e., the rapid temporal variation of the light intensity) may cause negative effects. Currently, apart from directly and immediately perceptible effects, hardly any attention is paid to

other, longer-term adverse effects of temporarily modulated lights.

Author's CV

Markus CANAZEI, PhD

Dipl.-Ing. MMag. Markus Canazei, MSc., PhD. studied Mathematics, Psychology, Philosophy and Educational Science at the University of Klagenfurt (Carinthia) and Psychotherapy Science at the Donau University in Krems (Lower Austria). He worked as a university lecturer at the University of Klagenfurt, as a family psychologist and psychotherapist with adolescents and drug addicts and as a biostatistician in the field of cochlea implant research. Since 2004 he heads the psychology of perception department at Bartenbach and investigates visual, emotional and health-related effects of light and lighting. In 2018, he completed his doctoral studies dealing with applied non-visual light impact research at the Department of Psychology, University of Innsbruck (Austria).

Organisation

Bartenbach

"Not from the luminaire to the overall ambience but from the desired effect to the lighting concept using the findings in perception psychology. And then applying physics and photometry to arrive at the optimal luminaire type respectively lighting system." Prof. Dr. h.c. Ing. Christian Bartenbach

Photobiomodulation: A New Dimension to Human Centric Lighting

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Co-Author(s): Jürgen Honold

Abstract

Human Centric Lighting is an established direction in General lighting, and many companies build products and services around it. It makes use of the interaction between light and photoreceptors in the retina to ultimately improve human wellbeing and productivity. The presence in the market of HCL has encouraged us to look for additional area's where human wellbeing can be improved by light. A scientific field called Photobiomodulation (PBM) emerged the last decades in medical science and goes by, so far, mostly unnoted by the General Lighting community. It has developed a detailed understanding of the interaction between light in the visible and near-IR spectral range and cells in and below the skin. This presentation aims to bridge this gap between science and lighting community and to show the very interesting possibilities that emerge to create new value add offerings in General Lighting based on the insights generated in the field of PBM for human wellbeing. First we summarize the insights and present applications of PBM with a focus on the mechanisms at the level of the individual cells and their "energy" factories, the mitochondria. Then we build a central hypothesis on how PBM through (selected parts of) the skin, by making use of the blood stream, can give rise to (positive) systemic effects in the human body as a whole. From the available literature of the effectiveness of PBM at the level of the individual cell we derive required dosimetry in the context of General Lighting and will discuss possible embodiments.

Author's CV

Martijn DEKKER, Dr.

After a PhD in theoretical physics, the author has joined Philips in 1993 and contributed to several different fields such as electron optics, micromagnetism, optical recording, lithography and personal care products. In 2007 he joined as CTO Lemnis Lighting, a pioneering company for retrofit LED lighting solutions. Between 2013 and 2017 he was MD of Carus, a fully automated German manufacturer of LED retrofit lamps. At present he is CEO and CTO of Seaborough, a Dutch R&D company that specializes in breakthrough technology developments in electronics, materials and applications for LED.

Jürgen Honold

Jürgen feeds as Technical Fellow Seaboroughs advanced lighting research and development. With an entrepreneurial focus and interdisciplinary approach he detects and starts research in several fields of interest, such as luminescent

materials and advanced designs and systems. As renowned developer of lighting concepts, electronics researcher, and award winning designer, Jürgen is considered one of the LED design pioneers par excellence in professional circles.

Since 1999 he has lived for the vision of bringing LED light to life, adding numerous inventions to his name since. He invented the world's first miniature torch with white LEDs (1999), fundamental concepts of LED lighting systems for big brands and as the Founder of the LEDO company produced the "bulled", an innovative family of designer lamps.

Organisation

Seaborough

Seaborough invents, develops and commercializes groundbreaking innovations for the lighting industry. Based in Amsterdam, Seaborough employs an expert team of electrical and lighting engineers, industrial designers, physicists and chemical engineers, and works in close collaboration with external specialists, each of them prominent in their field. In addition, the company runs a number of long-term research and development projects in collaboration with world leading research institutes and universities.

Seaborough develops for its own account intellectual property rights (IP)-specifically in LED systems- that are commercialized through licensing, outright sale or contracts with strategic partners. Some of the concepts and IP are developed in-house through to finished products and commercialized through dedicated, group-owned, companies. Seaborough is majority-owned by Momentum Capital, a specialized private equity firm; is fully financed by shareholder funds, and completely free of bank debt.

Human Centric Lighting for Top Performance – Learnings from Light Stimulation of World Class Athletes

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Abstract

Professional athletes work hard to improve their physical and mental and skills. However, when it comes to competition, they often have to face locations and timing that have not been chosen because of optimum performance conditions, but more according to e.g. broadcasting needs or global partition. The Athletes and their teams permanently look for strategies to minimize risks of impact on their results and nowadays look very interested into the effects of light on human rhythms and cognition. Osram started to cooperate with the German Ski Team end of 2014 in order to find practical solutions for this somewhat special application, but also in order to gain valuable experience for broader application in human centric lighting (HCL). Mainly three challenges in professional sports were tested to tackle with light strategies. First use case is the increasing number of so called night races in alpine skiing. These late evening competitions pose a clear challenge with respect to concentration and alertness and may result in a higher risk of accidents. The second use case is the travel jetlag application. In many world-class sports, intercontinental travel is frequent and the sequence of competitions may well overburden the ability of the internal clock to follow the location changes without strategic support. And in the meantime, the well-known jetlag symptoms impair the athlete's abilities to perform in training and competition. The third application is related to mood impairments in longer training periods in northern countries with low daylight availabilities. Even subsyndromal winter blues effects interfere with the motivation needs in the season's preparation phase and reduce training outcomes. Specific light interventions with mobile supplemental lighting turned out to be a valuable countermeasure against these three threats for athlete's performance. For Osram, the long-term partnership helped to improve human centric lighting solutions and led to the development of products for individual light exposure. How to balance between state of the art HCL solutions for general lighting of spaces and individual light solutions like innovative light glasses will be discussed in the presentation.

Author's CV

Andreas Wojtysiak, Dr.

Dr. Andreas Wojtysiak is a Business Innovation Manager in INO Lighting Services at OSRAM GmbH. He studied biology and holds a PhD in natural science. He worked in medical and technical departments in universities, research institutes, and industry and established as an expert in effects of new technologies on health and well-being. He is Osram's key expert for Science & Applications in Light + Health. He is Convenor of CEN/TC 169/WG 13 and contributes to international and national committees (e.g. ISO, CIE, CEN, DIN, ZVEI, LiTG, VDE).

Organisation

OSRAM

Mobility, Safety & Security, Connection as well as Well-being & Health: these are the central areas in which we tirelessly search for the answers to the big questions of the 21st century. How are we to feed around 10 billion people on the planet in 2050? How does urban living and traffic work if 70 percent of people live in cities? How can we save our vital resources? And how can we ensure data protection and access security in a digital world? OSRAM makes a key contribution to resolving the problems of today. Our products and services will help people to see better, communicate better, move better, work and live better, now and in the future.

TheNewOSRAM: Our vision is Light for a Better World. To accomplish this, we are embracing our new mission: OSRAM unlocks the potentials of light to improve people's lives. We primarily perform this in four areas of expertise: Mobility: With light, we make driving easier and safer. Safety & Security: With light, we protect people and their data, both online and offline. Connection: With light, we connect people and technology to their environments. Health & Well-being: With light, we help improve the health and well-being of a growing population.

Innovation in Lighting – Process & Realization

Virtual Prototyping in the Lighting Product Development

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Abstract

Product development in the area of optics is often bound to manifold requirements and detailed validation. Multiple iterations in the product refinement loop lead to increasing cost and duration on the way to the desired solution. However, optical simulation allows for overcoming this hurdle by the means of virtual prototyping. In this presentation, I will illustrate this concept with the specific focus on lighting applications.

The workflow starts with the light design. A particular choice of the spatial light distribution implies specific luminous flux values. Those are translated into the setup of luminaires, with the luminaires' positioning and number being evaluated using the simulation software.

Subsequently, the desired setup is engineered down to the level of the required optical shape geometry (such as reflectors and lenses), e.g. using CAD tools. This step can be highly automated using the parametric features of the corresponding geometry software. The photometry data obtained thereafter is evaluated with respect to the initial target values as well as the industry standards. In some cases, it may be important to perform additional analysis steps specific to human vision. Those can include glare or color uniformity analysis.

Remarkably, the virtual analysis of the lighting setup attains its striking significance by the virtue of consistent use of accurate optical description of all relevant materials. This includes both the bulk and the surface properties and complements the detailed physical modeling of the sources. Eventually, this also enables the physics-based rendering of the lighting design, a shortcut to provide an insight to the customer, with no real prototype required.

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Since 12/2018

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Organisation

CADFEM

CADFEM offers a complete range of CAE software and hardware from leading suppliers - from individual components to customized and complete solutions, ready for immediate use.

Engineering Simulation opens up a huge range of possibilities. Since CAE-simulation requires more than just software, CADFEM supplies all the tools which are critical for success in simulation from one source. Leading software and IT-solutions, support, consultancy as well as Transfer of know-how.

Founded in 1985, CADFEM is one of the pioneers of numerical simulation based on the Finite Element Method (FEM). CADFEM is one of the largest European suppliers of Computer-Aided Engineering (CAE). We work closely with ANSYS, Inc., a worldwide leading provider of CAE-software. CADFEM is the ANSYS Elite Channel Partner in Germany, Austria and Switzerland.

Through CADFEM International, our Products, Services, and Know-how are also provided by local CADFEM companies worldwide: the Czech Republic, Slovakia, Poland, Great Britain, Ireland, Russia, India, China, the United States and North Africa. This helps us supporting our global customers with local companies and expertise.

Mass Personalization and Lighting

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Abstract

»Mass Personalization« involves the comprehensive reorientation of product creation, from building a holistic understanding of the user to seamless implementation in personalized product and service innovation at a cost close to mass production.

Health, housing and mobility are basic human needs. Satisfying these needs with personalized, customized products opens up a great future potential for the manufacturing industries and completely new, closely interlinked opportunities for the entire society. Starting with the user and its real needs, thinking of potentials for marketing, sales, planning, production, distribution, logistics and product development, and including politics and regulation there are many fields to be observed and implemented to create value for the industry, but also for small and medium entrepreneurs. Against this background, the Fraunhofer-Gesellschaft launched the "Mass Personalization" performance center in Stuttgart (Fraunhofer-IAO, IBP, IGB, IPA) in May 2018 in collaboration with the University of Stuttgart and with the support of the state of Baden-Württemberg. The contribution to the LPS 2019 in Bregenz focuses on user-centered development of lighting solutions and services. It will show how the industry and manufacturers can succeed with the support of new technologies when it comes to user integration, using Augmented Reality (VR, AR, MR), user profiles and artificial intelligence. Innovative production methods, like additives, lasers and new innovation models and services (organization, processes, IoT, SmartHome ...) to focus the entire value chain on people and individual user's needs. The constraints that have grown over the decades and have been imposed by industrial mass production and ERP systems should be reduced or serve people rather than the other way round. The digital transformation is not at the beginning anymore, we want to contribute that the lighting industry makes use of the potential in the context of personalization in order to continue with a bright future.

Author's CV

Daniel Neves PIMENTA, DI

After studying carpentry and interior design, Daniel Neves Pimenta gained experience at Behnisch Architekten with sophisticated architectural projects, including the "Haus im Haus", the world's first LED illuminated office building.

Fascinated by the potential of LED, he worked for Nimbus as a developer, and subsequently as development manager, until he took over development management at XAL in Graz. After a brief stop at Georg Bechter Licht in Vorarlberg, the Stuttgart born Portuguese returned to his Swabian roots to research the future of the lighting industry and Mass Personalization at the Fraunhofer Institute for Building Physics IBP (Stuttgart).

Organisation

Fraunhofer IBP

The application of building physics principles is the foundation of the research and development work of the Fraunhofer Institute for Building Physics IBP. In addition to classical building physics topics such as acoustics, energy efficiency, indoor climate, hygiene and sensor technology, recycling of building materials and hygrothermics, the institute also conducts research on a wide range of projects of high social relevance. For example, it is a matter of integrally designing schools or workspaces, making flying more environmentally friendly or sounding out the energy potential of entire cities. Further focal points are the analysis of products, processes and services from an ecological, economic, social and technical point of view and their holistic balancing.

Efficient laboratories and testing facilities as well as the largest known open-air test site at the Holzkirchen site make complex building physics investigations possible. Modern laboratory measurement technology and calculation methods optimize building products for practical use. Investigations in model rooms, in the test field and at the completed object serve the building physics testing of components and complete systems for the new building as well as for the renovation case.

Building physics findings are not only incorporated into buildings and construction elements; they also inspire developments in plant engineering and extend the application of building physics competences to neighbouring fields of the automotive and aviation industries. At the same time the connection to the regional industry offers a maximum of presence of the respective professional competence.

The Fraunhofer IBP is a "building authority recognized body" for testing, monitoring and certification of construction products and types in Germany and Europe. Four testing laboratories of the institute have the flexible accreditation according to DIN EN/ISO/IEC 17025 of the Deutsche Akkreditierungsstelle GmbH (DAkkS). This entitles them to develop new test methods or to modify existing ones. The accredited certification body is an independent unit within the Fraunhofer IBP and carries out monitoring and certification activities for various construction products within the framework of the state building regulations and the Construction Products Act or the Construction Products Ordinance. This applies to products in the fields of windows, thermal insulation, fireplaces and exhaust systems.

Complete Luminaire Development Workflow and Practical Results for Tunnel Lighting

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Abstract

Solid State Lighting already made his debut in vehicular tunnel application since some years. The replacement of older light source technologies like HPS or MH lamps with LED is attractive due to its lower Total Cost of Ownership (TCO), related to higher efficacy and reliability. Focusing on the European market, while we already attended to a massive replacement of the night-time lighting (the inner zone of the tunnel), the day-time lighting (or entrance zone) made by LEDs has been starting only in recent times. The reason of this slower adoption process can be mainly ascribed to the complexity of designing high power LED luminaire with better performance and lower costs than a traditional luminaire. On the other hand, improving the performance for entrance lighting luminaire can be really a benefit for the stakeholders and the end user. From a TCO point of view, it is important to underline that the power consumption for entrance lighting in an average 1km long tunnel is up to 82% on the total power consumption of the tunnel. On the end-user side, it is widely recognized that a smooth luminance variation entering the tunnel, together with a good uniformity and precise glare control can only enhance the perceived and effective safety of the driver. The only way to win this challenge was to completely change the approach of day-time lighting, thanks to the leverages that the new technology gave us. The focus of this proceeding is to show which is the impact of a complete luminaire development workflow on the TCO and safety side, both working on optical components and on system design, and to demonstrate that the synergy between these two parts of the design process can enhance the result. Starting from a component prospective, we investigated the benefits of having a small light source combined with a reflector-based optics. Given a typical tunnel scenario, we found out the best trade-off between the different requirements of the application (illuminance, uniformity and glare) by means of parametric ray-tracing simulation, always targeting the higher optical efficacy of the luminaire. Then, from the application stand point, the light distribution obtained by tailored optical design is used in lighting design, targeting the entrance luminance curve and acting on luminaire flux, position and tilting/rotation. An additional iteration through the development chain is than performed in case some room of improvement of the results can be achieved. Finally, in order to validate the model, we made luminance measurement of the installation, before and after the relamping, comparing the results. The case studies are discussed, giving evidence to the development process proposed.

Author's CV

Lorenzo TREVISANELLO, PhD

Lorenzo Trevisanello received his Ph.D. in Electronics and Telecommunication at the Univ. Of Padova (Italy) in 2009, working on reliability of GaN LEDs. Then he has been working in the R&D Dept. of a big lighting multinational. Since 2014 he's the head of R&D dept. of ARIANNA SPA, an Italian company specialized in design of luminaires for road, tunnel and sport lighting.

Organisation

Arianna

Arianna S.p.A. is a company specialising in the design and manufacture of LED lighting systems that feature an international patent on total reflection. Founded in 2009 by Alberto Giovanni Gerli, the company's CEO, Arianna joined the Carel Group in 2012. In 2014 Arianna was recognised as an innovative start-up. The international patent on total reflection has revolutionised the optical principle of diffusion in traditional lighting. This system consists of an internal reflector that collects and combines the light emissions, and then casts them uniformly onto the ground. Tangible results are obtained in terms of energy savings and visual comfort. The total reflection patent has been recognised by the United States Patent and Trademark Office, making it applicable also in the United States. Technology, innovation and energy savings are the guidelines that underlie Arianna's operations and growth. The company's research is the basis for the development of products that increasingly meet customer demands, following an approach focused on continual improvement. Certifications and awards received guarantee the quality of the company's work and the reliability of the products developed for public and industrial LED lighting. The first products developed by Arianna were designed for public lighting. Patented and innovative streetlights for country and city roads, bike paths, parks and gardens, and car parks. As well as floodlights for roundabouts and tunnels, which maximise efficiency and energy savings. Following Carel's acquisition of a stake in the company, Arianna has designed a line of products for professional indoor lighting: large retail areas, stores, background and accent lighting for supermarkets.

Light Sources I–IV

LED Innovations for the Improvement of HCL Luminaires

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Abstract

Human Centric Lighting (HCL) is currently one of the primary drivers of lighting innovations. Tuneable (white) solutions play a major role in this innovation. Whether it is to simulate the changing colour temperature of sunlight during the day, or to let the user pick their own preferred light, the colour changing aspect of the light is at the heart of it. The conventional way to achieve a tuneable white solution is to use separate light sources of different colour-temperatures. In this paper we will introduce new innovations which support HCL luminaire design by having the tuneable white solution in one light emitting surface (LES). Having one LES, but still two separate controllable channels, allows for freedom of design of luminaires previously difficult to achieve with tuneable white. For example, having a single LES reduces the need for additional optics or diffusers while still maintaining a good (colour-) homogeneity. We have achieved single LES tuneable white LED's. The (Chip-on-Board) CoB style package enables tuneable white spot solutions which before were only realisable using DMC (Direct Mountable Chip) or CSP (Chip Style Package) solutions. Having a small tuneable LES available in a ready-made solution, without having to make a peak-design PCB, will enable luminaire manufacturers to much easier expand their tuneable white portfolio and hopefully inspire many new designs.

Author's CV

Menno SCHAKEL

As a Technical Marketing Engineer for Nichia, Menno Schakel focuses on customer's technical requirements, bridging the gap between the customer and Nichia's product research and development. Menno has worked as an optical measurement specialist at Philips Lighting and a British measurement laboratory in his earlier career. He is also a member of several CIE Division 2 technical committees and currently holds the committee chair of TC2-89, developing a measurement method for Temporal Light Modulation.

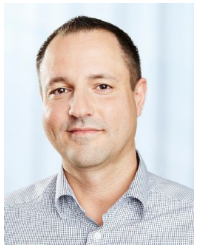
Organisation

Nichia

Having "Ever Researching for a Brighter World" as our motto, Nichia has grown in the field of development, manufacturing and sales of fine chemicals, particularly inorganic luminescent materials (phosphors). In the process of the challenging pursuit of brighter luminescent and light-emitting materials, we succeeded in developing and commercializing the super high brightness Blue LED in 1993, which greatly impressed the world. Since the first introduction of the Blue LED in 1993, we succeeded in developing the world's first white LED by

combining yellow phosphor and blue LED, followed by the successful development of practical level of blue-violet semiconductor laser for the first time in the world. The invention of these Nitride-based LED and laser diodes causes the technological innovation of light source in the field of display, general lighting, automotive, industrial equipment, and medical care & measurement. We hope that Nichia will continue to be a company that will contributes to the world by evolving its original and unique technologies in the field of manufacturing.

Value and Opportunities from Integrated LED Matrix Solutions



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Abstract

This paper discusses the value and opportunities that integrated LED Matrix solutions can provide to Lighting Manufacturers.

In the past years, LEDs have become more powerful, and cheaper. Level-1 LED components still require some work to be designed into final solutions. Lighting Manufacturers often are caught in significant work when designing their solutions, means costs and valuable time.

Lumileds has introduced its Matrix program that provides solutions for this challenge. Integrated LED module solutions may consist not only of the LED and the PC board, but also of driver-on-board solutions, or connectivity and control blocks, or also integrated optical elements, such as like lens or lens plates, or even integrated Light Guide Plates (LGP).

While driver-on-board solutions or connectivity considerations are widely known today, more freedom in design becomes possible by LGPs. Originally used display technologies now evolved further and optical system efficiencies have reached levels of 80

Powerful in applications, todays ink technologies enable not only typical lambertian light distributions, but also batwing distributions for outdoor applications. Smart designs can be optimized towards custom specific Light intensity distributions/beam patterns. Furthermore, also the mechanical interface of LGPs can be designed to custom needs, from low level partial modules, all the way up to e.g. IP67 solutions. Most importantly, the number of LEDs is relatively free in LGP products, basically is limited by the overall dimensions for the module. That means that more LEDs can be used, driven at lower currents, leading not only to easier thermal designs, and also to surprisingly high efficacy levels. Dim-to-warm is needed in your solution? That already is a ready-made building block, too.

The presentation will show several Light Guide Plates demonstrators will discuss the benefits towards quality of light and improved characteristics and leave room to look into the future of integrated solutions.

Author's CV

Ingolf SISCHKA (Author)

Study: • 1991 – 1996, Technical University of Ilmenau, Mechanical Engineering, specialized in Lighting Technology and Mechatronics (Dipl.-Ing.)

Professional Carrier: • 1996 – 2001, Application Engineer Philips Business Center Automotive Lighting, Aachen, Germany; • 2001 – 2004, Product Manager, Philips Business Center Automotive Lighting Plauen, Germany; • 2004 – 2009, Product Manager/Marketing Manager/Data Manager, Philips Automotive Lighting North America, Farmington Hills/Detroit, Michigan, USA; • 2009 – 2014, Business Creation Manager/Product and Marketing Manager OLED, Philips Business Center OLED Lighting, Aachen, Germany; • 2015 – today, Technical Solutions Manager EMEA and Business Development Manager Matrix Lumileds, Germany

Shih Shun Chang, Ph.D. (Co-Author)

Study: • 1991 – 1996, Ph.D. University of Colorado Boulder, Electrical Engineering, Thesis: High-temperature GaN/SiC heterojunction bipolar transistor;

Professional Carrier: • 2012 - 2013, Director, Segment Marketing Standards and Retrofit Lumileds, USA; • 2013 - 2014, Director, Marketing for 3535 Mid Power Lumileds, USA; • 2014 - today Director, Global TSM Team Lumileds, USA.

Organisation

Lumileds

Technology advancements in lighting, especially LED, are creating tremendous opportunities in the field of light. Lighting solutions today not only need to work and to last, they need to give customers a competitive edge. Companies developing automotive, mobile, IoT and illumination lighting applications require a partner who can collaborate with them to push the boundaries of light. With more than 100 years of inventions and industry firsts, Lumileds is a global lighting solutions company that helps customers around the world deliver differentiated solutions to gain and maintain a competitive edge.

As the inventor of Xenon technology, a pioneer in halogen lighting and the leader in high performance LEDs, Lumileds builds innovation into everything it does. What's more, quality and reliability are guiding principles for Lumileds. The company demonstrates this by maintaining control over materials, processes and technologies and by helping customers engineer the best quality of light for their application to achieve the highest levels of performance.

The best innovation happens when great minds work together. Lumileds acts with integrity as a trusted partner to its customers, honoring commitments, offering deep expertise, and going the extra mile — making the world better, safer, more beautiful — with light.

GaN-Substrate LEDs: Introduction nPola

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Abstract

Seoul Semiconductor's patented nPola technology increases brightness levels 5 times over existing LEDs. This technology took more than 10 years to develop and is set to revolutionise the LED lighting industry. nPola stands for Numerous polarities and is related to the substrate in which the LED is grown. nPola is grown on a GaN (Gallium nitride) substrate, whereas conventional LEDs use Sapphire or Silicone substrate in which most of the energy is converted to heat instead of light due to a defect caused by lattice mismatch. nPola, however, does not have the lattice mismatch issue like conventional LEDs because the GaN epitaxy has the same crystalline structure as the GaN growth substrate. Furthermore, nPola technology involves the utilization of the one of the nPola non-polar planes in the GaN crystal, either the a-plane or m-plane, whereas traditional LEDs currently utilize the polar c-plane GaN epitaxy on Sapphire or Silicon. nPola LEDs offer reduced electrical resistance, increased electrical efficiency, reduction in colour shift with varying operating current and smaller device size.

With nPola, Seoul Semiconductor has already improved the lumen density of LEDs by 5 times over the conventional LEDs based on equivalent die surface area and it expects to further improve this margin to 10 times in future.

Author's CV

Hong Jae JUNG, Dr.

Organisation

Seoul Semiconductor

Seoul Semiconductor develops and commercializes light emitting diodes (LEDs) for automotive, general illumination, specialty lighting, and backlighting markets. As the fourth-largest LED manufacturer globally, Seoul Semiconductor holds more than 12,000 patents, offers a wide range of technologies, and mass-produces innovative LED products such as Wicop – a simpler structured package-free LED which provides market leading color uniformity, cost savings at the fixture level with high lumen density and allows design flexibility; Acrich, the world's first high-voltage AC-driven LED technology developed in 2005, includes all AC LED-related technologies from chip to module and circuit fabrication, as well as multi-junction technology (MJT); and nPola, a new LED product based on GaN-substrate technology that achieves over ten times the output of conventional LEDs.

CEO Statement: "Life is a drawing which cannot be erased and redrawn Thank you for your interest in Seoul Semiconductor. I believe a company should help the world, create value for its customers, let employees have pride and ensure the stability for its shareholders Seoul Semiconductor started in 1992 with around 30 employees in a small space of a commercial building in Bongchen-dong, Seoul. We have grown exponentially over the years creating many success stories With a dream that we would make our LEDs lit up even a space station, we built our company Logo and CI(Corporate Identity) in 1994

and have invested in R&D for the last two decades. Consequently, we also invented the world's first AC driven LED technology, "Acrich", 10 times brighter LED "nPola" and package-free LED technology "WICOP" With these technologies, not forgetting our original intention, we would like to build a clean, healthy and beautiful world! Moreover, we will do our best to meet stakeholders' expectations and requirements with our products and service and will abide by national and international standards. Lastly, I want to make a new history of light and wish to be a hope for young generation." CEO, Chung H. Lee

Towards New Generations of Lighting and Display: Micro-LEDs

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Abstract

In preparation.

Author's CV

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In preparation.

Organisation

Cea Leti

Leti, a technology research institute at CEA Tech, pioneers micro and nanotechnologies, tailoring differentiating applicative solutions that ensure competitiveness in a wide range of markets. The institute tackles critical challenges such as healthcare, energy, transport and ICTs. Its multidisciplinary teams deliver solid expertise for applications ranging from sensors to data processing and computing solutions, leveraging world-class pre-industrialization facilities.

Leti builds long-term relationships with its industrial partners - global companies, SMEs and startups – and actively supports the launch of technology startups. Leti is a member of the Carnot Institutes network.

Leti's main divisions: Architecture and IC design, embedded software, Silicon components, Silicon technologies, Optics and Photonics, Technologies for Biology and Health, Systems and solutions integration.

CEA Tech is the technology research branch of the French Alternative Energies and Atomic Energy Commission (CEA), a key player in research, development and innovation in defense & security, nuclear energy, technological research for industry and fundamental physical and life sciences. In 2015, Thomson Reuters identified CEA as the most innovative research organization in the world.

Degradation of Green High-Power LEDs - Influence on Color Stability of Multi-Channel Luminaires

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Abstract

In the field of interior lighting, multi-channel luminaires are increasingly being used to present daylight-like lighting situations. Depending on the application, RGB or RGBW solutions can be applied. In order to evaluate the color stability of multi-channel luminaires, commercially available red, green, blue and white high-power LEDs were submitted to various stress levels. Due to the low efficiency and the material composition of green GaN-LEDs, an increased degradation can be observed. In order to describe the degradation behavior of green LEDs, the LEDs were aged at 4 different junction temperatures. In addition, by determining the thermal resistances, aging at 4 different currents with a constant junction temperature was performed.

Due to the strong efficiency droop of green GaN-LEDs, the droop was measured over the aging period in order to separate aging mechanisms. The measurement of the spectral distribution as well as the measurement of the I-V characteristics provide additional information about the degradation mechanisms.

The results show a significant degradation of the LEDs with respect to their optical and electrical properties, which varies depending on the applied current and selected junction temperature. Using the measured efficiency droop and the I-V characteristics, an increase in the non-radiative recombination can be observed, which initially mainly affects the range of low operating currents 100 uA - 10 mA. As the number of defects increases, the range of practice-relevant operating currents is increasingly influenced by degradation, which could be visualized using a semi-log efficiency droop plot. Furthermore, there is no color shift of the LEDs during the degradation, only an absolute degradation of the spectrum can be observed in pulsed measurement. Due to the latter, a differently pronounced color shift of the system can be expected in RGB or RGBW systems. RGB systems have significantly lower degradation tolerances with regard to green LEDs than RGBW systems in order to guarantee color stability along the Planckian locus. The ageing results of the LEDs in combination with a simulation of multi-channel luminaires show that, depending on the operating conditions, visible shifts in the color coordinates can occur in comparison to the initial state due to the degradation of green LEDs.

Author's CV

Alexander HERZOG, MSc

Alexander Herzog studied electrical engineering at TU Darmstadt and received his M.Sc. degree in 2015. Since April 2015 he is working as a research assistant at the Laboratory of Lighting Technology of the Technische Universität Darmstadt finishing his graduation in 2019. The main research interests are the investigation of LED degradation and thermal analysis of LEDs.

Organisation

TU Darmstadt

Since its foundation in 1877, the TU Darmstadt has been characterized by a special pioneering spirit. It is part of our self-image to continuously continue this tradition of innovation. Through outstanding achievements in research, teaching and transfer, we open up important scientific fields of the future and continually open up new opportunities for shaping society. This makes the TU Darmstadt one of the leading technical universities in Germany with high international visibility and reputation.

LED Spectrum Optimization for Improvement of Human Performances and Psychophysiological Responses

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Abstract

In recent years, LED luminaires are replacing conventional light sources (e.g. fluorescent lamps) for office and school indoor lighting, where the time exposure to LED light is increasing. In general lighting market, LEDs with color rendering index (CRI) 80 have been widely adopted. However, to bring solutions for further market growth, LED manufacturers must focus on new light sources added-values and benefits with continuous process of improving LED performances such as luminous efficacy. Human Centric Lighting (HCL) for living and working needs new development of LED lighting to improve human work efficiency without harming individual health conditions. By applying its 50+ years of advanced phosphor technology, Nichia has developed an innovative LED which can provide positive effect on psychophysiological responses, for visibility, workability and eye fatigue, of working individuals. In this paper, we discuss about the effect of LED light source with different spectral distributions on visual workability and eye fatigue based on the results of psychophysiological response measurement. This achievement would be the first step to propose an optimal LED light source for commercialization to offices and educational facilities.

Author's CV

Makoto OGAWARA

Makoto Ogawara is currently Assistant Manager of the technical marketing division at Nichia Europe. He is focusing on connecting customers' technical requirements into Nichia's product features. Since he joined Nichia Corporation in Japan from 2013, he has worked in production engineering and LED product planning for general lighting. Makoto holds a master's degree in Material Science and Engineering from Tsukuba University in Japan.

Organisation

Nichia

Nichia Corporation (Nichia Kagaku Kōgyō Kabushiki-gaisha) is a Japanese chemical engineering and manufacturing company headquartered in Anan, Japan with global subsidiaries. It specializes in the manufacturing and distribution of phosphors, including light-emitting diodes (LEDs), laser diodes, battery materials, and calcium chloride.

The Nichia Corporation comprises two divisions — Division 1, responsible for phosphors and other chemicals, and Division 2, responsible for LEDs. In the field of phosphors the company has 50% of the Japanese market and 25% of the world market.

Nichia is the world's largest supplier of LEDs. It designs, manufactures, and markets LEDs for display, LCD backlighting, automotive and general lighting applications with the many different leds across the entire visible spectrum. Nichia's invention and development of white LEDs have spanned several accomplishments throughout the history of the company.

Wafer Integrated Chip on PCB

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Abstract

During the last years the pressure in the LED makers for producing cheaper, more efficient and more reliable products have only increased and push their R&D teams to bring new solutions to the table. As it's well know the CSPs are starting to take the lighting market and partially is because they're cost, reliability and efficacy. They are also some of the smallest products in lighting that results in smaller lenses and smaller systems with all the benefits this bring to luminaire makers and lighting designers. They have been used since years in tablets, phones, cars and recently in general lighting after the challenges of a high lifetime at high temperatures and high efficacy levels have been achieved. The technology is evolving fast and we can find CSPs in all kind of LED solutions from a mid-power LED to a super-high power array of LEDs with the advantage of a very high lumen package density and a new way for mixing colors and spectrums. We will show in this paper how the WICOP technology behaves and bring new solutions to the luminaire makers in different fields. From indoor lighting where the tunable white and small components are the key for the smart light and HCL revolution to the outdoor streetlights, tunnel lights and architectural lights where the reliability, lm/w and cost are the key for success while making smaller luminaires that require less metal materials and less space while bringing new design possibilities and more integrated solutions with the construction blocks. One of the keys for the success will be the cost that CSPs can achieve in the future. Some of the experts in the industry sees the WICOP as the only way to reduce cost from a ceramic package with a typical silicone dome or a plastic packaged LED. In the case of WICOP, the LEDs are completely manufactured at a wafer level that makes it much more economic and easy to produce than a packaged LED that involve many operations like die attach, bonding, curing, silicone molding, sorting, testing... We see a bright future for LEDs based on wafer integrated manufacturing processes as today the cost and the performance are key and the integration at a module level of this components is more and more common among the CMs.

Author's CV

Marc JUAREZ

2014-Actually – Seoul Semiconductor – Technical director Europe, 2012-2014 – Lucibel – R&D Project manager for luminaires, 2010-2012 – Founder of LEDsPRO – Lighting company, 2007-2010 – Xavier Alsina SA – Construction project manager, Master in project management by the University of Barcelona, Industrial Engineer , Member of IES and APDI associations.

Organisation

Seoul Semiconductor

Seoul Semiconductor develops and commercializes light emitting diodes (LEDs) for automotive, general illumination, specialty lighting, and backlighting markets. As the fourth-largest LED manufacturer globally, Seoul Semiconductor holds more than 12,000 patents, offers a wide range of technologies, and mass-produces innovative LED products such as Wicop – a simpler structured package-free LED which provides market leading color uniformity, cost savings at the fixture level with high lumen density and allows design flexibility; Acrich, the world's first high-voltage AC-driven LED technology

developed in 2005, includes all AC LED-related technologies from chip to module and circuit fabrication, as well as multi-junction technology (MJT); and nPola, a new LED product based on GaN-substrate technology that achieves over ten times the output of conventional LEDs.

CEO Statement: "Life is a drawing which cannot be erased and redrawn Thank you for your interest in Seoul Semiconductor. I believe a company should help the world, create value for its customers, let employees have pride and ensure the stability for its shareholders Seoul Semiconductor started in 1992 with around 30 employees in a small space of a commercial building in Bongchen-dong, Seoul. We have grown exponentially over the years creating many success stories With a dream that we would make our LEDs lit up even a space station, we built our company Logo and CI(Corporate Identity) in 1994 and have invested in R&D for the last two decades. Consequently, we also invented the world's first AC driven LED technology, "Acrich", 10 times brighter LED "nPola" and package-free LED technology "WICOP" With these technologies, not forgetting our original intention, we would like to build a clean, healthy and beautiful world! Moreover, we will do our best to meet stakeholders' expectations and requirements with our products and service and will abide by national and international standards. Lastly, I want to make a new history of light and wish to be a hope for young generation." CEO, Chung H. Lee

Synergy Between Display and Lighting Technologies

James Norman BARDSLEY, Dr.
President
Bardsley Consulting
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Abstract

During the last two decades, the development of new technologies for flat panel displays and general lighting have become intertwined. Replacement of fluorescent tubes with LEDs in display backlights led to substantial increases in manufacturing capacity for LEDs, resulting in dramatic cost reductions. Efficiency and color quality have been raised in both applications. However, the contrasting demands in the two fields have led to different priorities in technology development. For example, the competition between inorganic LEDs, OLEDs and quantum dots has progressed very differently in the two applications. Nevertheless, advances in one field almost always lead to improvements in the other. OLEDs have demonstrated superiority in both small and large display screens. Some of the reasons, such as fast response, ultra-high resolution and contrast are of less value in general lighting. Substantial cost reduction has been achieved in OLED TV and is being transferred to OLED lighting panels, but further advances will be critical to broad adoption. In particular, methods are needed to increase the throughput of panel production without necessitating the investment of multi-billion dollars in manufacturing facilities. The emphasis needs to change from increasing substrate area to reducing process time. The importance of roll-to-roll processing in achieving this objective will be assessed. The development of OLEDs and ultra-thin backlights has led to substantial reductions in the weight and thickness of displays and the emergence of flexible panels. These advances are being translated into some lighting applications, particularly in transportation. Research on electroluminescence in quantum dots has been underway for around 30 years, with only limited success. However, the need for more precise color control in displays has led to the large volume use of QDs in down-conversion, which may soon have a substantial impact in lighting. The manufacturing cost reductions and technology improvements have led to accelerated development of electroluminescence. The past two years have seen substantial investment in the development of mini- and micro-LEDs for display applications. This could lead to substantial increases in efficiency as well as in picture quality. The current value of these devices in general lighting is relatively low, but the technical advances and processing techniques could have long-term impact on all areas of lighting. The status of research into micro-LEDs and implementation of mini-LEDs will be reviewed and the implications for lighting applications assessed. Even with the introduction of miniature light sources with digital controls, most luminaires provide static sources of light. This is changing. As display and lighting technologies merge, dynamic control of light intensity and color balance will be followed by adjustable beam shape and beam direction. Remarkable progress already been made in automobile headlights and in spot lights for museums and theatres. The presentation will include highlights from over 100 papers on lighting topics that will be presented during the SID Display Week in May 2019. The division of time between these various topics will be designed to avoid duplications with other presentations at the Symposium.

Author's CV

James Norman BARDSLEY, Dr.

As President of Bardsley Consulting, Norman advises industry, government and academia on solid-state lighting, flat panel displays and energy efficiency, with special emphasis on diffuse lighting, organic electronics and smart lighting networks. He is a member of the Technical Advisory Team for the Solid-State Lighting Program of the US Department of Energy. Dr. Bardsley also acts as Chief Analyst for the International Solid-State Lighting Alliance (ISA) and is a member of the UNEP Expert Task Force on LED Lighting and Controls.

Organisation

Bardsley Consulting

To support the development of solid state lighting as a prime example of increased energy efficiency and to help harness solar power and associated technologies in revitalizing the economies of rural communities in Malawi and elsewhere.

Case Studies of Lighting Applications Implementing High Luminance Laser Light Sources

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Abstract

With white laser light products and systems in production and implemented in the field, applications are highlighted and their performances and reliabilities are described. In the automotive lighting application arena, laser lighting systems have played instrumental roles in the winning course times of racing vehicles in the famous Baja 1000 off-road race. The candlepower and beam angle performances of these systems are showcased and their implementation designs are outlined to exhibit how these cases can apply directly to safety design in conventional road vehicles. Application examples in specialty lighting are also highlighted in the areas of search and rescue, architectural and other outdoor application. These cases describe long throw distances of light for extended visibility and which secondary optical solutions are implemented. Finally, high luminance laser light sources are particularly well suited to coupling with fiber optics. Solution cases are described that transmit laser light through fiber optics to unique specialty lighting applications that implement optics at the low temperature and highly reliable distal end of the fiber while the laser light sources are maintained for optimal thermal management and serviceability.

Author's CV

Julian A. CAREY

Julian Carey is the Director of Product Marketing at SLD Laser, a leader in the commercialization of laser light sources for automotive and specialty lighting applications. At SLD Laser, Julian oversees product strategy and marketing for new laser based light sources. In his prior role, Julian acted as head of marketing at Intematix, a leading innovator of phosphors and remote phosphor components for high-quality LED lighting. His previous roles were marketing and developing scanning laser based display systems at Prysm and LED based lighting components and systems at Philips, Lumileds and Agilent. He holds a BS degree in Mechanical Engineering from Stanford University and an MBA from MIT Sloan.

Organisation

SLD Laser

SLD Laser is where the future of lighting is being built. New ideas are being harnessed to realize tomorrow's product innovations. We are pioneering new ways to generate light that weren't thought possible – until now. The next generation in lighting has arrived, shining brighter and farther than ever before. In the last decade, LED enabled a new generation of lighting that changed everything. Now, LaserLight outshines the limits of LED to deliver safe, high luminance white light from an incredibly small point source. LaserLight doesn't just offer superior technology, it's enabling entirely new opportunities. We are commercializing revolutionary semi-polar GaN LaserLight for the next generation of display, automotive, and specialty applications. LaserLight sources are used directly in single color and R-G-B applications, or integrated into laser pumped phosphor architectures.

As an independent spin-off from Soraa Inc, SLD Laser was founded in 2013 by several leading global pioneers in solid state lighting, including Dr. Shuji Nakamura, a 2014 Nobel Laureate in Physics for his groundbreaking work with LEDs, Dr. Steve Denbaars, Dr. James Raring, and Dr. Paul Rudy. Our laser technology incorporates a robust intellectual property portfolio of over 500 patents.

A New Method of Spectral Tuning LED With High Color Quality

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Business Development Director
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Abstract

Currently it is possible to find different methods of spectral tuning LEDs on the market, like semiconductor LED chip of red, green and blue to combine for white light, or with additional phosphor converted white light base for the consideration of better color rendition, or mixing two phosphor converted white light LEDs of low and high correlated color temperature (CCT) to get a flat spectrum during the tuning process. However, there are always color quality and accuracy issues, or photobiological safety concern due to the blue light output when tuning to high CCTs in conventional methods.

This report introduces a new method of tunable spectrum LED developed by YUJILEDS, named as Spectrum X system, aiming to solve the problems above by utilizing and integrating semiconductor chip and LED phosphor adequately. Different from general white light spectrum, regardless high color rendition feature or not, Spectrum X separates different but necessary parts from a full white light spectrum into individual channels or packages, combining the parts and adjusting each channel by electrical circuit to achieve dynamic and broad spectra to maintain high color quality at all CCTs essentially. In this report, we will also introduce the tuning theory and data, and convert the spectral power distributions to Color Rendering Index (CIE) and TM-30-18 (IES) to present the color rendition performance which will also be compared to conventional methods as mentioned.

This new method is ideal for optimizing human-centric lighting (HCL) solution, as widely recognized, HCL is not just CCT tuning but is about the essence of a spectrum. Comparing to conventional methods, the Spectrum X matches circadian rhythms better and the broader spectra avoid spiculate peaks especially on blue light range, which means it mimics natural light from morning to night to a greater extent, providing comfort light on both visual and biological levels. Furthermore, it is not only suitable for HCL, all applications that demand dynamic and flat spectrum will prefer this method. For example, it could simulate standard illuminants of A / B / C / D50 / D55 / D65 / D75 to an ideal degree. Considering the flexibility of the use of semiconductor LED chip and phosphor, the method of Spectrum X can also be extended to more spectral elements to match more different and specific lighting applications.

Author's CV

Daniel HAN

With a technical background in photoelectricity, Daniel is currently the business development director at Beijing Yuji International. He is focused on market research, R&D of innovated LED technologies and products, as well as global business strategies implementation. With profound understanding of the LED technology and extensive experience in different LED industries, Daniel leads a business department mainly concentrating on utilizing and optimizing its expertise and resources to provide comprehensive solutions for various applications and markets.

Organisation

Beijing Yuji International

Yuji began as a chemical company focusing on the development of the highest quality phosphor materials. When we began producing LED phosphor material in 2006, white LEDs were still in their infancy, and the industry's focus was on improving device brightness and efficiency via yellow phosphor development. Recognizing this, we took a slightly different approach and focused on red phosphor technology, a necessary addition to any LED phosphor recipe for high CRI and/or low CCT, which at the time represented a small, yet rapidly growing market opportunity.

Today, we are known for our red LED phosphor materials with superior brightness and stability, having established key partnerships around the globe, including Mitsubishi Chemical Corporation. In order to build upon our phosphor expertise and address the higher-end lighting markets requiring the highest color quality white LED devices, we began offering our own line of packaged LEDs and solutions, with CRI levels reaching 98. We manufacture LED products for specialty applications demanding full or specialized spectrum coverage.

Our turnkey product lines include high CRI SMD and COB LEDs, flexible strips, PCB modules and lamps. We welcome custom designs ranging from specialized spectral requirements to complex PCB designs, and have knowledgeable sales and engineering staff who will gladly help with any kind of project.

Internet of Things (IoT)

Monetizing the Cloud for Lighting Control

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Abstract

IoT and lighting as a service have been discussed and written about for years. However, other than a few exceptions, the power of the Cloud has not yet made its way into mainstream lighting projects. They main 3 obstacles for mass adoption of the Cloud have historically been cost, complexity, and perceived value of the Cloud.

The Qualified Bluetooth mesh interoperable standard is addressing the first 2 obstacles with low-cost simple sensors and controllers that don't require gateways to setup or to operate. As a result, low-cost simple gateways that act as a protocol translator between the Qualified Bluetooth mesh nodes and the Cloud can be added to the network. Various examples of how the Cloud can be leveraged will be explored in order to estimate the value of the services that leverage data from a variety of sources such as occupancy sensors and power monitoring LED drivers. Only by understanding the value of the services can we truly start monetizing the Cloud for lighting control.

Author's CV

Patrick DURAND

Patrick Durand is the Worldwide Technical Director at Future Lighting Solutions (FLS) with over 15 years of experience in the solid state lighting industry. Patrick leads the FLS Technical Marketing teams and FLS laboratory teams located in multiple regions around the world with the objective of providing world-class support to lighting OEMs in developing luminaires with the latest SSL technology from the light source to the complete system incorporating the LED driver, optic, thermal management and intelligent control solutions. Patrick also works with vendors of emerging technologies where he develops the ecosystem necessary to enable and accelerate broad adoption in the lighting market. He has developed a suite of award winning online design tools to help lighting OEMs make informed design decision at both the LED and the luminaire level to reduce time and cost to market. He is also the inventor of a patent related to optimized LED color mixing for generating high CRI white. Patrick has received a Bachelor of Electrical Engineering from Carleton University as well as a Bachelor of Commerce and an MBA from the University of Ottawa. He can be reached at patrick.durand@futureelectronics.com.

Organisation

Future Electronics

Future Electronics Inc. is a distributor of electronic and electro-mechanical components headquartered in Pointe-Claire, Quebec. Founded in 1968 by Canadian Entrepreneur Robert Miller, the company is one of Quebec's largest privately owned companies and is currently the fourth largest electronics distributor in the world. It operates in 169 locations in 44 countries Worldwide. Since 15 years Future Lighting Solutions is the dedicated lighting business unit delivering solutions enabling customers and suppliers to generate new revenue out of photons. FLS leverages Future Electronics' broader set of innovative products and advanced services to unlock the growth potential of the lighting customers' footprint.

IoT System Architecture Testing as Part of Continuous Integration

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Abstract

Utilising light as a form of infrastructure to create a scalable and open IoT system architecture is the concept behind Tridonic's net4more. Organising the Internet of Things via an Internet of Light offers a huge amount of possibilities and Tridonic, a leading global provider of lighting technology, has developed net4more on the basis of this concept. net4more offers a scalable and open form of IoT system architecture that can be updated and provides the basis for future applications with IPv6 connectivity right up to the end node (individual luminaires).

The net4more toolbox comprises of a range of different modular hardware components with embedded software applications, such as luminaire fixture devices and independent devices that incorporate wall switch or sensor information into the network. The app and server side of the system involves pure software including apps required to plan, commission or switch and dim the lighting solution. Together with the link server and the software suite, they form the heart of the lighting system. Alongside this, there is a cloud server for saving data and a management portal for visualising data.

In order to ensure the toolbox is of a high level of quality, software testing forms an integral component of product development at Tridonic in addition to testing the hardware components. The wide range of components and level of innovation in the project means there is a high degree of complexity that can present some risks during the testing phase. Taking this into consideration, Tridonic has taken a new testing approach when developing the software for net4more. The presentation will explain the reasons behind this decision, the technical challenges involved and the innovative testing approach implemented for the testing of net4more.

Author's CV

Jürgen WÖLFLE

As Head of Embedded Software IoT at Tridonic, Jürgen Wölfle is responsible for the development and testing of software solutions for field level devices deployed in smart lighting systems as part of the Internet of Things. Jürgen has over 17 years' experience in research and development of electronic controls in the automotive and lighting industries. His expert knowledge is combined with practical know-how which was obtained early in his career as a testing engineer along with 15 years' experience as a team leader of software developers, engineers and testers. Jürgen Wölfle holds a diploma in Electronics from the University of Applied Sciences Ravensburg-Weingarten.

Organisation

Tridonic

Tridonic is a world-leading supplier of lighting technology, supporting its customers with intelligent hardware and software and offering the highest level of quality, reliability and energy savings. As a global driver of innovation in the field of lighting-based network technology, Tridonic develops scalable, future-oriented solutions that enable new business models for lighting manufacturers, building managers, systems integrators, planners and many other types of customers.

To promote the vision of the “Internet of Light”, Tridonic relies on partnerships with other specialists. The goal is the joint development of innovative technological solutions that convert lighting systems into intelligent networks and thereby enable associated services. Its profound, technical industry expertise makes Tridonic an ideal partner for established brands and for newcomers to the market.

Tridonic is the technology company of the Zumtobel Group and is headquartered in Dornbirn, Austria. In the 2017/18 tax year, Tridonic generated sales of €352.7 million. 1,690 highly skilled employees and a worldwide sales presence in over 50 countries reflect the company’s commitment to the development and deployment of new, smart and connected lighting systems.

The Transformation from a Luminaire Manufacturer to a Smart Building Enabler

Fabian GERSCHWILER
Product Manager Connected Lighting
Regent Lighting
Dornacherstrasse 390
Postfach 139, CH 4018 Basel
Switzerland

Abstract

The influence of disruptive technologies as in the field of IoT is accelerating the paradigm shift in a wide variety of industries, also in lighting. Radical innovations usually result in new business models. Product development, sales channels and services are radically changing. Commercialized IoT product solutions in lighting just started, but where is the journey taking us? The mesh network of luminaires and the collection of data provides new, previously unknown information about a building and its use. With the added value for the customer comes the uncertainty from the manufacturer. Which services must be offered by a luminaire manufacturer? What know-how will employees need in the future? What does digitalization mean for a luminaire manufacturer? Which customer value will come up in the future? Regent Lighting has recognized the potential of IoT in Lighting. Over the last few years, Regent has devoted itself intensively to the development of Connected Lighting solutions, which has been used by various customers already. Instead of talking about the opportunities and technologies of IoT, which has been known for a long time, Regent now presents the first IoT solutions from customer projects. Chances but also challenges are pointed out and valuable insights are shared with the audience. How did everything start? How can a "waste product" like data satisfy a customer need? Why do we believe that we as a luminaire manufacturer can participate in the market of Smart Buildings? What are the challenges in project implementation? In this speech, Fabian Gerschwiler, Product Manager Connected Lighting, talks about the lessons Regent learned. What motivated, what defocused Regent? And which tasks are still time consuming today - why could that be? Looking into the future tells us, why we remain motivated despite many obstacles.

Author's CV

Fabian GERSCHWILER

Fabian Gerschwiler is working as a Product Manager Connected Lighting for Regent, headquartered in Basel. He has worked in the lighting industry for several years in various positions in Switzerland and Middle East. With education in electrical engineering, business administration and product management, his responsibilities consist the development of an IoT-product roadmap including new revenue models and services.

Organisation

REGENT

Proud though we are of our hundred-year-old tradition, we do not regard that as a reason for us to stand still. We are always on the lookout for the latest technologies, materials and designs to be able to offer our end customers lighting solutions that will also be ahead of their time tomorrow. Which is why we are committed to “Lightuition”. Our ethos is based on the combination of the terms “lighting” and “intuition”, wherby the focus of our work is on the individual needs of our customers and how our luminaires and systems can be intuitively operated. We create lighting solutions to improve and enhance workplaces, control functions and the quality of life. Regent Beleuchtungskörper AG, with their headquarters in Basel, have approximately 600 employees in six countries, are a market leader in Switzerland and one of the leading manufacturers in Europe. Our products are sold internationally through our distribution partners in 35 countries around the world. Thanks to our extensive expertise and know-how, we are able to provide advice and guidance in a market that, thanks to LEDs and the use of ground-breaking digital technologies, now offers enhanced design scope. We develop high-quality conventional or semiconductor-based, optoelectronic lighting systems. We explore digital innovations in order to be able to provide smart connected lighting solutions. Our products today already feature technologies of tomorrow. Our Executive Board, headed by our new CEO Christoph Platzer, is responsible for the operational management and sustainable development of the company. Only those who are in a position to make fast decisions in a focussed, differentiated manner are able to meet the challenges of tomorrow today. Besides the CEO, the Executive Board comprises the Heads of our Sales, Operations, Finances, IT and Innovations.

Optics I–II

Micro-optics for Efficient LED Spotlights with Arbitrary Farfield Distributions

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Abstract

Usual tertiary optics for collimated LED light sources are diffusers for simple rectangular or elliptic farfield distributions which result in enlarged etendue and thus increased lamp size for a given beam divergence. Replacing diffusers by aligned double-sided microlens arrays with buried slide structures enables realization of etendue conserving spotlights for arbitrarily shaped and structured illumination – but this has to paid by decreased system transmission. A first commercial application of this design, referred to as arrayed projector, is the exterior luminaire of the BMW “Welcome light carpet“, presented at IAA 2015. We present a further development of this design approach for spotlights which employs irregular, aligned double-sided microlens arrays in a fly’s eye condenser arrangement omitting the buried slides. This allows for arbitrary intensity distributions, etendue conservation – and thus minimum system size – together with high transmission. Optionally variable farfield distributions can be realized by switching indiviudal LEDs, which leads either to controlled array cross-talk and/or to adressing of different array areas generating different farfields. Realization of the irregular lens arrays starts with design by raytracing, which has to deal with a large number of individual lenslet sizes and decentrations relating to the respective apertures. In the next step lenslet data are transferred to the mastering process. This is carried out by greyscale lithography. From the master profiles tandem lens arrays are replicated by UV reaction molding. The aligned, double-sided polymer-on-glass optics wafers are then diced, to obtain the optics chips with typical sizes between about one and hundred cm^2. This process is available from different commercial suppliers. The potential of this spotlight technology is demonstrated by different samples, which e.g. realize an automotive headlight with a passing beam and a segmented driving beam. Other applications for pattern projection and signaling are discussed. Important advantages of the presented design approach are high transmission, smallest unit sizes because of entendue conserving design and system length shortening by multi-channel architecture, variable switch- and dimmable farfields and design freedom for realization of nearly arbitrary spotlight exit aperture shapes.

Author's CV

Peter SCHREIBER, Dr.

Dr. Peter Schreiber is head of the illumination and projection group at the micro-optical systems department of Fraunhofer IOF. He is with Fraunhofer for 24 years working in the field of design and application of micro-optics. After study of physics he received a PhD on light scattering in optical glasses at Friedrich-Schiller University Jena in 1988. Current work is devoted to multi-aperture micro-projectors for LED light sources. Development and application of this optics architecture were awarded the Rudolph Kingslake price 2014 by the SPIE and the Joseph Fraunhofer price by the Fraunhofer Society 2016.

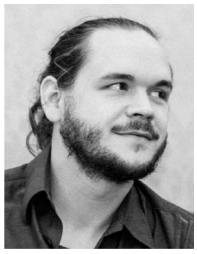
Organisation

Fraunhofer IOF

The Fraunhofer Institute for Applied Optics and Precision Engineering IOF in Jena conducts applied research in the field of photonics and develops innovative optical systems to control light - from the generation and manipulation to its application. The services offered by the Institute covers the entire photonic process chain from opto-mechanical and opto-electronic system design to manufacturing of custom-specific solutions and prototypes. Current focuses of our research activities include freeform technologies, micro- and nanotechnologies, fiber laser systems and optical technologies for safe human-machine interaction or quantum technologies. The Institute is active in its business fields Optical Components and Systems, Precision Engineering Components and Systems, Functional Optical Surfaces and Layers, Photonic Sensors and Measuring Systems, and Lasers.

The competence portfolio encompasses: Design and Simulation, Micro and Nano-structuring, Optics and Photonics Materials, Coating and Surface Functionalization, Diamond-Based Ultra-Precision Processing, Materials Processing Using Ultrashort Laser Pulses, Micro-Assembly and System Integration, Laser Development and Non-Linear Optics, Measurement Methods and Characterization.

Ultrathin Freeform Micro-optical Elements – The Potential of Tailor-made Light-directing Structures on Foil



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Abstract

The research of the past years showed that freeform optics offers new opportunities to optical designers in many different fields because of their unique ability for creating tailor made radiant intensity or irradiance distributions which cannot be achieved using conventional optical lenses. However suchlike lenses are very challenging for production and replication, as techniques like diamond turning, milling, grinding and polishing are used in general for the manufacturing of the required tools for injection molding. In contrast, the possibility of imprinting optical elements in roll-to-roll processes like roll-to-roll UV nanoimprint lithography or the roll-to-roll extrusion process promises a cost-effective production with a very high throughput of tailor-made optical elements in a mass production process. However, in order to be able to produce free-form optics using such effective manufacturing methods, the maximum height of the optics must be limited. In the current contribution we will present the design (calculation) process of so called freeform micro-optical elements (FF-MOEs), where the maximum height of the resulting structures can be confined to several 10 microns and will discuss their advantages in different lighting applications. A direct-lit luminaire, where an array of LED light sources is generating a homogeneous irradiance distribution on the exit surface of the luminaire, is in this context an example of special interest. Key parameters of a suchlike luminaire are the homogeneity of the irradiance distribution, a low height of the luminaire for design reasons as well as a high DHR ratio, which is the ratio of the distance between the LED light sources and the height of the luminaire. By using FF-MOEs on foil, the DHR value can be significantly increased (by a factor of 3) with comparable homogeneity of irradiance distribution. Furthermore, the thin design of the FF-MOEs allows a thin design of the luminaire. A wall-wash application, where an LED light source located on the blanket of a room should homogenously illuminate a target surface on an adjacent wall, is another interesting example. A suchlike luminaire has high demands on the optical system because it requires a strong light-direction to produce an asymmetric radiation pattern. In this context, we present the potential of FF-MOEs on foil to fulfill these requirements.

Author's CV

Claude LEINER, Dr.

Dr. Claude Leiner (male) studied physics at the Karl-Franzens-University Graz, where he graduated with a PhD degree in 2015. Since 2014 he is scientist at JR mainly active in the field of optical simulation with different simulation techniques like classical Ray-Tracing, the finite difference time domain method or combined approaches for multiscale optical simulations. A special focus here is on the design, simulation and further development of ultrathin freeform micro-optical elements (FF-MOEs) on foils.

Organisation

Joanneum Research

JOANNEUM RESEARCH Forschungsgesellschaft mbH (JOANNEUM RESEARCH) is a business oriented leader of innovation and technology providers. It is linked to a worldwide network and has been providing leading research according to the highest international standard since the 1960s. With focusing on applied research and technology development, the INNOVATION COMPANY plays a key role in transferring technology and know-how in Styria.

To benefit the region, JOANNEUM RESEARCH performs the following key tasks: INNOVATION JOANNEUM RESEARCH actively cooperates with business, industry and the public sector to generate innovations. We focus on application-oriented research and development projects to promote technology transfer into the economy. KNOWLEDGE NETWORK JOANNEUM RESEARCH forges organisational links between national and international research networks. It acts as a customer interface, providing advice and facilitating contact between research, business, industry and the public sector. KNOWLEDGE TRANSFER JOANNEUM RESEARCH provides access to new science and technology for the benefit of the region. We set a high value of targeted programs to foster career development of our employees and the advancement of women in our staff. Shareholder The shareholders of JOANNEUM RESEARCH are represented by the Province of Styria (80,75% of the shares), the BABEG - Kärntner Betriebsansiedlungs- & Beteiligungsgesellschaft (14,25%) an the Landesholding Burgenland (5%).

Research Units MATERIALS – Institute for Surface Technologies and Photonics HEALTH – Institute for Biomedicine and Health Sciences DIGITAL – Institute for Information and Communication Technolgies POLICIES – Institute for Economic and Innovation Research ROBOTICS – Institute for Robotics and Mechatronics LIFE – Centre für Climate, Energy and Society COREMED - Cooperative Centre for Regenerative Medicine

LOCATIONS More than 440 employees carry out research work at the main location in Graz and at the other locations in Hartberg, Niklasdorf, Weiz, Pinkafeld, Klagenfurt and Vienna.

Holdings under corporate law JOANNEUM RESEARCH has holdings in 17 enterprises under corporate law. These corporate holdings support the key thematic priorities and the achievement of corporate objectives in many different ways. Close cooperation among shareholders in each of the involved enterprises translated to a highly significant added value for the research portfolio of JOANNEUM RESEARCH.

Freeform Optical Structures: From Macro to Micro Scale

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Abstract

The interest in freeform optical components has increased rapidly in the last years. Their non-symmetrical shape enables illumination patterns impossible with standard components, the design of complex, albeit compact, optical arrangements and enhances device performance. Design methods have been developed for imaging and non-imaging applications that have led to conception of better or even innovative devices. Accordingly, most efforts are committed today to the high-quality manufacturing of these components. Freeform microlens arrays, FMLAs, are, in addition, compatible to large-area and/or flexible devices and can couple light effectively into arrays of electronic (e.g. CCD sensors or LCD pixels) and optical (e.g. waveguides and fibers) microscopic components. Their microscopic nature carries specific design challenges which currently limit FMLA application to for example collimated sources and relative simple optical effects such as square/rectangular uniform illuminance distributions. Here we report on CSEM latest achievements in the design of FMLAs.

Author's CV

Tamara ADERNEUER, MSc

Tamara Aderneuer studied physics in which she received her BSc from the Technische Universität München, Germany in 2014 and her MSc from Eidgenössische Technische Hochschule Zürich, Switzerland in 2016. She conducted her master thesis in the "Photonics" Group at IBM Research Rüschlikon, Switzerland. Her international experience include a year at the Robert Service High School in Alaska, USA and a semester at the Universidade Federal do Rio Grande do Sul, Brazil. During the studies she got awarded with the scholarship "Deutschlandstipendium" and one from the "Bayerische EliteAkademie". In September 2017, she started her PhD in the "Micro- Nano Optics & Photonics" Group at CSEM in Muttenz, Switzerland in cooperation with Prof. Cajochen, head of the Centre for Chronobiology at the University of Basel, Switzerland.

Organisation

CSEM

Mission—Ensuring competitiveness through innovation CSEM's mission is to develop and transfer world-class (micro) technologies to the industrial sector—Switzerland being our priority—in order to reinforce the sector's competitive advantage. We do this by:

Making cooperation agreements with established companies Encouraging the creation of start-ups. Vision—Technologies that make the difference CSEM strives to be the Swiss cornerstone of innovation and technology transfer in micro-engineering and digital deep tech.

Maintaining industrial (manufacturing) activity in Switzerland is essential to the country's future prosperity and stability. But Swiss labor costs are comparatively high. Innovation is the only proven path to successfully managing these overall situation. Innovation, however, suffers from a bottleneck: technology transfer. And this is particularly true in an SME-driven economy. This is why we strive to facilitate and even to accelerate the technology transfer process, employing outstanding CSEM technologies that make the difference in the digital world. Strategy—Making the difference We position CSEM as the foremost national player in the field of technology transfer. In this way, we explore new means of collaborating with academia and the economy, creating conditions favorable for the technology transfer required by the industries of tomorrow:

Leveraging our excellence in integration and multidisciplinary research in the broad field of microtechnology in order to strengthen our differentiation. Intensifying our collaboration with Swiss academia and Swiss research and technology organizations (RTOs). Encouraging more entrepreneurs to create start-ups. Strengthening our position at the European level, with the Heterogeneous Technology Alliance (HTA) as our preferred tool. The disruptive microtechnology platforms we develop today—strengthening the "Swissness" of products and processes—will, tomorrow, help Swiss industry maintain its leadership, creating wealth and jobs in the process, said Mario El-Khoury, CEO.

Rapid Optics Design and Manufacture for Future Proof Illumination Systems and Customized Project Lighting

Marco de VISSER
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Abstract

Additive fabrication of custom LED optics is a future proof methodology of rapid prototyping optical parts by means of digital 3D printing technologies. The lecture 'Custom Optics Design and Digital 3D Fabrication' teaches practical approaches on how to design for additive optics manufacturing by using state-of-the-art 'target-to-source' optics design software, aiming to overcome the challenges in todays landscape of lighting system design and project application.

Additive Optics Fabrication encompasses a 3D printing technology utilized to produce custom optics directly from a CAD file. In sharp contrast to conventional subtractive processes of milling, turning, grinding and polishing, additive manufacturing creates parts by building them up with progressive computer controlled deposition of material, in a process that resembles printing, but with multiple passes until the desired 3D shape is achieved. How this works in detail and how optimized design software minimizes effort, while providing outstanding results is demonstrated.

Intelligent Optics Design Meets 3D Printing Technology Fortunately, there are also some very interesting developments underway that enrich today's optics and system design landscape. Where additive optics fabrication technology breaks down the barriers of manufacture and addresses the "pain points" in today's lens fabrication processes, conventional optics design software still needs a high level of expertise and time to get to a solution, mainly a compromise between the design software and the fabrication process. The answer to overcoming the bottlenecks in conventional optics design methodologies is to apply modern mathematical methods from physics and computer programming to generate the required optics, leading the focus away from how to achieve it towards where the light is desired. Paving the Path for Novel Optics Solutions and Applications New opportunities in custom optics design and development appear for the lighting industry when "smart optics design" and "additive manufacturing of custom LED optics" get together. A combination of those two emerging technologies is extremely powerful, as the intelligent piece of design software incorporates and considers the optical 3D printing platform capabilities when generating designs for manufacture. Product developers, on the one hand, can now benefit from the 'printing-on-demand' of custom designed LED optics, with no costly commitments to tooling and inventory, while creative lighting specifiers can get uncompromised lighting solutions,

meeting the exact quantities and needs for their custom project.

Lecture attendees will gain deeper insights in the software and fabrication capabilities, while they get educated and challenged accordingly to openly share their ultimate design challenges and frustrations. Finally, they will be provided with a toolkit including novel methodologies in design and fabrication to ease future lighting system and project design and overcome the current constraints and bottlenecks.

Kick-Out: Raising awareness for reduction of 'light pollution' and 'light nuisance' (glare, blinding) is a 'take-away-message' that will enable the audience to rethink their current lighting design approaches using the new tools as offered.

Author's CV

Marco de VISSER

Marco de Visser is a Dutch self-proclaimed 3D Printing and Lighting enthusiast. Marco is Founder and Editor in Chief for 3DPrinting.Lighting and Inspiration.Lighting and is actively involved and engaged with the global lighting, optics and maker movements. De Visser is Co-Founder of 'Luximprint', a multi-market service provider in 3D printed optics and Optographix for illumination system engineering and project design applications. In parallel, he runs Luminous Concepts, a creative lighting design and consulting practice that is actively promoting integrated lighting solutions for branding and interior design, using (and mis-using) state-of-the art interactive and lighting technologies.

Organisation

Luximprint

Luximprint is a globally operating additive manufacturing firm offering its novel additive optics fabrication technology as a service to rapidly create functional prototypes and signature projects in illumination engineering and design, temporary events and interior spaces. Luximprint, based in Wemeldinge, Netherlands, introduces a novel additive manufacturing technology that enables the creation of 'Optographix': a unique combination of transparent and graphical elements applied onto technical plastics. Combined with day or artificial light, the structures come to life and create stunning luminous objects that can be used for functional or decorative application in illumination projects.

With the introduction of 'Optographix', Luximprint opens up a new market space for the design-, artist and engineering community to make unique projects come to life in a fast, effective and affordable way.

Freeform Optics for Precise Non-uniform Illumination Patterns

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Co-Author(s): Tamara Aderneuer and Rolando Ferrini

Abstract

Freeform optical components, lacking symmetry constrains, have the potential to re-distribute light extremely precisely since their surface can be optimize for nearly all incident rays. This property has been exploited to create uniform illumination of non-symmetric shapes. However, freeform optical design can be exploited further to achieve off-axis, asymmetric and precisely non-uniform light distributions which are impossible with standard, axially invariant components. Here we present several of such cases and discuss how freeforms help achieving such demanding targets. Furthermore, we also report on potential strategies to transform freeform components by freeform microlens arrays hence exploiting the flexibility and large-area compatibility they offer.

Author's CV

Oscar FERNANDEZ, PhD

Oscar Fernandez, male received his MSc and PhD degrees in Physics from the University of Valladolid (Spain) in 2000, and the University of North Wales, Bangor (UK) in 2004, respectively. After his PhD Oscar investigated the interfacial origins of threshold voltage instabilities in organic thin-film transistors (OTFT) as a post-doctoral researcher the Molecular Electronics Group in Bangor. In 2006 he joined Cambridge Display Technology (CDT) where he led the device physics activities in the lighting program. In 2011 he joined Polymer Vision BV in Eindhoven (Netherlands) where he worked on the development of OLED processing and characterization for oxide TFT-based rollable OLED displays. Since May 2012 Oscar is part of the Micro/nano optics and photonics Group at CSEM in Muttenz (Switzerland).

Organisation

CSEM

Mission—Ensuring competitiveness through innovation CSEM's mission is to develop and transfer world-class (micro) technologies to the industrial sector—Switzerland being our priority—in order to reinforce the sector's competitive advantage. We do this by:

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Maintaining industrial (manufacturing) activity in Switzerland is essential to the country's future prosperity and stability. But Swiss labor costs are comparatively high. Innovation is the only proven path to successfully managing these overall situation. Innovation, however, suffers from a bottleneck: technology transfer. And this is particularly true in an SME-driven economy. This is why we strive to facilitate and even to accelerate

the technology transfer process, employing outstanding CSEM technologies that make the difference in the digital world. Strategy—Making the difference We position CSEM as the foremost national player in the field of technology transfer. In this way, we explore new means of collaborating with academia and the economy, creating conditions favorable for the technology transfer required by the industries of tomorrow:

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Application of Diffraction-based Optical Components in Advanced Lighting Systems

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Abstract

In this paper novel approaches to optical beam shaping for lighting applications are discussed. The invention of LED sources into the lighting industry initiated new requirements on optical components used for beam management. Besides the application of refractive and reflective elements, some luminaire manufacturers started to use optical components based on diffraction of light in their products. The simplest example of such an element is a diffuser based on random micro-structure which scatters the light and softens the light distribution. Such elements are used either separately or in combination with other conventional optical components (typically lenses or reflectors). In addition to well-known conventional optical diffusers (usually manufactured using grinding or etching techniques) also synthetic diffusers were developed based on point-by-point calculation and direct writing of the micro-structure. As a consequence of this approach various asymmetric light distributions can be created which are difficult to achieve with conventional diffusers. However, the direct approach to the design and manufacturing of micro-structures (or even nano-structures) can result in much more sophisticated optical elements (or even whole optical systems) which can hardly be called diffusers. Although these components can look very similar to conventional diffusers (from a macroscopic point of view), in optical function they are much closer to optical elements. They can also work in imaging regime as conventional lenses or even as holographic imaging systems. This contribution analyzes various approaches to the design and manufacturing of generalized diffusers and new complex micro- and nano-optical components. Besides the relief-type modulation a volume modulation of optical properties can be used for manipulation of light on a basis of diffraction. Volume elements can further improve general properties of the products and their resistance against various environmental influences. Applicability of volume structures in lighting applications have been analyzed in detail also with regard to mass-production processes. Volume gratings (or general volume diffractive elements) are usually recorded inside a plan-parallel layer and thus they are well protected against most environmental conditions. Moreover, in some cases, the diffraction efficiency of volume structures can be significantly higher than the efficiency of relief-type elements. This paper analyzes the application of volume elements for managing white light beams from LED sources. Dispersion of light, angular and spectral selectivity and other effects are discussed. Volume diffractive elements have also significantly different requirements on mastering and mass-replication technology. Innovative approaches to manufacturing of volume structures will be presented including optical recording processes and mechanical replication techniques. IQ Structures developed a

general approach to design and manufacturing of optical systems for lighting applications which applies mentioned elements in complex systems. Combination of conventional components with optical micro- and nano-structures gives us an ability to achieve interesting light distributions together with new visual design of luminaires. Simultaneous use of volume and relief elements ensures high performance and robustness of the optical systems integrated under the trade name Nanoptiqs.

Author's CV

Marek SKEREN, Dr.

Marek Škereň received his master degree in physical electronics (2000) and PhD. degree in optical physics (2006) from Faculty of Nuclear Sciences and Physical Engineering of Czech Technical University in Prague. His fields of interest are computer generated optical diffractive structures, optical holography, design and manufacturing of optical nano-structures and application of nano-structured materials in advanced light management systems. He is an author of numerous scientific papers from field of synthetic holography. In 2010 he co-founded HoloPlus company oriented on diffractive optics. Until 2015 he was also a head of Optical Physics Group at Czech Technical University in Prague. Currently, he holds the position of chief-technology-officer in IQ Structures s.r.o.

Organisation

IQ Structures

We use state of the art technology and interdisciplinary expertise to form micro- and nanostructures of materials and their surfaces to enhance products with new functions and properties.

Controls I–III

80-20 Vision HCL: How to Conduct an Orchestra of Tunable White Lights to Deliver Affordable HCL

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Abstract

Human centric lighting is a broad concept encompassing the promotion of circadian rhythm entrainment, the delivery of good visual acuity, and the avoidance of glare and flicker. In this paper, we draw upon headline scientific and field study results on these aspects of human centric lighting, to inform the development of a high performance human centric lighting system, deliberately limited to dual channel 2700K and 6500K tunable mixed white, and capable of delivering these lighting results on a multiplicity of fitting formats. The headline results to which we are developing are that: (i) we must take care to deliver melanopic (blue) content when it is healthy for us, and to reduce it at night; (ii) beyond neutral white (c. 4000K), visual acuity is primarily promoted by delivering higher illuminance; (iii) glare and flicker must be mitigated. We explore "Edison's Cave" and the socio-economic revolution wrought by incandescent light, and the legacy chains from which we can now escape with LED. Too many pre-LED legacy factors continue to condition lighting standards. We demonstrate the key objectives of human centric "lightswitch" type and app control, from the end user's point of view. Our objective is to create an affordable, mass market, form of human centric lighting, pitching beyond the innovator and early adapter markets (16%) to the mainstream commercial and residential market. We then discuss the comparative merits of dual channel tunable white compared to more advanced systems (RBW, RGB, RGBW, RGBWW, RGBW&CO, and multichannel systems using an approximate sun spectrum white light at high CRI as white channel). Complexity costs more – so what are the benefits? We explore the "do no harm" ethical principle, and why, in the context of human centric lighting, doing nothing is harmful, and doing something without all the bells and whistles delivers benefits. Finally, a roadmap towards the future convergence of intelligent controls, sensor networks, and complex spectral human centric lighting is charted, pointing to a personalised light experience.

Author's CV

Patrick V. KELLY, PhD

Dr. Pat Kelly is Research, Development and Innovation Director at the ROBUS Innovation Hub, LED Group, Dublin, Ireland. He is the company's technology pathfinder. Since 2014, he has introduced Driver-On-Board technology at ROBUS. He leads the company's development of Human Centric Lighting, and related wireless controls.

A physicist, he graduated from the University of Dublin (Trinity College) with a B.A. (Mod.) in experimental physics in 1986, and a Ph.D. in Physics in 1992. He worked for ten years at NMRC (now Tyndall National Institute), University College Cork, where he became Group Director –

Photonics in 1999. He was Founding Director and Chief Technology Officer of Optical Metrology Innovations Ltd from 2002 to 2007. He worked as a Commercialisation Executive at the National University of Ireland, Galway, Ignite Technology Transfer Office from 2007 to 2011, before joining Adelaide Research & Innovation Pty Ltd, Australia, as Deputy Director from 2011 to 2013. He is a named inventor on seven patents, author of some 60 papers, and is also a self-published travel author.

Organisation

ROBUS

As a market leading brand, the ROBUS range of lighting solutions are proven and trusted by over 3,000 stockists and thousands of installers internationally. Since its introduction the ROBUS brand of lighting solutions has become synonymous with innovation, quality and value for money. Simple installation, significant energy savings and 'fit and forget' solutions are key hallmarks of the range. All new product introductions to the ROBUS range are advanced LED solutions to replace traditional light sources for both commercial and residential applications. Over 1,100 product lines are held at our Central Distribution Centres in Dublin and Australia.

Customers: ROBUS products are sold through electrical wholesalers and we pride ourselves on the partnerships created to service all who order through the wholesaler with the right product range, stock availability, fast service and technical and marketing support.

Quality: ROBUS products are designed to comply with EN 60598 and the Lighting Association Code of Practice. All products are rigorously tested with full serial number traceability. LED products in the ROBUS range use high-bin LEDs in partnership with manufacturers who have complete and tested product performance data.

Technical Support: All ROBUS products are supplied with installation instructions. The ROBUS technical support team are available to take any queries or referral to installation instructions and diagrams.

Luminaires and the Internet of Things – A Feasible Approach for Retail Applications

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Abstract

Advances in technology led to connecting many small devices to the Internet, forming the Internet of Things. This approach enabled us to develop retail lighting with not only superior lighting quality but also additional sensing functionalities leading to valuable additional features at only slightly increased costs.

Modern fixtures for retail lighting may provide multiple spectra to intensify the color characteristics of several specific products. To control various parameters such as brightness, color temperature or said spectrum a digital interface is needed. As a consequence, luminaires are usually networked, thus connected to a wired bus system like DALI. Luminaires are powered by mains, digitally networked and have a known physical location. They therefore constitute an excellent base for the Internet of Things (IoT) as they are already forming the digital infrastructure of a building.

Equipped with sensors for people counting, retail luminaires can provide information that can be used for marketing purposes like heat mapping or customer footfall analytics, asset tracking, facility management or simply observing waiting queues and providing service personnel before they exceed a given length.

Since DALI is simple and commonly used in interior lighting our approach for connecting the luminaires is using this existing DALI infrastructure bidirectionally for lighting control as well as for the transfer of sensor data. Besides the common DALI components the resulting system consists of a cloud and interfaces for mobile devices. Well-known DALI is thereby getting into competition to wireless systems like Bluetooth or Zigbee.

As a sensor for our application we chose the Panasonic GridEye. It presents a convincing solution not only in functional terms, but also regarding its price-performance ratio. This sensor includes an 8 by 8 pixel array of thermocouples measuring the infrared radiation emitted by objects and persons underneath. The sensor data is processed inside the luminaire and compressed to the information necessary and valuable for the specified application thus coping with the limited bandwidth of the DALI system. This is managed by averaging over one or more seconds, whereby the averaged data is still absolutely sufficient for all given applications. The resulting thermal image can be analyzed to detect persons and their movements.

After being transmitted to a central embedded

light controller, the data is written to a database. Cloud-based services using the aforementioned database can be accessed worldwide and provide useful features. Moreover, now that luminaires are equipped with sensors, the commissioning process can be sped up drastically.

In summary it can be said that the Internet of Things offers a great potential for retail lighting. The concept introduced shows that implementing sensing features in addition to lighting is feasible and generates added value by enabling shopkeepers to carry out helpful analytics.

Author's CV

Meike BARFUSS, Prof.

Meike Barfuss is professor of Electronics and LED-Systems in Hagen, Germany at Fachhochschule Suedwestfalen, University of Applied Sciences. In bachelor and master theses as well as in R&D projects she works on intelligent connected lighting systems and electronic circuit design -often for lighting applications- with a focus on cost optimization and energy efficiency. She is a member of the managing board of LiTG, the German society of lighting technology.

Christian MIESNER

Christian Miesner is CTO at BÄRO GmbH & CO. KG. and in charge of innovation and development, laboratory's and quality management for Retail Lighting and Clean Air Technologies.

Organisation

FH Südwestfalen

The South Westphalia University of Applied Sciences [German : Fachhochschule Südwestfalen] is a high-ranked research institution located in the state of North Rhine-Westphalia, Germany. With more than 14,000 students, it is one of the largest of its kind in North Rhine-Westphalia. It has five campuses located in Hagen, Iserlohn, Lüdenscheid, Meschede and Soest. It offers a total of about 52 bachelor and master courses in the fields of Engineering, Natural Sciences, Information Technology, Business management and Agriculture. The university is known for its innovative, future-oriented study programmes and good student-faculty ratio. It offers courses for both full-time students and for those in employment. It also accommodates those who wish to combine vocational training with studies.

Sensing Outside the Box – The Lighting and Building Automation Convergence

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Abstract

Adoption of optical sensor-in-the-loop technologies has not only simplified and optimized tunable white luminaires, it has also provided a business case to embed intelligence and implement basic connectivity. While this task has only just begun, we can now expect to see a rapid increase the range and ease of use for connected solutions, which will further drive demand for smarter lights. We're only a few short years away from a majority of new lighting installations to take for granted that all lights are connected endpoints. Once smart and connected, the next wave will be to add additional sensing features and value that drive lighting to its proper leadership position in building automation. This crown is not to be worn lightly, and most luminaire manufacturers have no idea how to implement this, and more importantly, how to get paid for it!

In this talk and paper, we will examine ways in which lighting will bring value-add outside the light. Areas to be examined include: • Enhanced spectral sensing technologies, hosted by our lighting, and potential use cases in building automation • Ripping the thermostat off the wall – how lights become our HVAC eyes and ears • The role presence and activity monitoring will play in building automation • Key technologies that will enable outside-the-box sensing • The soon-to-be simple keys that will enable the business case

We will also address the breadth of sensing technologies that could find their way into the lights, including a discussion of how different types of evolving technologies will compete for certain sensing functions, while other technologies may provide multiple functions from a single type of sensor.

Author's CV

Tom GRIFFITHS

Tom Griffiths is Senior Marketing Manager for Industrial Spectral Sensing Segments at ams AG. He has spent the last 20 years as a strategic consultant, communicator and evangelist immersed in LEDs, LED lighting, and the associated markets, including his roles as the founder and publisher of several well-recognized industry publications. Tom's background prior to those successful endeavors included 15 years of staff-level marketing and sales management within the board-level embedded computer industry. He holds bachelors and masters degrees in economics from the University of California.

Organisation

ams

Leading manufacturers around the globe rely on ams' sensing know-how for advanced systems design. For ams, "Sensing is Life" and our passion is in creating the sensor solutions that make devices smarter, safer, convenient and more environment-friendly. ams' sensor solutions are at the heart of the products and technologies that define our world today – from smartphones and mobile devices to smart homes and buildings, industrial automation, medical technology, and connected vehicles. Our products drive applications requiring small form factor, low power, highest sensitivity and multi-sensor integration. We offer sensors (including optical sensors), interfaces and related software for consumer, communications, industrial, medical, and automotive markets.

Data Analytics in Connected Lighting Systems – A Case Study

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Abstract

Today's lighting systems offer the opportunity to gather large amounts of data on their usage, operating conditions and readings from multiple sensors. In systems with advanced features like daylight control, presence control and circadian lighting, the observed data is complex enough to pose interesting research subjects. Analysis of these datasets yields insights that are valuable for future developments of luminaires and lighting systems. This talk will start off with an exploratory analysis of real-life data collected from an installation in Arnsberg, Germany. After touching some of the most intriguing findings and correlations, we will concentrate on the analysis of energy savings offered by systems that include daylight control. A simple model for the energy savings over the days of a year and over the times of a day is presented, which is in good agreement with the measurement data and can easily be generalised to different geographic locations. Moreover, it is shown that daylight control systems significantly elongate the lifecycle of LED components and thus generate an additional benefit regarding the environmental impact of lighting systems. The research presented here is part of an in-depth Life Cycle Analysis of lighting systems conducted within the European research project Repro-light. This project aims to support the European lighting industry in moving towards a more sustainable and competitive future. It has received funding from the European Union's Horizon 2020 research and innovation program.

Author's CV

Sebastian KNOCHE, Dr.

Sebastian Knoche studied physics and obtained a doctoral degree in the field of theoretical soft matter physics from TU Dortmund university. In 2015, he changed from academia to industry and started working for the Innovation and Technology Center of the TRILUX Group. Since 2017, he is in lead of the lighting research team.

Organisation

ITZ / Trilux

The Innovation and Technology Center (ITZ) operates as an independent company and is a central link between the single business units of the TRILUX Group, without having an influence on the independence of the brands. The combining of core expertise from the technology sectors of electronics, photometrics and mechanics enables the utilisation of greater synergies for optimal, application-oriented system solutions. Components developed are made available to individual companies of the TRILUX Group for their applications and marketing.

With the setting up of a strategic technology management system within the ITZ, trends in the market and future technology are identified in good time and integrated into future product concepts. The basis for successful implementation includes cooperation in

international networks, partnerships, associations and standardisation organisations, as well as active participation in research projects. In addition to technology and information topics, the ITZ provides central services for the complete TRILUX Group such as project management, laboratories and patent information.

Repro-Light

Repro-light is a European research project that aims to support the European lighting industry in moving towards a more sustainable and competitive future.

The Repro-light project will harness innovative technologies and materials to design a modular luminaire architecture with a smart production scheme as part of the circular economy, a reconfigurable customised LED luminaire, the ‘Luminaire of the Future’.

IP to the Node - An Upcoming Disruption in Lighting Controls

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Abstract

Bacnet, Zigbee, KNX, DALI, BLE-mesh, LON, Z-Wave, and many many more private systems: Who is going to finally win the lighting controls protocol race? Surprisingly this question can be clearly answered today, and the answer is „none of the above“: it will be CoAP based IP (internet protocol) based systems that directly address the luminaires and sensors. My lecture will show why this is going to happen, and what the associated benefits are. Moreover, I will address how this will affect the lighting controls (and -possibly later- also the building controls) market and the lighting supply chain structures. I will finish motivating some steps that can be taken by companies operating in this field to avoid hazardous impact from this disruption by picking up its momentum.

Author’s CV

Walter WERNER, Dr.

Dr. Walter Werner is head of the Werner Management Services, a consultancy company in the field of innovation, lighting controls and the Internet of Things. He worked as Head of System Architecture at the Austrian lighting enterprise Zumtobel Group from 2011 until 2014. From 2009 to 2011 he worked as an Innovation Consulter and parallel to that taught at the Institution for Higher Education in Rankweil, Austria. From 2006 to 2008 he was the Managing Director of a Swiss software startup company called mivune, situated in Zurich. He was employed at Moeller of Germany as Technical Manager Switchgear from 2004 – 2006 and prior to that, formed the smart lighting agenda of Zumtobel in the years 1985 to 2004. Dr. Werner completed his studies at Innsbruck University in Experimental Physics with a PhD.

Organisation

Werner Management Services

Werner Management Services e.U. is a consultancy, that focuses on Innovation Management and provides related services. Well managed innovation is a core success factor. However, it is often a major challenge to identify what innovation fits best, and to drive a success portfolio. That’s where Werner Management Services offers a helping hand: Implementing successful and tailor made systematics into the innovation process, unchaining the flow of valuable ideas, and guiding processes to achieve self guidance to the point. In addition we are prepared to bridge missing expertise in communication and controls if required, both as reporting external experts, as team challengers or workshop organizers that help to come to a sound conclusion.

NFC Current Configuration and Constant Lumen Output Functions in LED Power Supplies

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Co-Author(s): Doris Keitel-Schulz

Abstract

In the LED market, more and more high-end LED power supplies offer two novel functions: NFC current configuration and Constant Lumen Output (CLO). The NFC current configuration function helps LED driver maker and luminaire manufactures to waive the inflexible and labor-intensive current configuration method using plugin resistor or DIP switches. It cuts the total product ownership cost by reducing the inventory and improves operational efficiency. Another very important function is the Constant Lumen Output (CLO) function that compensates the luminous flux drop (aging effect) of the LED module by adjusting the LED current according to the total operation time. This function is beneficial for both end customer and environment since it reduces the total energy consumption and improves the product quality and lifetime. Since the NFC current configuration and CLO are digital functions, as of today, they are only implemented in highend LED power supply products where a Micro-Computer is available. In high volume, middle- and low-end LED power supply market, there is no solution available for easy implementation of those functions. With a new concept to integrate smart logic functions into the NFC IC and using PWM signal to control analog driver IC, both NFC current configuration and CLO functions can be enabled in analog systems without a need of Micro-Computer. This solution is compliant with most analog LED driver ICs and in align with the specification from MD-SIG about the common approach to wireless and mainvoltagefree programming of LED drivers using nearfield communication (NFC).

Author's CV

Qi ZHU, Dr.

Dr. Zhu joined Infineon Technologies AG in 2002. He is working in PMM division as a senior business development manager. One of his focus area is developing smart NFC solutions for lighting and industrial applications. With more than 15 years professional working experience in semiconductor industry, Dr. Zhu has solid experiences in business development, innovation management and management of complex product development projects. Dr. Zhu owns MBA degree from Collége des Ingénieurs (CDI), Paris, France and Ph.D. of Optical Engineering from Zhejiang University, China.

Organisation

Infineon Technologies

Infineon Technologies AG is a German semiconductor manufacturer founded on 1 April 1999, when the semiconductor operations of the parent company Siemens AG were spun off to form a separate legal entity. As of 30 September 2018, Infineon had 40,100 employees worldwide. In fiscal year 2018, the company achieved sales of €7.599 billion.

On 1 May 2006, Infineon's Memory Products division was carved out as a distinct company called Qimonda AG, which at its height employed about 13,500 people worldwide. Qimonda was listed on the New York Stock Exchange until 2009.

Clock-Driven Control in Combination with a Linear LED Strip for Human Centric Lighting

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Abstract

Human Centric Lighting is a break-thru technology in General Lighting where two color temperatures are tuned in accordance to the natural day light cycle. The physiological impact on the well-being of humans is very well know. However most of the lighting applications are still not using Human Centric Lighting mainly because of cost reasons.

In this paper we are presenting an interface for human centric lighting which is an integrated part of a linear LED luminair. This interface is clock-driven and also adjusted to an internal calendar. Therefore, it follows automatically the natural day light cycle without the need of any external control. In combination with an integrated light sensor also geographical impacts on the natural day light cycle can be recognized and compensated. The function of this interface is transparent for any external lighting control. This means dimming is still determined by an one-channel controller.

With the combination of such a clock-driven control and an advanced linear LED strip we present a new technical approach how Human Centric Lighting can become an integrated part for illumination under special consideration of total costs. We also discuss some extensions of this internal controller which makes a luminair to become a smart illumination device.

Author's CV

Roland MICHAL, Dr.

Roland Michal has 20 years' experience in the lighting industry. His responsibilities in the lighting industry were leading positions operation and technology. He was working with light sources, control gears, luminairs and light application. During all this time his focus was close to the LED technology for general lighting. Currently Roland Michal is CTO of Bilton International, an Austrian company developing and manufacturing linear LED lighting. The core products of the company are flexible linear LED-tapes.

Organisation

BILTON

BILTON International is the full-range supplier of high-quality and durable linear LED solutions with intelligent lighting management systems. The company was founded in 2009 by Patrick Müller in Saalfelden, Salzburg. Today BILTON is an innovation leader on the market and produces and develops LED modules in Austria. BILTON sees itself as a project and system partner for architecture, trade and industry.

Miniaturization of LED Drivers and Integration of Connectivity

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Abstract

The efficacy of mid power LEDs is driving indoor lighting solutions power consumption down to an area where the driver either dominates the size or the mains performance is not standardized. The upcoming standards in the US and in Europe will start to end the lively discussion about PF and THD sub 25W.

In 2018 ERP has started to introduce first high density constant voltage LED driver. In this lecture ERP will Introduce a new technology for constant current application, how new standards for LED drivers and downsizing can be amalgamated with by keeping the key attributes of a high performance LED solution.

Beyond downsizing there also is a need to enable higher functionality and connectivity mirrored by new specifications for wired and wireless communication. During the second part of this lecture ERP will discuss the impact of new standards and how such complexity of the designs can be integrated into the same high density driver in order to enable communication technologies such as DALi2 or Bluetooth mesh.

Author's CV

Laurent JENCK, MBA

Laurent has 28 years of experience in product marketing, business and operations management. He is currently the Vice-President of business development and marketing at ERP Power, where he drives the expansion of customers and the product roadmap definition for ERP's portfolio of LED drivers and power supplies. Previously, Laurent held a variety of business management and marketing positions in the areas of green energy, AC-DC power supplies, web-based circuit modeling, DC-DC power conversion, portables and wireless. Laurent has extensive working experience in the USA, Asia (China, Korea, Japan, Taiwan, etc. . .) and Europe. Laurent received his MSEE degree from INSA in Lyon-France and his MBA from the W.P. Carey school of business at the Arizona State University in Phoenix, Arizona, U.S.A.

Organisation

ERP Power

ERP designs and manufactures small, smart and connected LED drivers. Established in 2004, and headquartered in Moorpark, CA, ERP owns and operates its own ISO 9001 certified manufacturing facility to ensure quality of design, sourcing, production and testing. ERP brings smart, connected and secure lighting to the world so people can enjoy engaging, interactive experiences with light. Research shows LED lighting is the most commercially-viable approach to reducing energy consumption and utility costs nationally and globally. Our industry-leading drivers and power supplies are compact, offer extensive dimmer capability, wireless controls, programmable output and high efficiency–all at a competitive cost. Our products are rooted in the expertise of ERP co-founder and CTO Michael Archer, who changed the computing industry by designing ever-smaller power electronics for notebooks, desktops and servers from companies like Apple, Dell, HP and IBM. Now, we're focused on powering what we call the Internet of Lights.

Quality and Testing I–II

Software for Detection of Color Defects in Light Beam

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Abstract

Most of the presented LED sources have angular and spatial non-uniformity of correlated color temperature (CCT). Therefore LED and secondary optics combination may lead to following problems on illuminated area: color non-uniformity, 'yellow rings', chip image, spilled light, unwanted patterns. Engineer must choose proper secondary optics to reduce these defects during optical design process. Today it is possible to use professional simulation software to control and calculate color when creating customized optics. However, there is no such option for choosing optics from catalogues from variety of the suppliers of optical components. Comparing dozens of combinations by eye brings non-objective conclusions. Moreover, there is no standard methodology or instrument for the quality evaluation of illumination spot. Definite criteria and digital instrument are required. Developed image processing software works with high definition images, which allows precise analysis of the illumination spot. Images can be taken by simple camera or even from a web-site. The software allows analyzing luminaire color performance, comparing multiple images at once and forming photo-bank of solutions. This instrument is developed to help controlling luminaire quality before bringing to a customer and to reduce time of the design process. The paper demonstrates this technique's potential for evaluating illuminated surface quality in application area such as museum, architectural and accent lighting.

Author's CV

Saitgalina Azaliya KAMILOVNA, MSc

2018 – till now Optical engineer – Optics for LED lighting, LLC "Lighting Technologies IGC"; 2015 –2017 Master's degree in Optical Engineering, ITMO University, Russia; 2016 –2017 Academic Exchange Program Institut d'Optique Graduate School, Palaiseau, France; 2011 –2015 Bachelor's degree in Optical Engineering, ITMO University, Russia.

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2013 – till now Optical engineer – Optics for LED lighting, LLC "Lighting Technologies IGC"; 2010 – 2013 "SUKHOI Design Bureau" Optical engineer – aircraft optical-electronic systems; 2010 National Research University "Moscow Power Engineering Institute", Radio Engineering and Electronics, Engineer on specialty: Quantum and Optical Electronics.

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Organisation

LLC - Lighting Technologies

Lighting Technologies is an International Manufacturer, Supplier and Designer of innovative, energy-efficient lighting solutions with Sales Offices and Production facilities across Europe, Russia, the Middle East and Asia.

Company Facts and Figures: Range of Products 9,000 luminaires; Production Space – 84,000 sq.m.

International Sales with local Presence Our Sales offices are located across Europe, Russia, the CIS countries, and India with sales representatives available in your region or through our Export Sales Team based in Moscow. The LT Production network includes facilities in Spain, Ukraine, Russia, and India. Working closely with Industry stakeholders; Architects, Designers, Builders, and Influencers, our products are ideal for Projects. Additionally, we work closely with Distributors and Dealers.

Innovative and diverse Portfolio for every Lighting Solution Lighting Technologies' product portfolio includes over 9,000 different luminaires designed to optimally meet your lighting requirements across a range of applications including: Indoor, Outdoor, Commercial Office and Trade, Industrial, Residential, and Sports facilities.

Best in Class Manufacturing using Tier 1 Components and Equipment Research and Development, translated into innovative, efficient and price competitive Designs, and brought to life in Modern Production facilities, enables Lighting Technologies to lead the Industry's evolution to advanced luminaires and solutions. Our in-house Industrial Design Bureau, in cooperation with leading European designers and consultancies, continuously studies the markets, materials, methods and applications to deliver the luminaires our customers envision. General and special-purpose luminaires are manufactured by the company's facilities in Ryazan (Russia), Slavutich (Ukraine), Vinaros (Spain) and Bangalore (India). Our production facilities have state-of-the-art equipment including Surface mounting (SMD) an aluminum foundry, 3D printing, and an advanced Design / Test laboratory. Finished products undergo stringent quality testing.

A Commitment to high Quality and Sustainable Development Lighting Technologies understands the paramount importance of Quality to our Customers and Partners. We actively embrace this commitment through active participation in key Industry Quality Standards.

Additionally, we also understand the value of sustainable development for our Partners and also as a member of the world community. This means the introduction of "green" technologies that enable higher energy efficiency, waste reduction, and environment-friendly product features. Our Design Teams are experienced and accomplished using LEED and BREEAM project design methods and criteria.

Challenges for Measuring Multichip LED Light Engines for Interior Lighting Applications

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Abstract

As LED systems have been evolving today in a great number of niche applications including automotive lighting, water purification, and skin imaging etc., extensive studies of scientists and engineers in the field have been constantly looking for ways to reduce generated heat loads and maximize the light output to reach the highest efficiency ratios. While the current systems developed over the last years achieved to reach even a 40% LED light efficiency, a higher portion of the electrical input energy of LEDs is still produced as heat and it hinders their development potential. In addition, the compact size of the LED systems poses some challenges to the reliable characterization of their performance at low uncertainties. Especially, the performance considerations associated with the thermal loads over a limited size of LED chips require the effective characterization of these systems for various operational conditions. One of the techniques used for this purpose is that an LED package is characterized by a decrease in forward voltage with increasing junction temperature. As LEDs are operated at higher junction temperatures, the amount and quality of the light deteriorates significantly, and the less efficient use of the LEDs results in additional operating costs and reduced lifetime of LEDs. In fact, accurate identification of thermal behavior of multichip LED light engines is one of the essential tasks towards improving the design of LED systems. If thermal characterization of LEDs is accurately done, performance parameters of each LED package is more reliably optimized to yield the highest possible performance ratios. Thus, this study introduces a novel, highly sensitive junction temperature measurement system for thermal characterization of LEDs. The proposed system is used for both single LED characterization as well as a multichip LED characterization. The results of white light LED engines are demonstrated over three different product lines and the measurement capability of the system is discussed.

Author's CV

Mete MUSLU, BSc

M. Muslu received the B.Sc. degree in mechanical engineering from Ozyegin University, Istanbul. He is currently pursuing his M.Sc. Degree in mechanical engineering in Ozyegin University. Mr. Muslu was a member of a competition team who received the "Best Commercial Potential Award" in developing a novel thermal connector design sponsored by U.S. Defense Advanced Research Projects Agency (DARPA) in 2015. From 2014 to present, he is a research assistant in EVATEG (Energy Efficient Lighting Technologies Research, Development, Education and Demonstration Center). His research interests include optoelectronics and thermal management of electronics.

Onuralp ISIL

Onuralp Isil was born in Istanbul (Turkey) in 1994. He completed his undergraduate education at Ozyegin University, Department of Mechanical Engineering (2017). He continued his graduate studies at Ozyegin University, Department of Mechanical Engineering. His current study field is in the alternative cooling, specifically cooling with synthetic jet actuators. Along with the Graduate Program working in heat transfer studies, he works at Rota Teknik, an engineering company in hydraulic, pneumatics and automation sector, as a mechanical design engineer and project manager.

Mehmet ARIK, Prof. Dr.

Dr. Arik received the B.Sc. degree in mechanical engineering from Istanbul Technical University, the MSc degree in mechanical engineering from University of Miami, and the PhD degree in mechanical engineering from the University of Minnesota in 2011. He has worked at the General Electric Global Research Center in Niskayuna, NY, on thermal management of electronics as a senior research scientist and program leader between 2000 and 2011. Dr. Arik is currently Professor of Mechanical Engineering at Ozyegin University. He is also the independent member of the board of directors at ASELSAN (Turkish Military Electronics Industry).

Organisation

Ozyegin University

The university was founded by the Hüsnü M. Özyeğin Foundation, and its establishment was approved by Foundation Act No. 5656, published in the Official Gazette No. 26526 on May 18, 2007.

Özyeğin University admitted its first class of students to the department of Business Administration and started its education in September, 2008.

According to the "Most Popular Universities" survey conducted by Bloomberg Business Week in 2014, Özyeğin ranked 3rd among foundation universities, following Sabancı and Koç universities, respectively. Özyeğin University was also placed 4th among all universities in the online survey conducted with 15.700 students from 89 universities between January and May 2014.

Özyeğin University ranked 6th among the Most Entrepreneurial and Innovative Universities of Turkey and rose in the ranking compared to 2013.

Automatized Lighting Audit: Development of a Robotic Illuminance Meter

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Abstract

Light and Colour Research Laboratory, University of Pannonia, Veszprem, Hungary The illumination measurement tasks of today didn't change compared to decades earlier. A well working illuminance meter developed in the last millennium can still be used and also according to the trend of recent years, more and more measuring devices do capture other measures (i.e. spectral power distribution, flicker) of the measured light. The illumination measurement task rarely occurs as a single point measurement, but rather the measurement of a whole grid has to be done and has to be logged in the same time. To achieve this in an automated way we've developed an illuminance meter robot which finds the given measurement positions both indoor and outdoor environments for itself. . In addition, a more difficult task arise when measuring the illumination not only in the horizontal plane, but with photometer in the vertical direction of the sensor of the measuring instrument perpendicularly in four or more directions like in pedestrian crossings or camera directional illuminance measurements in case of stadium installations. This can be done in our case by a two axis goniometer installed on the robot. By using today's technical capabilities it is possible to measure the illumination of a room or even a whole outdoor area in a fully automated way. Therefore, our aim was to develop a robotic illuminance meter that moves independently between two measurement points by positioning itself and arrives at the predetermined measurement spots to perform the required number of illuminance measurements with practically any photometer direction. In addition to the measurement results, it stores the position coordinates, the precise two-axis orientation of the photometer sensor, the inclination and geographical direction of the robot and the measurable environmental parameters. In the presentation the stages of the whole development process will be introduced, highlighting the specific goals and presenting the most interesting engineering challenges that have been arisen during the development.

Author's CV

Péter CSUTI, PhD

Dr. Péter Csuti is working as a research fellow at the Light and Colour Science Research Laboratory at University of Pannonia. He is dealing with the problems and solutions of photometry and colorimetry for more than 15 years. His field of expertise is goniophotometry, spectroradiometry and the questions of the colour perception of the human visual system especially when using LEDs as sources of light. He is member and secretary of the Hungarian National Committee of the CIE and member of the Lighting Society of Hungary.

Organisation

University of Pannonia

The University of Pannonia (University of Veszprém until March 1, 2006; Hungarian Pannon Egyetem, formerly known as Veszprémi Egyetem) is a university located in Veszprém, Hungary. It was founded in 1949 and is organized in five faculties: Arts and Humanities, Engineering, Agriculture, Economics and Information Technology. The university was founded in 1949. In the beginning it worked as a regional faculty of the Technical University of Budapest. In 1951, it became independent under the name of Veszprém University of Chemical Engineering. From 1991, the university has been called the University of Veszprém.

The university first offered courses in four areas of Chemical Technology: Oil and Coal Technology, Electrochemical Industry, Inorganic Chemical Technology, Silicate Chemistry. From the mid-1960s two courses — Nuclear Chemistry and Technology, Process Control and System Engineering — became part of the Chemical Engineering education in Veszprém. The changing and increasing requirements set for the graduates persuaded the university to continually reform and restructure its education activity. As a result, new courses were introduced: agrochemistry in 1970, Chemical Engineering Management in 1973, higher level foreign language teaching in 1983 and Instrumentation and Measurement Techniques in 1984.

The restructuring process accelerated in the past few years and this resulted in the renewal and expansion of the university's education profile. To respond to the society's growing demand for computer professionals, with the help of external financial support and the university's scientific expertise, the education infrastructure of the Information Technology and Automation courses has been created.

As a result of the increasing openness of Hungary, the need for teachers of foreign languages increased considerably. Having recognized this, the university introduced Teacher Training courses for teachers of English and then for teachers of German and French and the education of philologists in specialties: Hungarian language and literature, theatre sciences. etc. In the meantime, the education of Catholic theologists started in the form of a regional faculty of the Theologic College. Simultaneously, the Faculty of Teacher Training (now: Faculty of Arts) and the Faculty of Engineering were established and the name of the university was changed to University of Veszprém. The centre of scientific and cultural life, the University of Veszprém with the 200-year-old Georgikon Faculty of Agriculture turned into a three-faculty university on 1 January 2000. On 1 September 2003, two new faculties were created: the Faculty of Economics and the Faculty of Information Technology. Every year the University of Pannonia hosts national and international research conferences, which strengthen its international reputation. In the near future, the offer will include new faculties and new schools. The leaders of the institution strive to turn the university into the educational, intellectual, and research centre of the Transdanubian region and to help find its place in Europe.

Increase Product Quality with Reduced Effort: Best Practice in Photometric Measurement of LED Luminaires

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Abstract

Process efficiency plays a key role in the development of new LED luminaires as well as in production environments. Due to the vast amount of options the LED technology offers to designers, fast and accurate measurement of the photometric quantities is gaining more and more attention. A novel photometric measurement system using solar panels is breaking the ground in the manner on how we can measure key lighting parameters in one step.

Since the first announcement of this innovative technology the product portfolio has broadened. The number of applications we can address has thus increased and initial hurdles in accepting the system have been overcome by the lighting manufacturers. In the article, best practice - which paved the way for the establishment of this photometric praxis - will be shown by introducing several case studies. The comparison with some of the long recognized photometric methods is showing the maturity of the system and its usability.

Futhermore, the possibility of the system to be adequately integrated into automated production process and its future development challenges (e.g. further hybrid combination developments for the rising lighting applications) are defined and discussed.

Author's CV

Simon RANKEL, Dr.

Simon Rankel studied physics and holds a Ph.D. from the University of Ljubljana on the topic of LED and OLED lighting in urban lighting design. He has more than ten years of experience in the LED lighting industry. After his studies in Ljubljana and Stockholm he started his career as R&D engineer and lighting designer and has been since then involved in international lighting business. Today, his focus is on future-oriented technologies for the photometric measurement of SSL lighting. Simon is LED business development manager at laser and light measurement specialist company Ophir MKS Instruments.

Organisation

Ophir Spiricon Europe, MKS Instruments

Established in 1976, Ophir Optronics is a global leader in precision infrared optics, photonics instrumentation and 3D non-contact measurement equipment. The company develops, manufactures and markets top quality products that are based on the most advanced technologies and are renowned for their quality and reliability. Ophir Optronics is headquartered in Jerusalem, with affiliates in the US (Massachusetts and Utah) and Israel, and sales offices in the US, Japan and Europe, and is part of MKS Instruments.

MKS Instruments, Inc. is a global provider of instruments, subsystems and process control solutions that measure, monitor, deliver, analyze, power and control critical parameters of advanced manufacturing processes to improve process performance and productivity for our customers. Our products are derived from our core competencies in pressure measurement and control, flow measurement and control, gas and vapor delivery, gas composition analysis, residual gas analysis, leak detection, control technology, ozone generation and delivery, power, reactive gas generation, vacuum technology, lasers, photonics, sub-micron positioning, vibration control, optics and laser-based manufacturing solutions. We also provide services relating to the maintenance and repair of our products, installation services and training. Our primary served markets include semiconductor, industrial technologies, life and health sciences, research and defense.

New EU Energy Consumption Regulation and Their Impact on Testing

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Product Specialist
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Abstract

Beginning of 2019 the European database for ErP relevant products started and will be public available from April 2019 on. First we will have a look to this database and the responsibilities for suppliers and retailers. Then we will continue and analyse new regulations of the EU. Not only repairing is now a topic within new regulations in 2019, a few new regulations is set out and will change a lot in the market. We will show an overview of new regulations of the EU, e.g. with external power supplies and will then focus on the coming changes in the lighting sector. Most visible will be the change in the energy label design and also the changes of the energy classes, probably in Sept 2021. Also, there are new parameters to be shown (like R9) and computations of the energy efficiency index will change. We will focus not only on the new parameters to be measured but we will also show the challenges for manufacturers that are coming by switching the information and documentation requirements from Ecodesign regulation to Energy Label regulation. Additionally, we will finally show an automated way of getting the lifetime view for light sources at our lab in Garching.

Author's CV

Fabian FLIGGE, DI

2010-now: TÜV SÜD PRODUCT SERVICE GMBH; 2007-2010: DELO INDUSTRIEKLEBSTOFFE GMBH & CO KGAA; 2001-2007: Technische Universität München

Organisation

TÜV SÜD Product Service

Everyday around the world, customers come to TÜV SÜD with questions. "Can we make it better, more efficient, secure and sustainable? How do we strike the balance between quality, profitability and sustainability?"

Beyond solving problems, TÜV SÜD is dedicated to adding tangible economic value to our customers. Through our portfolio, we optimise our customers' operations, managing risks while enabling them to access global markets. We partner our customers with early consultation and continuous guidance to make sustainable progress a reality.

Headquartered in Munich, Germany and founded in 1866, TÜV SÜD is one of the world's leading technical service provider of testing and product

certification, inspection, auditing and system certification as well as training solutions.

Today, we are represented by about 24,000 employees across more than 1,000 locations, partnering clients wherever they are in the world. Our community of experts is passionate about technology and is inspired by the possibilities of your business. United by the belief that technology should better people's lives, we work alongside our customers to anticipate and capitalise on technological developments, enabling progress for businesses and the society.

Quality Engineering I–II

Analysis of Improved SAC+ Solders for CSP LEDs on Al-IMS

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Co-Author(s): Alexander Hanss

Abstract

Reliability remain a serious concern when soldering modern Chip Size Package LED (CSP-LEDs) on Al- IMS in especially for automotive applications. Due to the mismatch of the coefficient of thermal expansion between the Al metal core and the semiconductor materials used in most of the CSP packages (AlN, Al2O3, silicon and GaN) large cyclic thermomechanical stress is generated. This stress is causing cracks in the solder joint by thermomechanical fatigue which are the most common failure mode. This failure mode is reduced when using improved tin silver copper solders, so called SAC+ solders, for which the yield strength and the thermomechanical fatigue resistance of the solders are improved by additives. However, in dependence of the CSP design a second failure mode on the CSP package can be observed like delamination or cracks using those solders. In this paper standard ceramic based CSP and new CSP technologies were the LED chip is mounted directly onto the Al-IMS are investigated. The different CSP technologies are analyzed. The CSP are soldered on Al-IMS using different SAC+ solders from different suppliers. Hard and ductile SAC+ solders are selected. Also soft pure Indium solder and classic eutectic PbSn solder is used for benchmark. Temperature shock test are performed. The crack formation is observed by automatic transient thermal impedance measurements. As failure criterion on the one side a 20% increase of the thermal resistance of the LED in the module and on the other side the detection resolution of 0,1K/W of the transient impedance measurement of the LEDs was applied. It could be revealed that in dependence of the CSP design and the solder already a chip size package size of approx. 1mm x 1mm can be critical following the challenging test requirement for automotive AECQ101. Figure 1 Weibull plot of a 1mm x 1mm CSP on Al-IMS using different solders in a temperature shock test (-10°C / 125°C)

Author's CV

Gordon ELGER, Prof.

Professor at University of Applied Science Ingolstadt (Technische Hochschule Ingolstadt), Germany Gordon Elger is a research professor at the university of Applied Science in Ingolstadt for microelectronic packaging and manufacturing technologies. His research team is focusing on LED and high power electronic packaging for automotive application and development of measurement and test methods for reliability and quality insurance. In especially one focus is transient thermal testing and heat management. Gordon Elger made his PhD at the Free University of Berlin and worked afterwards at different companies and institutes in the field of optoelectronic, MEMS, HF and LED packaging (Royal Philips, Hymite GmbH, Fraunhofer IZM).

Organisation

Technische Hochschule Ingolstadt

Our institution is a dynamic and highly committed university of applied sciences. Since its foundation in 1994, THI offers a wide range of programs that prepare students to use scientific methods in their professional career. Excellent learning and working conditions create the necessary framework for a short period of study and a high level of success.

The impressive campus, completed in 1999, is defined by its glass architecture, large green spaces and the functionality of the buildings. The expansion of the campus was inaugurated in 2014 to provide more space for our increasing number of students. The first construction phase included two buildings for lecture and seminar rooms, laboratories and offices, as well as a spacious bistro-café.

Transient Infrared Thermography for Thermal Conduction Path Analysis of LED Modules

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Abstract

In the past years, LEDs have undergone a significant increase in performance and efficacy. Though modern white LEDs are highly efficient in generating illumination, a significant part of the electrical energy is converted to heat. A proper thermal management is thus one of the key issues. It is of great importance to consider the thermal losses in the design of cost efficient and durable luminaires, in particular in the dimensioning of appropriate heat sinks if necessary. (Note that the lamp housing often serves as a heat sink.) The thermal load is often a limiting factor in the performance of such a luminaire. As the LED manufacturer already optimizes the inner structure of the LEDs, the luminaire manufacturer is responsible for the choice of a suitable printed circuit board (PCB) as well as a proper thermal contact between all components.

A common way to qualify the thermal conduction path of LED modules is to measure the operational temperature of the LEDs at specific reference points. While thermocouples are widely used for this purpose, infrared thermography offers a contact-free and efficient method to obtain the required temperature information. In contrast to thermocouples, thermographic imaging allows to measure the temperature distribution over a relatively large area. Though the static thermographic images are used to detect hotspots and temperature gradients, they are less helpful for the analysis of the thermal conduction path between LED and the heat sink (or the lamp housing).

In this work, the potential of transient temperature measurements by infrared thermography is evaluated. For illustration, different sets of LED modules are investigated. The modules are operated on a temperature controlled heat sink. After the thermal equilibrium is reached, the power supply is switched off and the cooling curve is recorded by a high-speed thermography camera. Subsequently, these images are numerically analyzed to reveal the single components of the thermal conduction path. This technique allows the analysis of slight changes within the LED-solder-PCB stack. Hence, inhomogeneous or defective soldering that leads to insufficient thermal contact between the LED and the board can be identified.

Author's CV

Peter W. NOLTE, Dr.

Peter W. Nolte obtained his master of science in physics from the University of Paderborn, Germany, in 2007. Subsequently, he started to work in the field of photonic crystals and silicon photonics at the Martin Luther University of Halle-Wittenberg, Germany, where he defended his PhD thesis in 2015. In 2014, he moved to the Fraunhofer Application Center for Inorganic Phosphors in Soest, which is a branch lab of the Fraunhofer Institute for Microstructure of Materials and Systems IMWS in Halle (Saale). Here, he leads a research team working on the reliability of light emitting diodes and phosphors.

Organisation

Fraunhofer Application Center for Inorganic Phosphors

Light emitting diodes (LEDs) are the future of lighting technology. Modern high-power LEDs offer numerous advantages in terms of efficiency, compactness, lifetime and environmental protection as compared to conventional incandescent and energy-saving lamps. New challenges not only consist of improving the LED chips, but also in the phosphors and encapsulation materials. In addition to the efficiency of the LEDs and the phosphor, reliability and colour stability are also important aspects. The thermal management in LEDs and LED modules is of crucial importance. Rising demands in intelligent lighting systems, especially those which are particularly adapted to the respective needs of the user or application, are triggering great amount of interest in starting new research projects. In the field of phosphors, our range of services consists of the evaluation, design, and development of phosphors and phosphor systems with the aim of improving their efficiency, reliability, and colour stability. In order to do so, we apply comprehensive optical and spectroscopic analyses, thermal and microstructural characterizations at the Fraunhofer Application Center in Soest as well as investigations into the long-term stability of light-emitting diodes and lighting elements. The output of our research activities have led to phosphor-doped glasses and glass ceramics for lighting and lighting technology as well as medical diagnostics. Further research fields include the characterization of optics for light-emitting diodes as well as the microstructuring of optics and phosphors.

Range of services: The Fraunhofer Application Center in Soest provides tailor-made services as per customer requirements. The aim is to support the competitiveness and the future of the lighting and its associated industry as well as related areas. The optimization of materials, components, and systems are aimed to contribute to the success of the project partners. The focus remains the collaboration of both parties in the concept and applications.

Plasma-metalized Flexible PCBs for LEDs Applications

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Abstract

Lumitronix in collaboration with their high-technology oriented partners have successfully achieved the implementation of a serial production line of metalized flexible printed circuit boards (PCBs) for LEDs applications. The pioneer technique is based on the latest state of the art in the field of plasma metallization at atmospheric pressure. It required an adhesive layer on the substrate e.g. silver on the paper rolls, this fabrication step is optimized to achieve a very rapid rotation rate with the maintenance of a reliable coated layer. Such a method enables deposition of circuits on almost any flexible surface for a subsequent soldering of electronic components. Particularly, soldering the LEDs on flexible PCBs opens a wide range of promising applications at large scale of production. The challenges of the transformation of this architectural engineering process have been overcome in the Hechingen-based LED Company Lumitronix.

Over one decade of work on the research and development has been invested for achieving this unique technology by an Austrian company. The pioneering process was initially applied in the medical field. The implant parts or prostheses were coated with bone powder for predefined time according to the required thickness of the coated layer. This method is very beneficial in order to reduce the likelihood of the rejection of implants by the human body. This high technology was transferred to the electronics industry and was further developed with digital direct metallization.

In this distinguished type of metallization, a conductive metal (most common copper) in powder form is transported through high temperature plasma nozzle usually in the range of 10 000–50 000 °C. This temperature is sufficient to melt the metal and subsequently enables the deposition of conductive layer on almost any substrate. The temperature of the metal particles is reduced gradually in cascade steps to a suitable value before reaching the substrate. This metallization process makes the base material conductive. Furthermore, electronic surface mounted devices (SMD) will be soldered on the top layer of the flexible substrate.

The pioneer technique is very beneficial for assembling electronic SMD e.g. LEDs on the surface of variety of material. An example is an illuminated wallpaper, which are only one utilization of this innovative invention. Further possible application is the use of inexpensive plastic as a base material coated with a wafer-thin layer of aluminum. Large area for a certain application can be envisaged, such as metalized paper equipped with LEDs in order to produce huge backlit posters or banners for exhibition stands that can be conveniently removable and eventually reusable. Moreover, textiles can be provided with a conductive surface and then individually fitted with LEDs and other electronic components. The applications of such a high technology are quite distinctive and are almost inexhaustible. This paper will cover the latest results of the evaluation of the new LED products obtained by the new assembly line. Furthermore, the new features will be also investigated and covered in the final paper.

Author's CV

Yaser HAJ-HMEIDI, MSc

The passion for optoelectronic and electronic accompanied me throughout my carrier. I am always curious about electronic devices, and how they function. Therefore, I studied physic of semiconductor, and finished successfully my diploma in physic in 2006. Furthermore, I completed my master's degree in electrical engineering (micro and optoelectronic) in 2010, with special focus on the manufacturing processes of light emitting devices, complementary metal–oxide–semiconductor devices and micro-electro-mechanical systems. I had also the privilege to do research on nanotechnology for optoelectronic applications, and some of the obtained results are already published. Currently I continue my research activity at LUMITRONIX® LED-Technik GmbH in the development and research department.

Organisation

LUMITRONIX©

LUMITRONIX is the specialist for LED light solutions. We were a part of the early success of LEDs and have extensive application knowledge from a wide range of sectors. As a competent partner of LED technology, LUMITRONIX became the official distributor of Japanese world LED market leader Nichia for Germany and since 2016 for all of Europe. As a result, LUMITRONIX has one the widest available LED assortments among all leading manufacturers for your special light solution. Since 2010, LUMITRONIX has produced LED modules developed in-house in a state-of-the-art production facility. These modules have been used successfully in a wide range of application and developed specifically to meet customer specifications. Regardless of which light solution you have your eye on – we implement your requirements in high-efficiency LED light solutions with our extensive expertise and assist every step of the way from the initial planning to the serial production.

An Evaluation Guide for Blue Light Hazard

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Abstract

The rapidly growing significance of modern solid state lighting (SSL) technology in our daily working and living environment raises important safety issues, such as the photobiological safety and the blue light hazard (BLH) in particular. The original International Standard IEC 62471 was prepared as a Standard CIE S 009 and gives guidance for evaluating the photobiological safety of lamps and lamp systems including luminaires. It assigns high demands to measurement equipment and procedures to ensure a reliable evaluation of photobiological hazards and in particular the assessment of the BLH risk classes of light sources. Blue light can cause photochemical damages of the retina and possibly leads to a degeneration of the macula. The corresponding weighting function covers the wavelength region between 300 nm and 700 nm and has its maximum around 435–440 nm. Considering the distinctive blue peak of white LEDs, the question of the hazardousness of SSL sources arises. Depending on the radiance levels, the BLH sensitivity, and the exposure times the IEC 62471 assigns light sources to four risk groups from 0 (exempt) to 3 (high risk).

Additionally, the IEC Technical Report 62778 explains how to apply the IEC 62741 for simple assessment of the BLH of lamps and luminaires with visible radiation. However, this has not yet become a standard. Currently, worldwide efforts are underway to elevate this report to a new standard and add more detailed measurement procedures for BLH assessment that are accessible to a broader community.

A correct risk assessment is a challenging task for the experimenter as one has to decide on the suitable test equipment. Today, the measurement instrument of choice is often an array spectrometer instead of the hard-to-handle double monochromator suggested by the standard IEC 62471. But even high-end array spectrometers must have advanced stray light correction methods to achieve the required high dynamic measuring range especially in the less sensitive blue region.

Two main measurement procedures for BLH assessment were proposed in the IEC 62471, the direct spectral radiance measurement with an optical system and an alternative method as an irradiance measurement performed with a well-defined field of view. Here, the measured irradiance value is divided by the measurement field of view to obtain the final radiance value. The direct spectral radiance measurement has been realized with a telescopic optic in combination with an array spectrometer calibrated on spectral radiance. Our alternative method consists of a stray light corrected array spectrometer with an integrating sphere calibrated on irradiance and a tube which contains apertures necessary for the calculation of radiance.

Both procedures have been realized, the measurements on several samples have been (and will be) performed, and the risk groups assigned and discussed. Additionally, some considerations about the risk group classification based on CCT (correlated color temperature) and luminance of the source, as proposed in TR 62778 and further developed in the emerging Standard, will be discussed.

Author's CV

Denan KONJHODZIC, Dr.

Biography:

- Born in 1976 in Mostar, Bosnia and Herzegovina
- 1997–2003: physics studies in Duisburg, Germany
- 2003–2007: PhD thesis in the department "Optical Materials and Nanostructures" at the Max Planck Institute in Mülheim an der Ruhr, Germany
- 2007: doctoral examination at the Free University Berlin
- Since 2008: applications engineer at Instrument Systems GmbH, Munich
- Currently: product manager at Instrument Systems GmbH, Munich

Main topics:

- LED and SSL (solid state lighting) metrology
- Product management for calibrations in photometry
- Participation in the standardization bodies of CIE, DKE and DIN

Organisation

Instrument Systems

Founded by Richard Distl in Munich in 1986, Instrument Systems is today one of the world's leading manufacturers of high-precision array spectrometers as well as complex light measurement systems. Our name stands for premium class, innovative products and outstanding expert knowledge in optical measurement technology. Specialized sales engineers can be relied on to provide a solution for even the most demanding measurement tasks, exactly tailored to the needs of our customers.

For many years Instruments Systems has been establishing global standards for spectroradiometric measurement in the LED industry. It is involved in standardization committees and associations such as DIN and CIE, and cooperates with the leading metrological institutes. Virtually all renowned companies in the automotive and aviation industry place their trust in our measurement systems for the qualification of lighting components and displays in the vehicle interior or cockpit. We place the focus of our product development on the use of our systems not only in lab but also in fast production tests.

More than 80% of our sales revenue is generated abroad. Since 2012 we have been a member of the Konica Minolta group and benefit from an international network, supplemented by our experienced representatives. As a continuously growing, medium-sized technology company we stand for customer proximity and the highest level of reliability in product quality, service and support.

Enhanced LED Lighting Modules Protection with New Silicone Encapsulant

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DOW SILICONES
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Abstract

LED luminaries in harsh environments need protective materials that are reliable, easy to apply, and that provide robustness of cure. Professional luminaires makers were constantly looking for solutions that help to eliminate time-consuming processing steps and reduce waste that can occur if curing is compromised by surface contaminants or moisture.

In response to those needs, DOWSIL™ EI-2888 Primerless Silicone Encapsulant, an optically-clear silicone for professional LED lighting that cures at room temperature, has been launched in 2019. This advanced silicone technology provides superb optical performance without compromise and offers unique rheological properties for use with lighting fixtures in a variety of shapes and forms. Designed for explosion proof and high ingress protection rated luminaries, this encapsulant is a patented composition that does not contain platinum– unlike other silicone solutions currently available on the market. The low-viscosity silicone also dispenses readily and adheres reliably on a large range of substrates without sacrificing optical properties. This novel silicone technology is an excellent choice for many professional applications, including explosion proof lighting, outdoor displays, and flexible and rigid LED strips.

This two-part protective material with a 1:1 mix ratio cures at room temperature with optional heat acceleration. This UL 94 compliant, 100% polydimethylsiloxane (PDMS) silicone provides even curing and is less sensitive to inhibition, a typical issue for platinum catalysts; and material reversion, a traditional problem in enclosed spaces at high temperatures. Furthermore, this material keeps his high reliability against heat and sunlight UV exposition where typical organic encapsulant could show high degree of degradation. DOWSIL™ EI-2888 Primerless Silicone Encapsulant can be applied with automated static or dynamic metered mixing, manual mixing, or with flow, pour or needle dispensing equipment.

Author's CV

Thierry COOREMANS, MSc

Thierry Cooremans received his MSc in Industrial Chemistry Engineering from University of Charleroi, Belgium (2015). He joined Dow Corning Europe in 2011 and worked on various silicone based materials development and applications, such as, e.g., silicone sealant & adhesives, Photovoltaïc applications before joining the Dow Silicones Belgium Advanced Assembly Solution TS&D team back in 2013, helping lighting and optical companies using silicone in their LED lamps and luminaires designs, with products such as, e.g., optical moldable silicones, thermal interface materials,

encapsulants, adhesives and coatings for lighting fixtures protection and assembly.

Organisation

DOW SILICONES

For more than 120 years, Dow has strived to create value through its diversified, market-driven portfolio of specialty chemicals, advanced materials, agrosciences and plastics businesses. Dow is committed to advancing science and innovation in response to the world's most pressing challenges – enhancing the quality of life for current and future generations, while creating long-term sustainable value for the Company, its customers and its shareholders. Dow delivers differentiated solutions that address these challenges and unmet market needs by leveraging cost advantage, scale and geographic presence, customer collaboration and industry-leading R&D expertise.

Predicaments & Strategies in the Development of Intelligent Lighting

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Abstract

With the advancement of science and technology, the quality of human life has increased. The demand for intelligent lighting has become ever more urgent. It has the characteristics of low power consumption, flexible use, convenient operation and easy to personalize, and has great potential for development. However, intelligent lighting technology is still in the early stage, and there are some problems in its development.

1. Poor interoperability: interoperability is the basis of intelligent lighting. However, information produced from various devices have difficulty in sharing with each other, and interoperability standards of various industries are not uniform, which makes interoperability difficult and cannot fully utilize the advantages of intelligent lighting.

2. There is no unified interface standard: the physical interface and software interface of smart products made by various manufacturers are not unified, limiting intelligent lighting technology from been mass adopted;

3. Product's functions are not tailored to actual requirements: At present, there are various kinds of intelligent lighting products, with huge variety of functions, but whether it satisfy the needs of consumers is debatable;

4. Investment can not produce profit as it should have: While the investment in R&D, production, sales and maintenance of intelligent lighting is relatively large, profits are getting smaller. Huge investment struggles to obtain profit it deserves;

5. Lack of quality assurance: intelligent lighting brings users better experience, it require more advanced technology to provide this effect. However, intelligent lighting technology is still in its early stage, quality usually can not be guaranteed.

Measures: 1. Cross-industry cooperation is the trend, breaking the industry barriers and establishing unified interoperability standards are the right way forward; 2. Compile unified production standards and enhance the interchangeability of intelligent lighting parts; 3. Strengthen the application oriented mindset, providing users with the products they needs; 4. Reasonably plan products range to increase the proportion of service in total revenue; 5. Increasing technology investment is vital in guaranteeing good quality.

Author's CV

Sandy ZHONG, MSc

1. Studied in Nanchang University from 2005 to 2009. Full-time undergraduate. Majored in electronic information engineering. Won several scholarships during that period.

2. Studied in Nanchang Hangkong University from 2009-2012. Master's degree. Majored in testing and automation equipment. Research direction: uninterruptible power supply control algorithm. Published the paper Research on UPS inverter based on repeated control and deadbeat control. The model was established by matlab-simulink and M file, preliminarily verifying hardware parameters and algorithms. Built a UPS of 1KW output power with the TMS320F2812 of TI company. Tested and verified the feasibility, superiority and rationality of the algorithm. Participated in several national fund projects during the period.

3. Worked in the Advanced Research Department of MORNSUN in Guangzhou from 2012 to 2013. Cooperated with Zhejiang University to study and research on synchronous rectification and isolated drive during the period. Applied for and later obtained a patent for invention.

4. Have been working for Lifud Technology Co., Ltd. since 2013. In charge of developing high power LED driver for street lighting from 2013 to 2015. Have become chief engineer since 2017 for researching and product upgrading. Applied for and later obtained 6 patents for invention.

Organisation

Lifud Technology

Established in 2007, Lifud, as a global registered brand, has been working on building a century-old brand so that users around the world can always get LED lighting products of reliable quality and enjoy timely service. Sticking to business spirits of Integrity, Responsibility, Dedication, Lifud has earned faithful trust and continuous support from our clients and end users at home and abroad. In order to offer more timely support to oversea clients and end users, Lifud has established subsidiary companies in CA, USA in January 2018 and Düsseldorf, Germany in December 2018. Besides, our increasing overseas distributors also make Lifud have better global presence.

In Shenzhen headquarters, Lifud has an authorized UL WTDP laboratory, and in Sichuan Province, we have a factory covering 40,000 m2, with ISO9001: 2015 certificate. Positioning as a global brand "Leading the LED Drivers' Standard", Lifud keeps developing and upgrading more products to meet various demands and even exceed their expectation. We have been specialized in developing constant current LED drivers but now we will start extending our product lines to more constant voltage LED drivers as well as some industrial-application LED drivers.

We dedicate ourselves to technology innovation, shouldering the mission of improving human beings' living environment. Our vision is to make the utilization of energy resources more efficient and cleaner.

Light in Applications I–II

Are UV LEDs a Credible Alternative for Disinfection?

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Abstract

Millions of people do not have access to drinkable water. Hospital-acquired infection, also known as a nosocomial infection, is a growing concern while bacteria develop antibiotic resistance. The germicidal properties of UV light have been known and used for decades however traditional UV lamps have limitations. How can the rapidly developing UV LED technology become a credible alternative? Can we apply the lessons learnt from the LED adoption by the lighting industry?

Author's CV

François MIRAND

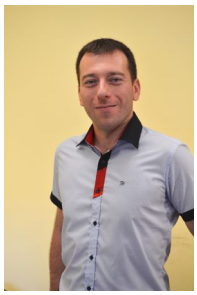
Coming from the "dark side" of electronics, François Mirand has been involved in supporting the first adopters of LUXEON High Power LED technology in the early 2000's. He participated in the foundation of Future Lighting Solutions and in the development of its unique solid state lighting expertise, advanced design tools and one stop shop offering of SSL system solutions.

Organisation

Future Electronics

Future Electronics Inc. is a distributor of electronic and electro-mechanical components headquartered in Pointe-Claire, Quebec. Founded in 1968 by Canadian Entrepreneur Robert Miller, the company is one of Quebec's largest privately owned companies and is currently the fourth largest electronics distributor in the world. It operates in 169 locations in 44 countries Worldwide. Since 15 years Future Lighting Solutions is the dedicated lighting business unit delivering solutions enabling customers and suppliers to generate new revenue out of photons. FLS leverages Future Electronics' broader set of innovative products and advanced services to unlock the growth potential of the lighting customers' footprint.

Real Environment Research Laboratory with Light Pollution Optimized Street Light Luminaires



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Co-Author(s): Péter Csuti, Zoltán Kolláth

Abstract

1. Motivation, specific objective

Light pollution is a growing problem for the natural environment, but also for human health. More and more international surveys show that blue radiation content of certain (mostly cool white) LED lighting increases the risk of some illness compared to earlier orange-yellow sodium lamps. This is one of the reasons why some of today's laptops and mobile phones are already set to decrease CCT (and blue content of the radiation) after sunset. Lighting trends of the last decade have been favoured by LED technology based on phosphor converting technology, which means significant emission in the 430 nm – 480 nm wavelength range, where ipRGCs are most sensitive. As a consequence of Rayleigh scattering, short wavelength photons are the most efficiently scattering photons, 9.4 times more efficient as scattering of 700 nm photons. As an experience of LED public lighting projects of the last decade, public lighting strategy is moving nowadays to warm white LEDs and Amber LED based solutions.

2. Methods

As a strong cooperation of astronomy, photometric laboratory and luminaire manufacturer, a real environment research laboratory has been realized at two venues in Hungary, by total reconstruction of the whole public lighting system of Répáshuta and Bárdudvarnok villages in Hungary. Two aspects were considered during the design: Recent research has shown that cool white light is harmful to the environment and to the human health and species of fauna and flora. Therefore, in designing the new public lighting, the primary consideration was to emit only warm white light with minimal blue radiation. In addition, on the side streets after 10 pm, the lights of the public lighting are weakened (according to the reduced traffic) and then only the biologically optimum amber yellow light illuminates. This capability is realized by specially developed spectrally tuneable LED public lighting luminaires. Further innovative content of the system is that the different LED channels have different lens optics as well. Thanks to that, spatial distribution of light output can be optimized as well for different needs of public lighting at night hours. An innovative control system translates the given schemes into LED current values at the luminaires. This solution is a novelty in the world as well. Another aspect was to totally exclude any light output at 90° and above (ULOR=0). This also helps to improve and maintain the status of the sky in two

Starry Sky Parks in Central Europe affected by settlements and gives a liveable environment for village residents at the same time.

3. Results

Development of luminaires has been a multiple step process with continuous laboratory control and feedback. Market survey revealed the most suitable LEDs to be applied in the luminaires. Photometric and electrical parameters of prototype luminaires have been tested. In order to compare the before-after state, illuminance measurements on the roads and sky luminance measurements had been done. After the installation of the developed luminaires, a public survey has been started and opinions of residents have been collected at both venues.

4. Conclusions

One of the most important conclusions, that it is possible to create minimal light pollution public lighting compared to traditional high pressure sodium public lighting installations, which provides safe and liveable environment of residents at the same time. These two real environment laboratories will host more scientific investigations in the future. With the improvement of phosphor amber LED technology, further advantages on energy efficiency can be reached.

Author's CV

Ferenc SZABÓ, PhD

In preparation.

Organisation

LightingLab Calibration Laboratory

The University of Pannonia (University of Veszprém until March 1, 2006; Hungarian Pannon Egyetem, formerly known as Veszprémi Egyetem) is a university located in Veszprém, Hungary. It was founded in 1949 and is organized in five faculties: Arts and Humanities, Engineering, Agriculture, Economics and Information Technology. The university was founded in 1949. In the beginning it worked as a regional faculty of the Technical University of Budapest. In 1951, it became independent under the name of Veszprém University of Chemical Engineering. From 1991, the university has been called the University of Veszprém.

The university first offered courses in four areas of Chemical Technology: Oil and Coal Technology, Electrochemical Industry, Inorganic Chemical Technology, Silicate Chemistry. From the mid-1960s two courses — Nuclear Chemistry and Technology, Process Control and System Engineering — became part of the Chemical Engineering education in Veszprém. The changing and increasing requirements set for the graduates persuaded the university to continually reform and restructure its education activity. As a result, new courses were introduced: agrochemistry in 1970, Chemical Engineering Management in 1973, higher level foreign language teaching in 1983 and Instrumentation and Measurement Techniques in 1984.

The restructuring process accelerated in the past few years and this resulted in the renewal and expansion of the university's education profile. To respond to the society's growing demand for computer professionals, with the help of external financial support and the university's scientific expertise, the education infrastructure of the Information Technology and Automation courses has been created.

As a result of the increasing openness of Hungary, the need for teachers of foreign languages increased considerably. Having recognized this, the university introduced Teacher Training courses for teachers of English and then for teachers of German and French and the education of philologists in specialties: Hungarian language and literature, theatre sciences. etc. In the meantime, the education of Catholic theologists started in the form of a regional faculty of the Theologic College. Simultaneously, the

Faculty of Teacher Training (now: Faculty of Arts) and the Faculty of Engineering were established and the name of the university was changed to University of Veszprém. The centre of scientific and cultural life, the University of Veszprém with the 200-year-old Georgikon Faculty of Agriculture turned into a three-faculty university on 1 January 2000. On 1 September 2003, two new faculties were created: the Faculty of Economics and the Faculty of Information Technology. Every year the University of Pannonia hosts national and international research conferences, which strengthen its international reputation. In the near future, the offer will include new faculties and new schools. The leaders of the institution strive to turn the university into the educational, intellectual, and research centre of the Transdanubian region and to help find its place in Europe.

Aspects of Different LED Spectra for Street Lighting

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Abstract

In the last years the increase of efficacy and robustness in LED technology has enabled the penetration of LEDs in street lighting. The new LED street lights could be noticed visually due to the different light color which they emit. In contrast to the widely spread sodium discharge lamps, which give an orange – yellowish light, the LED streetlights were designed typically with a color temperature of 4000K and a CRI of 70. However LED technology offers the possibility to adjust the spectra of LEDs and thus to provide a variety of color temperatures, color points and CRIs due to the method of light generation. The light of white LEDs is generated by mixing the blue light of the LED chip and the yellow light of the converter, which covers the chip. In this way even "saturated" colors like yellow or red can be generated. In addition there is the possibility to generate narrow spectrum saturated colors simply by using a different chip technology, which emits the yellow or red light directly without any converter. Currently there is a trend towards LED streetlights with warmer CCTs, which even could go down to a color temperature of 2200K. Especially in residential or urban areas there is a demand for warmer and cozier light. This trend is supported by other factors, like the requirement to minimize light pollution or the need to provide light which has less effect on animals or does not attract insects. Using the right combination of the wavelength of the LED chip and the material mixture of the converter, the various demands for different CCTs can be fulfilled. In this paper various LED spectra will be introduced and the impact on LED efficacy will be shown.

Lessons Learned: - Insights in LED Chip and conversion technology - Comparison of different LED spectra for street lighting - Impact of warmer CCTs on LED efficacy - Optional: Demonstrator to visualize the appearance of different spectra.

Author's CV

Markus HOFMANN, DI

Markus Hofmann is Senior Key Expert for System design in the GL application engineering department at OSRAM Opto Semiconductors in Regensburg. After graduating from the University of Applied Sciences in Regensburg with a diploma in Electrical Engineering, he joined OSRAM Opto Semiconductors in 2000. At this time he worked on LED technology and applications for automotive interior and exterior lighting. In 2008 he started to work for OSRAM GmbH as a technical project leader for LED retrofit lamps. Since 2015 he is at OSRAM Opto Semiconductors and works as Application Engineer for general lighting LEDs.

Organisation

OSRAM Opto Semiconductors

Osram Opto Semiconductors is one of the guiding lights both in technological development and in the manufacture of high-quality products. For nearly four decades, the high-tech company has been investing in research and developing new products on the technological cutting edge - enabling Osram Opto Semiconductors to set international standards in the fields of illumination, visualization and sensor technology. The expertise of Osram Opto Semiconductors extends from basic semiconductor technologies to individual customer applications. The company produces top-quality solutions in various fields such as sensor technology and laser systems. The product portfolio comprises high-performance light-emitting diodes (LEDs) – e.g. for automotive and general lighting applications – miniature LEDs for mobile devices, as well as infrared diodes (IRED), semiconductor lasers and detectors. The global player accords top priority to offering its customers professional and comprehensive support based on many years of well-founded expertise. With a focus on promoting future development, the company has been involved in high-caliber technology partnerships for many years, collaborating closely with partners from the commercial sector as well as with universities and colleges. Additionally, the high priority attached to ongoing internal development has spawned many innovations and optimized the product portfolio. All this makes Osram Opto Semiconductors one of the key players in the global opto-electronic semiconductor market today.

How to Reduce Jetlag by Innovative Cabin Lighting

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jetlite
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Abstract

First study: The purpose of this paper is to examine how chronobiologically effective cabin lighting increases comfort and well-being for passengers on long-haul flights. The experience of comfort and positive emotions during a long-haul flight depends on many factors. In addition to seats, cabin climate, vibrations, turbulences and external influences on the flight, light in the aircraft cabin plays another important role. Chronobiologically improved cabin lighting concepts by new LED-luminaires may enhance passenger-comfort on long-haul flights by increasing in-flight relaxation and activation levels at the destination. The conducted experimental study compares conventional cabin lighting with new modified LED-technology. In the context of six simulated long-haul flights (within-subject-design; 21:00 - 07:00 h; n = 32) comfort and emotions are measured by saliva-melatonin, ECG and self-reports. The results show higher comfort and positive valence in the warm white LED condition and the circadian effectiveness of blue light within a daily routine building the foundation for future related studies on behalf of preventive Jetlag-reduction.

Second study: In order to prove the effect of chronobiologically improved cabin lighting in real-life environment, a second study has been carried out together with Lufthansa, the institute of experimental psychophysiology and the Ludwig Maximilian University of Munich. The aim of the study was to analyse the relationship between chronobiologically modified cabin lighting and indicators of well-being and jetlag symptoms on board long-haul flights. For this purpose, 77 business class passengers were accompanied on various Airbus A350 flights from Boston to Munich. Subjective and objective indicators of emotional, cognitive and sleep-related symptoms were collected during the flight and in a four-day follow-up survey. Based on the extensive research literature and the previously conducted study, it was expected that adapted lighting scenarios could contribute to an improvement of well-being and a reduction of jetlag symptoms. The results of the subjective and objective indicators recorded correspond to the anticipated changes. In summary, the findings obtained here support the initial hypothesis of the effectiveness and acceptance of chronobiologically adapted cabin lighting.

Author's CV

Achim LEDER, Dr.

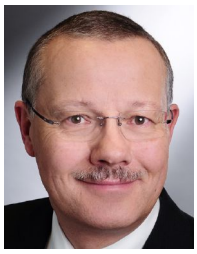
Achim Leder is founder and CEO of jetlite. Leder studied Economics & Management at Free University of Bolzano. After his graduation he completed his studies with a Master in Business & Engineering at Steinbeis University Berlin. Since then Leder worked in the aviation sector in different positions at EADS/Eurojet and Dortmund Airport. From 2011-2014 Leder studied for his PhD the effects of cabin lighting on passengers. Based on his PhD-Thesis and diverse surveys from all over the world, Leder defined the jetlite-algorithm that regulates the light on board in respect to different flight parameters to reduce the effects of jetlag.

Organisation

jetlite

More than 60% of all passengers on long haul flights suffer from jetlag. This is not only a problem for passengers themselves but also causes billions of dollars losses for economy. Besides, airlines aim for differentiation and perfectly satisfied guests. jetlite's mission is to reduce jetlag, increase passenger-comfort and satisfy airlines & aerospace needs regarding the needed knowledge of the real impact of lighting and food over the whole passenger journey. jetlite offers a holistic algorithm-based approach to increase the comfort of passengers (pre-, in-, and post-flight) by reducing jetlag on long-distance flights. jetlite mainly focusses on (1) chronobiologically improved lighting for aircraft, airports and even personalized for passengers before and after the flight, (2) customized nutrition concepts for airline-catering and airport-services, as well as (3) personalized suggestions for passengers via an app regarding sleep-, light- and nutrition-impact, which together form the backbone of this scientifically proven solution. jetlite can increase the comfort and satisfaction of passengers while reducing fuel consumption and the workload for the crew on board.

UL 8800 Update and New Performance Label for Horticultural Lighting



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Abstract

In 2017, according to a market study provided by CSIL the Centre for Industrial Studies, the European Market for horticultural lighting jumped to 350 million Euro and worldwide to about 850 – 900 million Euro. The main segment is represented by commercial greenhouses (around 50%); a bit smaller the segment of indoor and vertical farming (around 45%) and a minor but significative slice is hold by R&D/universities. Horticultural lighting is one of the fastest growing segments in the lighting market. UL already helps manufacturers bring horticultural lighting equipment to the market while ensuring the highest levels of safety by certifying products and writing standards the industry has come to trust.

About UL 8800: Unlike UL 1598, Standard for Safety of Luminaires, UL 8800, Outline of Investigation for Horticultural Lighting Equipment, is intended to address the unique safety issues applicable to horticultural luminaires, lighting components and grow systems, and represents the first set of standardized requirements specifically designed for horticultural lighting equipment. As a result, UL is currently using the requirements of UL 8800 to evaluate horticultural lighting equipment from manufacturers seeking the UL safety mark for their equipment and devices. Introduced in 2017, UL 8800 provides a published set of safety for lighting equipment and grow systems intended for use in a horticultural environment, and installed in accordance with the National Electrical Code. Lighting equipment covered under the scope of this Outline of Investigation include luminaires and, when a horticultural system is employed, can also include an assessment of lampholders, wire harnesses, plugs and connectors, light-emitting diode (LED) packages, ballasts/LED drivers, lamps, and hardware and structures (also known as systems) specifically designed or intended for use in optimizing plant growth. In March/April 2019 the final version of this standard will be published and the presentation will refer to it. In November 2018 UL introduce a new label available to horticultural luminaire manufacturers as part of the UL Horticultural Performance Report. Manufacturers can now use this special label to provide independent, third-party confirmation of their luminaire performance and help differentiate their products from the competition. This new UL Label offers a quick and easy way for buyers and consumers to understand the vital plant-growth-based performance aspects of a horticultural luminaire and is an exciting way for manufacturers to demonstrate performance.

Author's CV

Hans LASCHEFSKI, Dr.

06/2018 - UL International Germany GmbH EU Lighting Business Development Manager

12/2010 – 05/2018 Alanod GmbH & Co. KG Business Development Manager

2010 Schnick-Schnack-Systems GmbH, DMX controlled LED Stage lighting Member of the Management Board

04/1994 - 12/2009 Oktalite Lichttechnik GmbH, Trilux Group Retail lighting

since 01/1995 Member of the leading committee „Lichttechnischen Gesellschaft (LiTG)", section "Rheinland", Leader of the "interior lighting" team, Head of the Support Center Gummersbach

Organisation

UL

As a global company with more than 120 years of expertise, UL works with customers and stakeholders to help them navigate market complexity. UL brings clarity and empowers trust to support the responsible development, production, marketing and purchase of the goods, solutions, and innovations of today and tomorrow. We connect people to safer, more secure, more sustainable products, services, experiences and environments – enabling smarter choices and better lives.

CHAPTER B

TiL LECTURES – LIGHTING DESIGN

How Smart and Intelligent Can Lighting Be?

Innovative PC-App Optionally Combined with Camera for Adjusting the Perfect Light Colour Fully Automatic

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Head of Technical Sales
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Abstract

The intelligent PC-APP myPI-LED combines luminaires using PI-LED technology with cameras and / or sensors and thus enables a lighting system that can respond quickly and personalized to a variety of requirements. Fully automatic or interactive - myPI-LED supports users intuitively and ensures optimal lighting conditions. The award-winning and patented PI-LED technology combines white light and RGB colors in a single light source and stays for the highest level of human centric lighting since over 10 years. With myPI-LED LUMITECH wants to make the access to professional lighting solutions easier for everyone. The functionality is very easy: the product or the room is photographed, a dot or area is marked in the photo and myPI-LED sets the optimal lighting conditions with the ideal white light for exactly this situation (RGB is also possible, if needed) – fully automatic and comfortable. MyPI-LED is an enormous advantage, especially for shop applications: Each product is set in perfect lighting at all times and impresses with its colors, material and haptics.

Control device for NeoLink Air luminaires

- Easy initial operation/installation of the NeoLink Air USB Stick on every Windows PC
- Communication between NeoLink Air USB Stick and luminaires via NeoLink Air (radio technology based on ZigBee)
- Automatic NeoLink Air network configuration (automatic registration of NeoLink Air luminaires in the network)
- NeoLink Air network reset via "myPI-LED" software (automatic de-registration of NeoLink Air luminaires from the network)
- Configuration of luminaire groups, brightness- and colour control of the groups via "myPI-LED" software
- Programming and calling various mood lights, daylight sequences and dynamic sequences via "myPI-LED"
- Integration of up to thirty WALLY in the NeoLink Air network of the Stick

Author's CV

Peter HAUMER, Dipl.-HTL-Ing.

Education 1983-1985: Electrical engineering, TU Vienna; 1996: Diploma examination (Electronics); 1998: Entrepreneur Examination; 2007: Diplom-HTL-Ingenieur (diploma thesis: electrically conductive plastics); 2009: Contribution to European Patent EP 2 088 369 A1 (Beleuchtungskörper).

Several speeches & lectures (e.g. Swiss Lighting Forum, LICHT2018 Davos).

At Lumitech since October, 2012 as Business Development Manager, since November 2017 as Head of Technical Sales.

Organisation

LUMITECH

This has been LUMITECH's commitment ever since its founding in 1997. Acknowledged as experts in the LED lighting field, we support, first and foremost, companies in the lighting and food industries, but we are also a partner of choice for highly-specialized special LED solutions in other application fields.

LUMITECH has extensive expertise in the field of LED technology right down the value-adding chain and was awarded the Austrian State Prize for Innovation in 2007 for its development of PI LED technology.

Our core competencies lie in a perfectly coordinated combination of various special fields of technology, such as electronics, semiconductors, lighting engineering, software and metrology, and in the ability to provide solutions to our customers' needs and demands and implement these in attractive and long-lasting lighting systems. The high quality of our colour rendering and the adjustability of colour temperature set industry benchmarks worldwide.

LUMITECH's headquarters have been located in Jennersdorf, Austria since the company was founded in 1997. We also have an office in Vienna. The company is owned by LUMITECH Holding and the Burgenland Athena/BRB Fond.

LUMITECH is certified according to ISO 9001:2008.

Smart Lights with Machine Learning for Truly Smart Living

Harry EDELMAN, Dr. Arch.
Co-Founder, Design and Business Development
AIDOMUS
AIDOMUS c/o Tampereen yliopisto, Harry Edelman
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Abstract

AIDOMUS is an integrated internet of things (IoT) smart lighting fixture for delivering various living services. The technology of AIDOMUS enables services, for example, automated heating and cooling control, safety and well-being, and supervision of in-home deliveries to empty apartments while residents are away. Integration of machine learning capability to the lighting opens up an opportunity to deliver smart interior design solutions through lighting without introducing additional smart devices, or extra eye-sore sensor fixtures to the surfaces of architectural spaces. The technology can be adopted to a variety of lighting designs. AIDOMUS is the first easy-to-use and "interfaceless" approach to manage living services in all kinds of apartments based on the demand, behavioural data, and real-time occupancy information. The current smart home solutions suffer from complicated user-interfaces that call for active attention from the users. Instead, a solution based on a lightning fixture offers a natural point of connection for intelligent services making everyday life easier, safer, cost-efficient, and mitigating the climate change. The machine learning system of AIDOMUS enables the prediction of occupancy and the use of space through non-intrusive sensor data. AIDOMUS connects the physical space and the use information of a space for enabling the services, such as controlling the indoor air conditions, or other services benefiting from the sensor based behaviour information in the spatial context. Currently, the system is under prototyping and commercialisation. The accuracy of the temporal behaviour detection in spatial context (entries and exists to a particular space) is over 90The system will be piloted in a residential development in Finland in the city of Tampere in 2019, by a rental housing company VTS with a total stock of over 9,000 apartments. As an example of the skills, the pilot will focus initially on energy management: setting the temperatures based on the occupancy (lowered temperatures) and desired predefined profiles that for example lower the night time temperature. Further skills of the system will be investigated, such as supervising trusted in-home deliveries, such as groceries, with the sensor data. The solution will solve the so called "Last Mile" problem in e-commerce logistics. Further, the AIDOMUS aims at providing hardware for security and health related services.

Author's CV

Harry EDELMAN, Dr. Arch.

Harry Edelman is Co-Founder (Design and Business Development) at AIDOMUS, a start-up for architecture, automation and artificial intelligence for doing good for people and the Planet. Smart lighting lies at the core of AIDOMUS solutions for truly easy-to-use smart living solutions. Dr. Edelman is an enthusiast and a tenacious doer in strategic design, innovations, and design on sustainable built environment, city development, and new business development. He conducted his doctoral research at the Massachusetts Institute of Technology, and has served as the Professor of Sustainable Design and Development at the University of Tampere in addition to kick-starting his first company.

Organisation

AIDOMUS

AIDOMUS was born out of academic research and multidisciplinary design studios. In 2014 professors and senior researchers from the fields of architecture, automation, and artificial intelligence initiated a data-driven design studio for sustainable design for the built environment. A couple of years later we had over 100 alumnae and a pool of ideas. We ended up with new technologies for understanding qualitative and quantitative data on cities and architectural spaces. The AI based technologies help us to save energy, deliver logistic solutions, provide security and well-being, and much more. This is how the journey of AIDOMUS got started.

Figure 1: New Innovation - AIDOMUS is a smart lighting fixture located in the entrance room of an apartment. It has the capacity to collect information about the use of space for controlling the indoor climate based on occupancy and use. It supervises also services with multimodal sensor data, such as in-home deliveries solving the Last Mile problem. AIDOMUS gathers non-intrusive sensor data on the use of architectural space for automated AI based services, such as heating and cooling control, security and in-home delivery services when nobody is at home. It may be integrated to any lighting design. AIDOMUS fits for both new and old buildings.

The Rise of Pixel Art: The Lasting Effects of Affordable Addressable LEDs

Stefan Yazzie HERBERT
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Abstract

Light based art has seen a recent surge, with many artists gaining widesperead accliam and recognition with art pieces featuring addressable RGB LEDs. So what are the reasons for this sudden change in medium?

The explanation can be split into three main pillars: the sinking cost and proliferation of certain technologies, the ease of sharing knowledge on internet blogs and forums, as well as a much less obvious reason: the rise of the DJ as a musical act.

Many years ago, the only musical acts on stage were musicians, bands and performers. However, as music producers and DJs became more and more common on large stages, lighting and stage designers realized that they had a problem: DJ's are boring on stage. And so began an arms race for the biggest and most intricate stage. As the architecture of these stages became more complex, lighting these complicated 3D shapes became difficult with standard industry equipment and so many designers reached to a tool that had largely only been used for home and retail decoration: the LED strip. The flexibilitiy, low cost and ease of use made it an incredibly popular tool over the years.

As the LED strip became a mainstay on the stage, many hobbyists saw it as an affordable way to practice their craft. Many who had started as VJ's now had a new weapon at their disposal, a new way to experiment with architecture and 3D space. As this market became more robust, software and hardware were developed to fit the needs of the their users in a price range that made it affordable to the masses.

From the early days of so-called „dumb" LEDs to modern addressable, self-reporting LEDs, there have been many iterations, but none as important as the introduction of the WS2812 LED series. While not the first addressable LED chip, the WS2812 chip (along with it's brethren WS2811, WS2812b, etc), drastically sank the cost of powering and controlling thousands of LEDs.

Hardware to control these strips also became incredibly affordable, with boards like the Arduino and the Teensy, which also had plenty of online learning resources for their hobbyist communities. Pair this with the fact that the control protocol Artnet now allowed hundreds of thousands of pixels to be controlled with simple computer software and cheap ethernet cables, and you have a recipe for creating a rich, creative landscape of light art.

Author's CV

Stefan Yazzie HERBERT

Stefan Yazzie Herbert is a dynamic speaker, entrepreneur and designer. With incredibly diverse influences coming from a variety of industries throughout his life, Stefan brings insight to a wide range of topics: design, science, culture, leadership and social entrepreneurship. His unique ability to create an air of curiosity and wonder in his audiences no matter the topic, makes him a perfect fit for any stage or event. Stefan's professional work focuses on using technology in innovative and creative ways. His philosophy is based around "recombinatorial creativity": bringing many different fields together to create new ideas. Over the past years, his work has expanded to include the educational, cultural and social aspects of the creative field.

"If you're the stupidest person in the room, you're doing something right." Stefan

Organisation

The Paranormal Unicorn

Founded in 2011 by Austrian-American art student Stefan Yazzie Herbert, The Paranormal Unicorn describes itself as an 'audio-visual artist collective' that specialises in stage and lighting design. Based in Vienna, Austria, the firm originally began as a platform for Herbert and two friends, carpenter Benni Frener and Philipp Gantioler to launch a prospective music career.

Figure 1: Stage Lighting

New Lighting Design Approaches in Applications

Hospitality Lighting Design

Theodore D. KONTORIGAS
Architectural Lighting Designer
Theodore Kontorigas Lighting Design
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Abstract

The lecture provides insight into the essential factors for creating successful lighting schemes for hospitality projects. Specific examples in the form of in-depth case studies are used to illustrate how lighting is creatively designed to transform the hospitality experience. The impact of recent advances in technology and particularly the development of LED technology to architectural lighting design will be also analyzed along with a presentation of the vast new opportunities for inspirational, innovative hospitality lighting scemes.

The lecture explores three main topics:

1. Human Centric Lighting and its psychobiological influence on hotel customers; Human centric lighting is not a new concept for the design of architectural lighting. The biological and emotional human needs beyond illumination for the visual system, were always to the core of the professional lighting design process. The benefits of designing human centric lighting schemes in a hotel environment are: visual comfort, safety and ease of orientation (visual), concentration and cognitive performance (biological), uplifting and positive mood (emotional). Human centric lighting installations require intelligent lighting solutions (sensors, controls), tunable white, personalised guest control and integration of daylight.

2. Internet of Things (Iot) and the design of connected and digitized lighting; Through digital infrastructure and sensorized luminaries the “Internet of Light” would be presented through its essentials: lighting quality, control and communications, awareness and sensing. New potential quests / customers (target group) experiences and services can be envisioned in order to open up possible future scenarios and to shape the adaptive rhythm of hospitable light.

3. Lighting as an iarchitectural material and the application of integrated, customized, controllable, miniaturized lighting systems. This is defining new creative possibilities for architects, lighting and interior designers. LEDs allow for flexibility—dynamic lighting with colour-changing elements is now within the source. LED lighting can be easily controlled through a smartphone, unlike other light source. As guests become more familiar with the power of smart LED lighting, lighting designers will become able to design dynamic ways to customise solutions that answer the wants and needs of the industry. The future of lighting and its responsive and organic ways will soon benefit the lives of quests active in a hotel space.

Light fundamentals, units of measure and perception, techniques like layering light, control protocols, families, principles, examples and applications, specialized products for hotels along with lighting design examples and case studies, will also be presented.

Author's CV

Theodore D. KONTORIGAS

Theodore Kontorigas is an independent lighting designer who works as a lighting consultant in Greece and abroad. He has an architectural background and a Master degree in Architectural Lighting from the Bartlett School of Architecture, UCL in London. In the past he was employed by the award winning lighting design practise Maurice Brill Lighting Design in London. In 2002, he set up his own independent lighting design studio in Athens, Greece. In the following years, he designed the lighting for high profile exhibition and conference spaces, luxurious hotels, monuments and historical places, office buildings, restaurants and shoping malls. He regularly lectures at universities, trade fairs and professional conferences about lighting design for the built environment.

"We create comfortable and inspiring visual environments where light is integral to architecture and responds efficiently to user needs, functional and technical requirements, energy savings and aesthetics." Theodore

Organisation

Theodore Kontorigas Lighting Design

Theodore Kontorigas Lighting Design is one of the leading lighting design consultancies in Greece and Cyprus. Its aim is to maximise the impact of the space around us, whether in hotels, shopping centres, museums or outdoor environments. The TKLD team strive to achieve their aesthetic objectives and fulfil the design requirements of the brief with a high degree of technical competence and imagination. With this background, the team has always been aware of the psychological effects of lighting in its approach to design. Light is used to enhance space: to define its authority and to evoke the right mood for people in and around the building. With over fifteen years of experience in lighting design, TKLD can dramatically transform the experience of space in response to the business needs of its clients.

Ambient Lighting Design for Persuasive Environments Using Social Media Data

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Abstract

Data is the driver of the digital world, and with the digital world playing an increasingly important role in our lives; I think designers ought to make more of an effort to consciously include it in products and built environments. People spend a significant part of their lives on the social media platforms; the average person spends more than two hours on social media every day, which translates to a total of 5 years and 4 months over a lifetime. This amount is only expected to increase as platforms develop. The world where we live in, is the context we use to produce social media feed; like posting the food we eat on the Instagram. As a result, the physical world plays a vital role in shaping the social media. However, there is no trace of the social media or its impact on the physical world; of course, it indirectly influences our mentality but nothing more tangible happens. Now the question is: “Would the digital world be able to influence the physical one as well? and therefore create a non-ending cycle which connects both worlds and results in having one big world instead of two separated ones?” If so, what would be the result and how can we contribute as designers? One of the tools used to communicate with the world and impact on architectural environments is light. Preset scene systems inside Architectural spaces are no longer capable of expanding to meet modern media demands. Architectural spaces need to responsively generate live content to truly exploit the potential of spaces filled with digital ambient media systems. During the presentation, I am going to explain how it would be possible to communicate the happenings inside the social media using light visualizations and further argue if these visualizations can become a tool to impact people’s behavior and decisions. Lastly, I will share the other opportunities and possibilities using this data translation as well as the ways we can enrich and develop it for the future needs. By categorizing the social media data and linking them to light visualizations, a light language is created. In the next step, after doing a field exploration and testing "ambient communications" concepts using a real live prototype, its influences on human behavior and actions will be evaluated. The test will be done in the lobby of the Industrial Design faculty of TU Delft. The light visualizations will be mapped on a 2.5x1.2m Philips textile panel using POET software by SKANDAL and Pharos Architectural Controls, and Advertima Artificial Intelligence as a measurement system to evaluate the impact of the visualizations on people’s attention and reactions. The project is a graduation thesis done at Delft University technology for Koerner design under the supervision of Brad Koerner and two of the university’s professors, Dr.Sylvia Pont, and Dr. Gerd Kortuem to tackle these questions and find out how we can connect these two worlds and enhance people’s lives.

Author's CV

Yasaman MAVVAJ, MSc

Yasaman (born, 1989) is a young product designer based in the Netherlands. She simultaneously graduated from Bachelor of Architecture and Bachelor of Industrial Design and continued her studies in the field of Architecture. After receiving the Master of Architecture and working for two years at the country of her origin, Iran, she moved to the Netherlands searching for new challenges. Yasaman is currently a Master student at TU Delft, soon to be graduated as an Integrated Product Designer.

Organisation

Koerner Design

Koerner Design helps our clients develop innovative new products, experiences and environments. We are specialized in the intersection of architectural lighting and digital media systems and provide a range of services, including lighting design, product design, product marketing and business development.

Inside the Pyramids - Light Where There Should be Darkness

Ruairi O'BRIEN, Associate Professor
Architect and Lighting Designer
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Abstract

The pyramids do not need an explanation. Practically everyone has heard about the pyramids and he or she who travels to Cairo has to visit the great pyramids of Giza. The Pyramid of Khufu also known as the Pyramid of Cheops is the oldest and largest of the three pyramids in El Giza, situated on the outskirts of Cairo. It is the oldest of the Seven Wonders of the Ancient World, and the only one to remain largely intact.

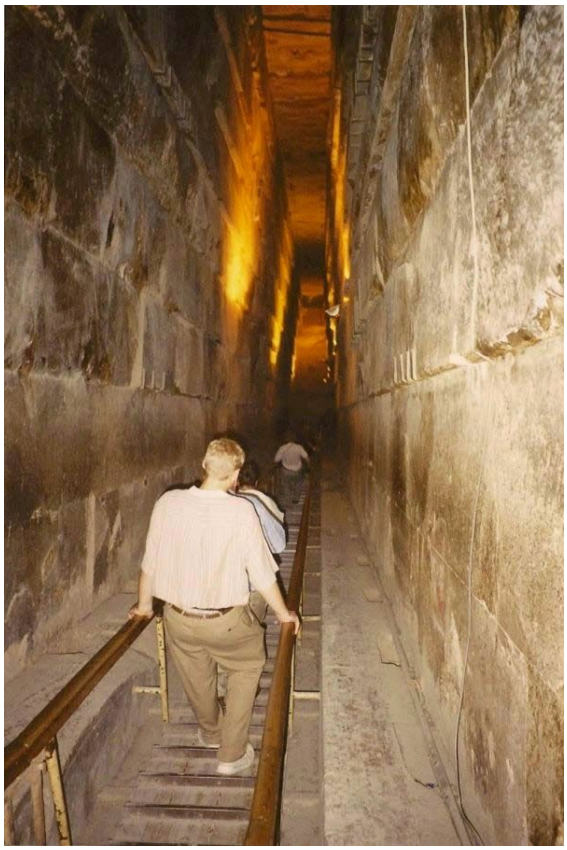

Figure 1: Inside the pyramid of Cheops, existing lighting situation

Modern day tourism is an important source of income for countries as rich in culture and heritage as Egypt, the cradle of civilization and the Pyramids are one of the country's greatest attractions. Tourism can also play a great role in intercultural exchange, understanding and education and every child who is privileged enough to go to school encounter the Pyramids in their school books as do all architectural students in their first semester history lessons.

I remember well the wonder I felt during my first time visiting the Pyramids. It started with the approach though the streets of Giza and suddenly being aware of their presence as I spotted them towering up behind between the gaps in the rows of the houses on route. Their purist forms absorbed the heat of the sun and stood firm in the wind and cutting sand. Observing how the pyramids in the strong Cairo daylight express their gravity and their eternity one is aware of the hard shadows, the clarity and the timelessness of light playing with one of its most perfect partners in the world of architecture.

Heritage buildings are extremely difficulty to light and thankfully the pyramids are as yet not lit at night so they can still master the dusk and the coming of darkness as they have done for thousands of years. There are of course light shows offered as a tourist attraction, my personal opinion is that the pyramids are so powerful in the sunset and in the darkness of the night accompanied by the moon and the stars that one does not need a light show to appreciate the importance of what one is privileged to see and I would definitely prefer to sit a stare and wonder in

silence without any special effects to distract my thoughts. Nevertheless, in my lecture I will be concentrating on another aspect of the Pyramids at Giza, the Inside. For thousands of years the interior space was in complete darkness, after all it was conceived to be a burial chamber. Today tourists' queue to enter this special unique space, a space that was not conceived to be entered ever again once the stones were closed. How do we light such a space? Once you have decided that it is morally acceptable to allow strangers enter the secret and private world of the burial chamber of a pharaoh, who is not around to ask if he would have a problem with his resting place being disturbed in such a manner, one gets on with the job as a professional and starts to analyze the situation. There is no daylight obviously and the lighting of the interior needs to provide safety for hundreds of visitors a day in high season who make the strenuous climb through the narrow passages to the burial chamber in the depths of the man-made mountain of stone. Should the lighting be purely technical or can it be designed to support not just seeing your way but also manipulating your emotions on route? Should one heighten the drama of the experience or just hope that no one has an accident.

This semester at the German University in Cairo I have worked with a group of students on an analysis of the present lighting situation and developed with them concepts on how one could improve the interior lighting of such an important example of cultural heritage. In the lecture I will tell the story of the project and I will present some of the results of the lighting design solutions. The lecture will also discuss in general the difficulty lighting designers face with heritage buildings of such importance.

Author's CV

Ruairi O'BRIEN, Associate Professor

Ruairi O'Brien was born in Dublin, Ireland, he is currently an associate professor and head of the Architecture and Visual design department at the German University in Cairo.

With his architectural practice, Ruairi O'Brien. Architektur. Licht. Raumkunst. and his lighting design studio, Ruairi O'Brien Lighting Design, O'Brien has executed a large and diverse portfolio of work which includes urban design, market squares, innovative and custom-built street lighting, public and private buildings, hospitals, schools, residential buildings, museums, memorials, exhibitions and interiors. O'Brien recently completed an "architectural design guide" and lighting masterplan for the central shopping area of Lichtenrade in Berlin.

O'Brien has also worked on theatre and dance projects, created a series of sculptures, installations and performances with light and exhibited his drawings, light sculptures and paintings in London, Berlin, Frankfurt (Luminale), Leipzig and Dresden. In 2003 he initiated the Light Poetry Festival LIGHT and WORD as a partner festival to the International Poetry Festival BARDINALE in Dresden, Germany and curated the festival until 2006. In 2014 he was one of 12 lighting designers who founded the Federation of International Lighting Designers and served on the board as Vice President until the end of 2018. O'Brien's international teaching experience includes contracts undertaken for universities in Germany, Czech Republic, Russia and Syria. During his time as a visiting professor at the University of Wismar in Germany (2001-2005) O'Brien helped initiate the international master's course in Architectural Lighting Design and was responsible for the programs design studios. O'Brien has given lectures, supervised workshops and organized exhibitions on architecture and lighting design in Japan, the Netherlands, Greece, England, Ireland, Sweden, Finland, Austria, Italy, Latvia and in the USA.

O'Brien studied architecture in London at the University of Greenwich and at the University of Edinburgh. During his time at Edinburgh he received a "Visiting Scholarship" to Columbia University in New York. O'Brien's research interests are an extension of the topics he has developed as an interdisciplinary practicing architect and lighting designer: Lighting and the

built environment, the development of old and new towns, the architecture of museums, memory and heritage, Human Centric Lighting Design.

www.ruairiobrien-international.com,
www.ruairiobrien-lightingdesign.com,
www.ruairiobrien-artworks.com

Organisation

Ruairi O'Brien Lighting Design

RUAIRÍ O'BRIEN. LIGHTING DESIGN. offers innovative high quality individual solutions in light from the first idea through to site supervision: City architecture, urban space, public and private parks, museums, exhibitions, lighting fixtures, installations and sculptures. RUAIRÍ O'BRIEN. LIGHTING DESIGN. deals with both daylight and artificial light and offers especially concepts for light and color. The work undertaken covers all aspects from the conception and design of lighting proposals through to their technical realization. RUAIRÍ O'BRIEN. LIGHTING DESIGN. also offers professional consulting service for investors, architects, landscape architects, engineers and also for providers and manufacturers of lighting.

The expertise offered in our design studio can play a major role in the further development of intelligent energy saving buildings, save costs for the client and the design team and ensure a beautiful sustainable built environment for future generations to come. Light is an integral component of urban planning, architecture and interior design and demands both technical expertise and aesthetic awareness on the part of the designer. Light should allow us to experience our environment, establish an appropriate atmosphere in a room or outdoor space and create comfortable and healthy living and working conditions. The architectural lighting designer Ruairí O'Brien and his interdisciplinary team offers you a comprehensive holistic approach to the implementation of your projects which will ensure that they will be as near to perfect as is humanly possible.

The Light – The New Awareness

Light as Essential Part of the Concept

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Abstract

Light forms and gives more importance to ordinary details, emphasizes façades and surfaces, sets accents, smoothes and conceals, enhances the understanding of buildings and urban spaces and so much more. Therefore it is of great importance for me to take lighting into account from the beginning of every project. In doing so I consider not only light design but also the use of natural light conditions, which influence spaces and buildings as well as their perception to a great extend. Working on a particular project I always try to respond to the given location. It can be a strong and colorful accent as it was the case with Cubix cinema on Alexanderplatz in Berlin, a vivid place which never sleeps. Light can act as marketing instrument, when thinking of retail. It can become an art concept when taking museums or other cultural institutions into consideration. A special interest for me is working on exhibitions or installations, as for example my latest ones, Roma Aeterna in Moscows Tretyakov Gallery or its resumption, Pilgrimage of Russian Art at the Vatican Museums in Rome. One of the highlights was the work on the stage design The Bright Way.1917 for the Moscow Art Theatre (MXT) in Moscow. Besides of playing a particular role for the stage construction, light was a strong means of expression for the whole content of the play.

Author's CV

Sergei TCHOBAN, Arch.

Sergei Tchoban (born 1962 in Saint-Petersburg) is a Russian and German architect. He is managing partner of the Berlin office TCHOBAN VOSS Architekten and director of the architectural office SPEECH in Moscow. He designed and built several internationally known buildings and ensembles in Germany and Russia, such as the Federation Complex in Moscow or the Museum for Architectural Drawing in Berlin. Tchoban curated twice the Russian Pavilion for the Architectural Biennale in Venice and in 2015 he was the architect of the Russian Pavilion for the EXPO in Milan. He is the founder of the first Biennale for young architects in Russia and jury chairman as well as jury member of several international architecture and drawing competitions. 2018 Sergei Tchoban received the European Prize for Architecture by Chicago Athenaeum Museum of Architecture and Design.

Organisation

TCHOBAN VOSS Architekten

“Before embarking on a new construction project, we always approach the specific urban situation as something unique and valuable in itself. This is what produces unique architectural solutions. The surrounding urban context guides us to the best possible result, which may be contrasting or discreet, massive or light and delicate. It is important for us to design our buildings in their entirety, down to the door handles, since only an interaction of exterior and inner structure, of details and the whole can make a building or a group of buildings a credible and characterful part of its surroundings. In a world which is becoming increasingly transient it is only enduring architecture which can meet the ever-changing requirements. Architecture which is valuable, aesthetic, and user-friendly can age gracefully and contribute to an authentic and livable environment. To this end, we place great importance on innovative and precise solutions at each step of the planning and construction process.” Sergei Tchoban, Ekkehard Voss

Figure 1: Project - VTB Ice Palace, Moscow 2015

Daylight and Light Design Intertwining

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Co-Author(s): Maha SHALABY, MSC (Sustainability Specialist)

Abstract

Light, both natural and artificial, plays a crucial role in the creation of sustainable built environments and democratic architecture with people in focus. Light affects our body, physically and psychologically, and has a direct impact on our health and well-being.

White Arkitekter works with lighting strategies that integrate daylight and electric light, taking into consideration the person, the task and the context in the best possible way. In the building design industry daylight and electric lighting planning are often treated separately. However, both disciplines address the same questions albeit through different means. As such, there is great potential for them to complement, rather than override, each other.

The integration of daylight and electric light simulations and analyses are, therefore, essential throughout the design process when taking a human centric approach, meeting new certifications but primarily optimizing the end-result by creating better spaces for people to work and live in.

The integration of the two disciplines is also important when considering the building's energy efficiency and environmental impact. Optimizing daylight in a building can significantly reduce the energy used for electricity and cooling.

To inform the building design process White strives to integrate the two disciplines in the practice. This presentation will focus on some of the challenges the architecture industry is facing to achieve people-focused lighting strategies. It will also illustrate some of the methods White has developed to tackle these challenges based on practical and research experiences. Case studies where this approach has been implemented will be presented to illustrate the benefits of integrating both disciplines and how it can affect the different design decisions and factors linked to room size and layout, spatial qualities, control systems and energy efficiency.

Author's CV

Isabel VILLAR, MSC

Isabel holds a Master's degree in architectural lighting design from KTH, Sweden. In 2017 Isabel joined White Arkitekter as Lighting Designer with the vision of working both with daylight and electric lighting at early stages of the design process. With over ten years of experience, Isabel designed the lighting for a wide range of national and international projects. In 2014 Isabel won the Swedish Lighting Design Prize for the Annexet at The National Library. She lectured at the Light Fair in Las Vegas, and PLDC in Rome. In 2018 Isabel was given international recognition receiving the 40under40 Lighting Designers Award.

Maha SHALABY, MSC

Maha has more than two years of experience in energy efficiency in Buildings and applying sustainability on the building level, specifically working with daylight in buildings, simulating energy need and thermal comfort, and wind simulations. She has six years of experience of working, scripting and carrying out different simulations in Grasshopper. She is very passionate about the impact of buildings on human beings and has extensive knowledge of the WELL certification system. She has excellent research skills, extensive tool development skills and led multiple R&D projects. She was also responsible and coordinating different projects and methods development at White.

Organisation

White Arkitekter

White Arkitekter is an interdisciplinary practice for architecture, urban design, landscape architecture and interior design. Embedded in our work is a commitment to sustainability in all its forms, underpinned by practice-based research. As a collective of 900 employees organised in networks across 13 offices in Sweden, Denmark, Norway and the United Kingdom, we work with clients, communities and consultants to create inclusive, resilient architecture that inspires sustainable ways of life.

Figure 1: White Arkitekter Proposes Transparent "Lantern" Design for Akershus Art Center

White Arkitekter is Scandinavia's leading architectural practice and the third largest in Europe, with projects across Europe, America and Africa. As an employee-owned company, we live by our values of sustainability and innovation; they permeate our entire organisation and every assignment we pursue. Exploring the field of architecture with dedicated applied research, and challenging ourselves to improve the ways in which we practice, are two key factors that help us to create engaging, lasting architecture.

The power of the collective: In 1951, White Arkitekter was founded in Göteborg by Sidney White with the aim to improve society through architecture. His legacy lives on in our ambition to contribute towards a more sustainable world. The ideals of collective thinking and employee ownership are as strong as ever today. We are collectively owned by 616 staff members, 122 of whom are partners; working together to benefit society as a whole.

Langsames Licht / Slow Light - From Theory Into Practice and From Art Into Function

Siegrun APPELT
Artist
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Abstract

Langsames Licht / Slow Light: From theory into practice and from art into function

The concept Langsames Licht / Slow Light is linked to an interdisciplinary exchange of experiences and knowledge, which deals with the impact and effects of light on people, nature and the environment. Artistic experiences and theoretical knowledge from technical, scientific and creative fields flow into the overall structure of lighting projects. These include public and private spaces, both indoor and outdoor. Artificial light, daylight and darkness play just as important a role as technological innovations and systems that are docked to various other systems in addition to pure lighting. Electrical lighting is part of an ever-increasing networked system. The conception and implementation of lighting in public as well as private areas takes place from the very beginning in close exchange with the clients and users on site. The aim is to sensitize the population to the use of light.

Langsames Licht / Slow Light: Von der Theorie in die Praxis und von der Kunst in die Funktion

Mit dem Konzept Langsames Licht / Slow Light ist ein interdisziplinärer Austausch an Erfahrungen und Erkenntnissen verbunden, bei dem es um die Bedeutung und die Auswirkungen von Licht auf Mensch, Natur und Umgebung geht. Künstlerische Erfahrungen und theoretisches Wissen aus technischen, wissenschaftlichen und planerischen Bereichen fließen in die Gesamtstruktur von Beleuchtungsprojekten ein. Diese umfassen öffentliche wie private Räume, sowohl Innen- wie auch Außenbereiche. Kunstlicht, Tageslicht und Dunkelheit spielen eine ebenso wichtige Rolle wie technologische Neuerungen und Systeme, die über die reine Beleuchtung hinaus an diverse andere Systeme angedockt sind. Die elektrische Beleuchtung ist Teil eines immer größer werdenden vernetzten Systems. Die Konzeption und Umsetzung von Beleuchtungen in öffentlichen wie auch privaten Bereichen finden von Beginn an im engen Austausch mit den Auftraggebern und Nutzern vor Ort statt. Ziel ist eine Sensibilisierung der Bevölkerung in Bezug auf den Umgang mit Licht.

Author's CV

Siegrun APPELT

Siegrun Appelt is an artist based in Vienna, Austria; in 2010 she launched the project Langsames Licht / Slow Light, that aims for an energy-efficient and aesthetically sustainable approach to light and darkness. Light is always part of her exhibition projects, e.g. 288 kW at the Kunsthaus Bregenz, 114 kW, Kunsthalle Schirn, Frankfurt, 64 kW at Updating Germany in the German pavilion at the 11th Architecture Biennale in Venice; 2010 - 2015 the light project in the Wachau, a first practice-oriented project ‚Langsames Licht / Slow Light, was implemented.

Siegrun Appelt ist Künstlerin und hat 2010 das Projekt Langsames Licht / Slow Light ins Leben gerufen, das einen energieeffizienten und ästhetisch nachhaltigen Umgang mit Licht zum Ziel hat. Licht ist immer wieder auch Bestandteil ihrer Ausstellungsprojekte, wie z.B bei 288 kW im Kunsthaus Bregenz, bei 114 kW in der Frankfurter Kunsthalle Schirn oder bei 64 kW anlässlich Updating Germany bei der Architekturbiennale in Venedig. 2010 – 2015 wurde das Lichtprojekt in der Wachau, ein erstes praxisorientiertes Projekt von Langsames Licht / Slow Light umgesetzt.

Organisation

Siegrun APPELT - Projects

1996 Raum für aktuelle Kunst – Prosart, Luzern (E); Coming up, Museum Moderner Kunst, 20er Haus Wien *; cartografia, Galerie Museum, Bozen *; 1997 it always jumps back / and finds its way, DE APPEL, Amsterdam *; Unbeschreiblich Weiblich, Kunstmuseum St. Gallen; Alpenblick, Kunsthalle Wien *; 1998 Reservate der Sehnsucht, hARTware projekte, Dortmunder U *; Stretch, Galerie Index at Tensta Konsthall, Stockholm *; 1999 Raumvorstellungen, Künstlerwerkstatt Lothringerstraße 13, München *; 2001 Mailand – Europa 2000, Padiglione d'Arte Contemporanea, Mailand *; Videos, Pavillon, Wels (E) Detourism, Rennaissance Society at the University of Chicago, Chicago *; 2002 Kunstverein Friedrichshafen (E); non-places, Frankfurter Kunstverein; Urbane Sequenzen, Kunsthalle Erfurt; Reale Fotografie, Kunstraum Dornbirn; Nachtschicht, Kunsthalle Faust, Hannover und Künstlerhaus Bethanien, Berlin; 2003 LokoMotive, Graz; Je veux, Palais de Tokio, Paris; kunst-en-passant, Basis und Kunsthalle Wien; 16.777.216, permanente Lichinstallation, Bludenz (E); Skating Cinepolis, Hamburg; hotel/hotel, Landesmuseum Linz*; 38.028.797.018.963.968 Lichtinstallation im Maag Areal, Zürich; 2004 Moderato cantabile, Landesgalerie /Landesmuseum Linz (E)*; Einleuchten, Museum Moderner Kunst, Salzburg*; 72 KW, a9 forum transeuropa, Museumsquartier; Moderato cantabile, Kulturwissenschaftliches Institut Essen; 68.719.476.736 Lichtinstallation im Museumsquartier Wien, MUMOK, Wien; 2005 288 KW, Kunsthaus Bregenz (E); Lichtkunst aus Kunstlicht, Zentrum für Medienkunst, Karlsruhe *; 2006 116 KW, Luminale, Kunsthalle Schirn, Frankfurt; Tunnels, Medienturm Grazon tunnels and corridors, Medienturm Graz; 2007 Reduzierte Aussagen, Kunsthaus Mürz; HOME, Voorkamer, Belgien; Lichtberlin, Tiergarten Berlin; Lichttage Winterthur; 2008 Twilight Zone, Mühlheim an der Ruhr; Updating Germany, Architekturbiennale Venedig*; 2009 Stark bewölkt, MUSA, Wien*; Entwurfsausstellung für Lichtparcours Braunschweig 2010, Kunstverein Braunschweig; Glow, Eindhoven

Figure 1: Slowlight Lichtprojekt Wachau

The Smartness of Buildings & Cities

Sensor Ready and MasterConnect: Simple, Scalable, Standardized

Peter DUINE, PhD
Global Product Marketing Manager
Signify fka Philips Lighting
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5656 AE Eindhoven
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Abstract

The lighting industry benefits from proper interface standards and building blocks to make fixtures cost effective, reliable, and versatile. The Xitanium SR product line was instrumental to establish fixture based control in outdoor and indoor lighting, and through proper standardization in DiiA can now carry the D4I logo. The next frontier for interop is the wireless protocol standard, that is needed as lighting will be the last mile in the smart building looking to get organized through a low latency, cost effective, low power wireless connectivity. We have defined the use case to drive such standardization, and have a broad portfolio of products that benefit from a standardized approach. The vertical link is provided by BLE, w meshing orchestrated on low latency cost effective Zigbee standard. This will drive connectivity for indoor applications to mainstream.

Author's CV

Peter DUINE, PhD

Peter Duine is Global Product Marketing Manager for LED Electronics. Based in Eindhoven, NL, he joined Philips 25 years ago as an engineer in the Research Laboratories. He joined the Lighting division 15 years ago as an optical engineer, and was a pioneer in developing LED light engines and drivers as systems for general lighting applications. He then moved to product management and is now responsible to develop a product line of OEM components for connected lighting. Peter holds Masters and PhD degrees in Solid State Physics from Delft University of Technology. In his spare time he enjoys running marathons and biking the tallest mountains all over the world.

Organisation

Signify fka Philips Lighting

Signify is the world leader in lighting for professionals, consumers and lighting for the Internet of Things. Our energy efficient lighting products, systems and services enable our customers to enjoy a superior quality of light, and make people's lives safer and more comfortable, businesses more productive and cities more livable.

With 2018 sales of EUR 6.4 billion, approximately 29,000 employees and a presence in over 70 countries, we're unlocking the extraordinary

potential of light for brighter lives and a better world.

A company with a purpose

Our purpose is to unlock the extraordinary potential of light for brighter lives and a better world. We achieve this through living our values, innovation, passion for sustainability and desire to transform people's lives.

Innovators today and tomorrow

For more than 125 years we have pioneered breakthroughs in lighting and been the driving force for many innovations. Our track record in innovation is strong and we invest heavily in R&D to stay at the forefront of technological developments.

Signify continues to innovate in LED lighting and is leading the industry's expansion to lighting systems in both the professional and consumer markets. Our position as the industry leader in connected lighting, makes Signify the lighting company for the Internet of Things (IoT).

Lighting knowledge for you

Lighting University offers a comprehensive range of educational resources for people who want to expand their lighting knowledge. With a rich history in lighting, Philips is uniquely qualified to bridge the gap between cutting edge lighting innovation and the real-world solutions required by professionals.

Intelligent Lighting for Smart Buildings and Smart Cities Enabled by Integrated Sensing Solutions

Richard FIX, Dr.
Senior Product Manager
Bosch Sensortec
Gerhard-Kindler-Straße 9
72770 Reutlingen
Germany

Abstract

Since 2017, there are digital sensors on the market which allow for simultaneously measuring barometric pressure, temperature, relative humidity and air quality on a few mm^2. Lighting systems equipped with those sensors can detect for instance volatile organic compounds (“VOCs”) in the home or office air and quietly inform the residents. Long-term studies clearly show the importance of low VOC levels for well-being. In the near future, miniaturized sensors can be used for dense sensor networks as well, e.g. for air quality mapping in cities.

Author’s CV

Richard FIX, Dr.

Richard Fix was born 1978 in Nürnberg. He studied mathematics & physics and finished his Ph.D. 2009 at the Robert Bosch GmbH and the Max-Planck Institute Erlangen. Within the Bosch group, Dr. Fix was leading innovation studies, research and development projects for products with chemical sensors for automotive, building, medical and consumer applications. Since 2017, he is senior product manager for environmental sensors of Bosch Sensortec GmbH.

Organisation

Bosch Sensortec

Bosch Sensortec GmbH, a fully owned subsidiary of Robert Bosch GmbH, develops and markets a wide portfolio of microelectromechanical systems (MEMS) sensors and solutions tailored for smartphones, tablets, wearable devices and IoT (Internet of Things) applications. The product portfolio includes 3-axis acceleration, gyroscope and geomagnetic sensors, integrated 6- and 9-axis sensors, environmental sensors, optical microsystems and a comprehensive software portfolio. Since its foundation in 2005, Bosch Sensortec has emerged as the MEMS technology leader in the markets it addresses. Bosch has been both a pioneer and a global market leader in the MEMS sensor segment since 1995 and has, to date, sold more than 10 billion MEMS sensors. More than every second smartphone worldwide uses a Bosch Sensortec sensor.

For more information, please visit www.bosch-sensortec.com, www.twitter.com/boschMEMS.

The Bosch Group is a leading global supplier of technology and services. It employs roughly 402,000 associates worldwide (as of December 31, 2017). The company generated sales of 78.1 billion euros in 2017. Its operations are divided into four business sectors: Mobility Solutions,

Industrial Technology, Consumer Goods, and Energy and Building Technology. As a leading IoT company, Bosch offers innovative solutions for smart homes, smart cities, connected mobility, and connected manufacturing. It uses its expertise in sensor technology, software, and services, as well as its own IoT cloud, to offer its customers connected, cross-domain solutions from a single source. The Bosch Group's strategic objective is to deliver innovations for a connected life. Bosch improves quality of life worldwide with products and services that are innovative and spark enthusiasm. In short, Bosch creates technology that is "Invented for life." The Bosch Group comprises Robert Bosch GmbH and its roughly 440 subsidiary and regional companies in 60 countries. Including sales and service partners, Bosch's global manufacturing, engineering, and sales network covers nearly every country in the world. The basis for the company's future growth is its innovative strength. At 125 locations across the globe, Bosch employs some 64,500 associates in research and development.

Additional information is available online at www.bosch.com, www.iot.bosch.com, www.bosch-press.com, www.twitter.com/BoschPresse.

Innovations in Lighting Design – Thinking Out of the Box

Lighting, Dynamic Urban Spatial Art and Teaching

Ruairi O'BRIEN, Associate Professor
Architect and Lighting Designer
Ruairi O'Brien Lighting Design
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Germany

Abstract

In the lecture I will discuss the growing importance of light in public space and the how dynamic-light spatial artworks could be used to light public spaces. The basis for my thesis is the practical work I have done over the years in the development of a series of micro-light-sculptures. The idea that fascinates me is how a lighting object such as a "Dynamic Light Spatial Artwork" can create its own magnetic like universe, one can get lost in the details of such an object observing how the light changes depending on the time of day, the materials used and the position of the viewer. The sculptures are often lit from within and can be enjoyed from the distance, but they also pull the viewer in to undertake a closer inspection and the closer you get the more there is to see in the micro world of the object. The macro context is the city, the market square, the streets or the surrounding buildings at the chosen locations where I installed the works.

The macro context of course is also the universal dimension, the sun, the moving clouds, the moon and the stars, the darkness, all of which are be reflected in mirrored surfaces which are part of the objects. The interaction between the big outside world and the object's inside world, create dynamic shadows or moments of light that flash across the construction, surrounding buildings, upon the pavements or across the faces of pedestrians in the immediate space. They can be mobile works or they can be installed on a permanent basis as part of the city fabric. They are also of course learning vehicles with which it is possible to experiment and test ideas about, light and materials, or on how urban space can be changed through small implantations and how passersby react to the irritation of dynamic lighting situations in such a concentrated form.

Figure 1: Laszlo Moholy Nagy's Light Modulator from 1930

I am also presently working on a "Light Machine" project with the students in my lighting design course at the German University in Cairo this semester. I will include this in the lecture as an interesting excursion into the history and the importance of the Bauhaus regarding lighting and

to set this into the context of dynamic light with Laszlo Moholy Nagy's Light Modulator from 1930. I told my students that Moholy Nagy's light modulator was not just a beautiful object that demonstrated countless optical effects and lighting scenarios but that it was also a child of its time and was inspired by the technological developments of a world in dramatic change. In this context I also understand it to be sub-consciously a homage to the changing city landscapes of Moholy Nagy's everyday/ night life. In the early part of the twentieth century the darkness of city life started to disappear at an increased pace as electrical light lit streets, squares, office buildings, the facades of theaters and cinemas. Lighting advertising signs blinked and shone, it was a fast- dynamic time and it produced a dynamic nightlife in light. The increased use of large glass fronts in cafes and shops mirroring passersby and the resulting merging and layering of inside with outside did not escape the photographer's eye of Moholy Nagy. The movement of cars and trams and people provided the artist with the largest human-made kinetic work of art of all, the modern city.

Today the explosive potential of the presently ongoing digital revolution is far from being fully understood, but in the bigger picture of things it is clear that the "Times are a changing" again. What this could mean for Lighting and Urban Spatial Art and the teaching of Lighting Design and Urban planning will be developed and presented in the lecture with the support of contemporary works executed by myself, examples of projects developed by my students and some examples of Moholy Nagy's exciting work.

Author's CV

Ruairi O'BRIEN, Associate Professor

Ruairi O'Brien was born in Dublin, Ireland, he is currently an associate professor and head of the Architecture and Visual design department at the German University in Cairo.

With his architectural practice, Ruairi O'Brien. Architektur. Licht. Raumkunst. and his lighting design studio, Ruairi O'Brien Lighting Design, O'Brien has executed a large and diverse portfolio of work which includes urban design, market squares, innovative and custom-built street lighting, public and private buildings, hospitals, schools, residential buildings, museums, memorials, exhibitions and interiors. O'Brien recently completed an "architectural design guide" and lighting masterplan for the central shopping area of Lichtenrade in Berlin.

O'Brien has also worked on theatre and dance projects, created a series of sculptures, installations and performances with light and exhibited his drawings, light sculptures and paintings in London, Berlin, Frankfurt (Luminale), Leipzig and Dresden. In 2003 he initiated the Light Poetry Festival LIGHT and WORD as a partner festival to the International Poetry Festival BARDINALE in Dresden, Germany and curated the festival until 2006. In 2014 he was one of 12 lighting designers who founded the Federation of International Lighting Designers and served on the board as Vice President until the end of 2018. O'Brien's international teaching experience includes contracts undertaken for universities in Germany, Czech Republic, Russia and Syria. During his time as a visiting professor at the University of Wismar in Germany (2001-2005) O'Brien helped initiate the international master's course in Architectural Lighting Design and was responsible for the programs design studios. O'Brien has given lectures, supervised workshops and organized exhibitions on architecture and lighting design in Japan, the Netherlands, Greece, England, Ireland, Sweden, Finland, Austria, Italy, Latvia and in the USA.

O'Brien studied architecture in London at the University of Greenwich and at the University of Edinburgh. During his time at Edinburgh he received a "Visiting Scholarship" to Columbia University in New York. O'Brien's research interests are an extension of the topics he has developed as an interdisciplinary practicing architect and lighting designer: Lighting and the built environment, the development of old and new towns, the architecture of museums, memory and heritage, Human Centric Lighting Design.

www.ruairiobrien-international.com,
www.ruairiobrien-lightingdesign.com,
www.ruairiobrien-artworks.com

Organisation

Ruairi O'Brien Lighting Design

RUAIRÍ O'BRIEN. LIGHTING DESIGN. offers innovative high quality individual solutions in light from the first idea through to site supervision: City architecture, urban space, public and private parks, museums, exhibitions, lighting fixtures, installations and sculptures. RUAIRÍ O'BRIEN. LIGHTING DESIGN. deals with both daylight and artificial light and offers especially concepts for light and color. The work undertaken covers all aspects from the conception and design of lighting proposals through to their technical realization. RUAIRÍ O'BRIEN. LIGHTING DESIGN. also offers professional consulting service for investors, architects, landscape architects, engineers and also for providers and manufacturers of lighting.

The expertise offered in our design studio can play a major role in the further development of intelligent energy saving buildings, save costs for the client and the design team and ensure a beautiful sustainable built environment for future generations to come. Light is an integral component of urban planning, architecture and interior design and demands both technical expertise and aesthetic awareness on the part of the designer. Light should allow us to experience our environment, establish an appropriate atmosphere in a room or outdoor space and create comfortable and healthy living and working conditions. The architectural lighting designer Ruairí O'Brien and his interdisciplinary team offers you a comprehensive holistic approach to the implementation of your projects which will ensure that they will be as near to perfect as is humanly possible.

When Lighting Design Meets Design Thinking: Putting People First

Sabine DE SCHUTTER, M.A Architectural Lighting Design / M.A. Interior Architecture
Lighting Designer, Director
Studio De Schutter
Hasenheide 9, Hof 2, Aufgang 1
10967 Berlin
Germany

Abstract

Lighting designers are architects of atmosphere and the visual experience. They can influence technology, sustainability and even future trends. In this role, how does one put people first when designing for the built environment? How can user-centred design lead to new insights and innovations? How does one identify and understand the core needs of their users, even when the problem is not clearly defined? Design Thinking is a design methodology that combines lean an agile practices in an iterative design process to tackling challenges. It's extremely useful when it comes to complex problems that are ill-defined or unknown, by understanding the human needs and the core values of your customer and stakeholders involved.

In her talk, Sabine De Schutter will illustrate with examples from their projects, how her studio has been working to integrate the users' needs and how the design thinking methodology and process forms a crucial part of their working process within her team and with their collaborators. Sabine is a lecturer at the HPI school of design thinking in Potsdam where she coaches in the professional education as well as the basic and advanced track for students. She has worked on many spatial challenges combining her knowledge as lighting designer and interior architect to guide teams through various space-related problems using design thinking tools. In this talk, she will give an introduction to design thinking, explaining the link to the Bauhaus movement and illustrate how design thinking is more than just a toolbox, it is a method to innovate and a mindset.

Learning Objective 1: Understanding what design thinking is and what it is about

Learning Objective 2: Gaining insight in how to use this as a method, tool and mindset for your work and business

Learning Objective 3: Be able to describe design thinking and the link to other design methods

Learning Objective 4: Gaining an understanding of how this can be used in our industry, and how to tackle spatial issues with design thinking

Author's CV

Sabine DE SCHUTTER, M.A Architectural Lighting Design / M.A. Interior Architecture

Sabine De Schutter is a Berlin-based lighting designer and runs her own architectural lighting design practice – Studio De Schutter. She has worked on projects ranging from creative lighting for working environments, to museum lighting and installations for public spaces. With her human-centred approach to design, she strives to blend this mindset into all her projects and collaborations. As a multifaceted entrepreneur, she also works at the HPI School of Design Thinking. For her research and design, she has been awarded prizes such as "Young Lighter of the Year" 2013, and a place in the "40under40" as aspiring lighting designer.

Figure 1: Team, Studio De Schutter

Organisation

Studio De Schutter

Our projects range from museum lighting through to office lighting and installations for public spaces. Sabine De Schutter is a lighting designer, design thinker and educator, with a background in interior architecture. Simultaneously, her passion for working with people led her to study design thinking, which trained her in different pedagogical methods and techniques to create human-centered design. Besides working on different lighting design projects, Sabine teaches at the HPI d.school, Hochschule Wismar and is an IALD Educator.

Isabella Mordeglia, Lighting architect and has an additional degree in Management of Artistic and Cultural Heritage.

Shintaro Ueno, Lighting designer.

Evolution of Lighting Design Processes in Digital Times

Bert JUNGHANS, DI
Head of Lighting Solutions & Concepts and Atelier of Light (AoL)
Zumtobel Lighting
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Austria

Abstract

Current Status: Today our clients live and work in a world where information is shared in high frequency and data is exchanged at high speed via networks like Facebook or WhatsApp. At the same time they are immersing into distant worlds with the help of VR Headset systems.

The processing of digital content through gateways and interfaces is improving and handling data is becoming more and more intuitive. For example: goods ordered online are often delivered within twenty four hours. How does this apply to the lighting world, is there an analogy"?

At the moment the lighting world consists of complex and singular offline solutions, combined with lengthy and faulty, ineffective processes.

The challenges for improvement are:

How can we communicate specific properties and USPs of different products, systems and solutions in a short lived world with tight product and project cycles where there is no time to wait for product samples?

Solution proposals:

- Mobile devices (Smartphones, Tablets) with live database access - Augmented reality with virtual luminaires in real surroundings - Virtual Reality Solutions for marketing purposes and project work. (cardboard panorama tour, VIVALDI, online player)

Desired Result: Creating a strong impact and a lasting impression on the client by implementing simple and easy to use tools and methods directly at the point of sales, and thus improving the speed of the decision making process.

How are complex system solutions such as controls, sensor technology, IOT, modular systems, et cetera, planned and handled efficiently?

Solution approach:

- Efficient 2D/3D planning tools with gateways to BOM / BIM / Quotations systems, e-Commerce - Graphically based configurators for products, lighting solutions and system solutions, focusing on the application and user instead of a technological focus and implementing gateways to planning-, quotation- and e-commerce systems.

How to provide planning and product data for a continuous planning process with interfaces to other trades?

Solution approach:

- Focus on flexible "open-source" backbone technology, e.g. Eastergraphics pCon-Technology - Cloud based services with cross-trade functionality (e.g. DALEC - Daylight and Artificial Light with Energy calculation including heating, cooling, air conditioning, facade systems, lighting controls)

How to convince customers of the value a sophisticated and high standard lighting solution?

Solution approach:

- Increase of interactive lighting design processes (e.g. Hilite) and easy to use and understand presentation tools at the point of sales. (VR-AR Applications, VIVALDI-Online Player, Online Cardboard Panorama Tours How to use the necessary data for the design process easily?

Solution approach:

- Online created Data packages with on demand accessibility

Conclusion:

The contribution shows examples and experiences for the above shown aspects and links them to a solution approach. The main focus is to transfer the importance of high lighting quality and innovative system solutions as a significant added value for customers and partner networks in the context of a digitized world.

The emphasis is on simplifying complex systems and speeding up planning and optimizing project processes in conception, calculation, optimization, visualization, quotation, commissioning and lifecycle management.

During a workshop some of these aspects can be tested and experienced in real time.

Author's CV

Bert JUNGHANS, DI

Education: Technical University Ilmenau – Lighting Engineering

Research Areas

* Lighting Application (Indoor+Outdoor application) * Virtual Reality (Terminal V – Lauterach, VRVIS Vienna) * Augmented Reality (Lighting application focus with Hololens / mobile devices) * Interactive Dynamic Lighting Visualisation (Software) * Stochastic Ray Lighting Design (Software) * Realtime Raytracing and Analysis (Software) * Daylight / Artificial Simulation * Building Energy Performance

Organisation

Zumtobel Group

The Zumtobel Group is an international lighting group and a leading supplier of innovative lighting solutions, lighting components and associated services. With its core brands, Zumtobel, Thorn and Tridonic, the Group offers its customers around the world a comprehensive portfolio of products and services. In the lighting business, the Group with its Thorn and Zumtobel brands is one of the European market leaders. Through its lighting components brand, Tridonic, the Zumtobel Group plays a leading role worldwide in the manufacture of hardware and software for lighting systems (LED light sources and LED drivers, sensors and lighting management). The Zumtobel Group's service offering is one of the most comprehensive service offerings in the entire lighting industry, including consultation on smart lighting controls and emergency lighting systems, light contracting, design services and project management of turnkey lighting solutions, as well as new, data-based services focused on delivering connectivity for buildings and municipalities via the lighting infrastructure.

The Group is listed on the Vienna Stock Exchange (ATX Prime) and currently holds around 5,900 employees. In the 2017/18 financial year, the Group posted revenues of EUR 1,196.5 million. The Zumtobel Group is based in Dornbirn in the Vorarlberg region of Austria.

Light and Lighting Design – Thinking Different

When Lighting Design Meets Design Thinking: Putting People First

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Italy

Abstract

The progress can't be stopped. Its influence can't be reduced for the future generations. However, it's up to us to decide how to use the new opportunities. Possibilities of our brains can be researched and developed today. On one hand, people can be nursed more efficient, taking their feelings and emotions into account. In contrast, life itself can be destroyed by playing with it at same time. One thing can be proclaimed: with the development of Neurotechnology we have a very powerful instrument in our hands today. It is not still well tested and used. But we already can see that the world of artificial intelligence and horror movies about robots and machines are becoming closer to us. The research during Summer School Neurotheatre, organized by Tallinn University and taking place in St. Petersburg (Russia) in 2018, was intended to identify how far we came with artificial world today. We got used to create a lighting design for performances and shows to lead observer's emotions, to create their mood and have special feelings the stage can give to a person. During CUCO performance this habit was changed completely. The audience was the one uniform organism who created the lighting design on stage itself with the help of mood and emotions. This collaboration between human, computer and perception was all the more interesting to see in the result of a new interpretation of this relationship. We got used to use music to help dancers on stage to present the idea and mood. The point was to break this rule completely, moreover to provide a competition between human creation and human being itself. Before the performance, there were 5 paintings selected, different emotional effects causing. Feedback they gave was tested by Muse — BCI device. Help of artists in choosing the colors as part of emotional perception was used. All the colors were added to AI. With these colors audience was able to perform colors with their emotions, drawing specific lighting projection on the screen. The second part was surrendered to sound. The question was if it can move attention of audience to a different mood. The melody was changing at some point completely from the whole scene line. Emotions of observers could stay on the same level or follow the music itself. All differences were projected immediately on the screen. The third part presented as human being itself presenting by sight of actor. The power of person in comparison with all the techniques in the world was tested the same moment. At some point the actor had to change the mood of the scene against the mood of sound and light working together. With this connection and interaction between different elements of performance: lighting, music, actor and audience, in the way has never existed before, a colorful result in form of lighting projection on screen was achieved.

KEYWORDS: Neurotechnology, performance, experimental methods, theater, comparison, color appearance, techniques, painting, actor work, show, neurotheatre

Author's CV

Olga TUZOVA, MA

Shortly about me: • Neurotechnology theater performance with Tallinn University (Russia) • Charity performance participation (Ireland) • 3 lighting design projects realized for theatres with Paolo Calafiore (Italy) • More than 10 implemented projects in lighting design (Russia) • Interactive installation "So different light" (Russia) • Online Lighting Design School foundation (Russia) • 3 years "LIDS" conference speaker (Russia) • Master degree in lighting design and LED technology (Italy) • Product design degree (Italy)

Certifications: • the 1st level University Master in Lighting Design and LED Technology

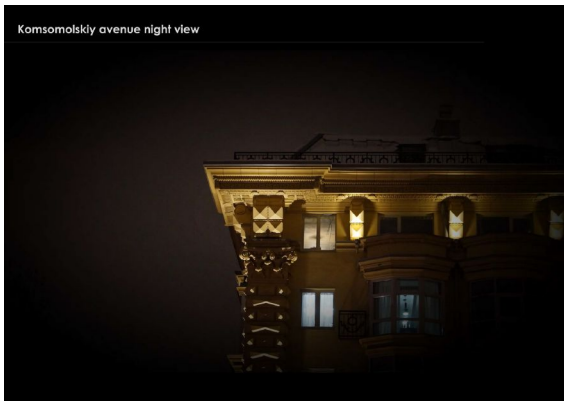

Figure 1: Komsomolskiy avenue night view

Organisation

Politecnico di Milano

Politecnico Milano is a scientific-technological university which trains engineers, architects and industrial designers.

The University has always focused on the quality and innovation of its teaching and research, developing a fruitful relationship with business and productive world by means of experimental research and technological transfer.

Research has always been linked to didactics and it is a priority commitment which has allowed Politecnico Milano to achieve high quality results at an international level as to join the university to the business world. Research constitutes a parallel path to that formed by cooperation and alliances with the industrial system.

Knowing the world in which you are going to work is a vital requirement for training students. By referring back to the needs of the industrial world and public administration, research is facilitated in following new paths and dealing with the need for constant and rapid innovation. The alliance with the industrial world, in many cases favored by Fondazione Politecnico and by consortiums to which Politecnico belong, allows the university to follow the vocation of the territories in which it operates and to be a stimulus for their development.

The challenge which is being met today projects this tradition which is strongly rooted in the territory beyond the borders of the country, in a relationship which is developing first of all at the European level with the objective of contributing to the creation of a single professional training market. Politecnico takes part in several research, sites and training projects collaborating with the most qualified European universities. Politecnico's contribution is increasingly being extended to other countries: from North America to Southeast Asia to Eastern Europe. Today the drive to internationalization sees Politecnico Milano taking part into the European and world network of leading technical universities and it offers several courses beside many which are entirely taught in English.

Illuminance, Apparent Brightness and Circadian Rhythms. A New Era in Lighting Design?

Alexandra KALIMERI
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Abstract

The two basic factors of lighting standards around the world are the average illuminance and the uniformity of the workplane. Today, it becomes evident that visual performance alone is not as important for interior and exterior architectural lighting. Illuminated screens and automation have shifted dramatically the way we work, live and experience our environment. Research proves that the appearance of vertical and near vertical surfaces is what affects our perception of spaces. Additionally, over the past two decades we have witnessed significant scientific breakthroughs regarding the function of our circadian system and its connection to light. The question that arises is whether illuminance should continue to be the main quantitative value mentioned in our lighting standards and guide the lighting practice. This paper provides an overview of research related to the fields of apparent brightness and circadian regulation and examines whether these criteria could be incorporated in the interior lighting design practice.

Despite being a characteristic of the humans' visual sensation, brightness can be expressed with quantitative terms. From Waldram to Cuttle, researchers have stated that apparent brightness can be quantified as a function of luminance and the adaptation level of the viewer. Although with some limitations, Hopkinson's diagram, Waldram' s Design appearance method and Cuttle' s approach provide ways of designing based on luminance. Additionally, research proves a strong correlation between light spectrum and apparent brightness. For a range of colour temperatures, the gain in perceived brightness increases linearly with the increase of colour temperature.

The spectral power distribution of a light source, its intensity as well as the timing and duration of the available light are some of the qualities that can impact the function of our circadian system. It is possible to optimize the light spectrum of lamps by taking into account the circadian action function which should be higher in the morning and lower in the evening. Also, although melatonin suppression occurs in relative high illuminance measured on the eye and appears to saturate above 1000lx, activating circadian rhythms can be effectively controlled in lower illuminance with the introduction of cooler light sources. Regarding the timing, exposure to high level of illuminance in the early or late hours of the night results to phase delay and phase advance of the circadian system respectively depending on body core temperature. Finally, melatonin' s suppression in humans starts around 10 minutes after the eyes have been exposed to light and ceases 15 minutes after return to darkness.

The lighting design of the building interior requires a new approach. It is possible to design based on apparent brightness and not illumination. Slightly developing the available tools will allow us to follow a more human centric design process. On the other hand, although circadian regulation can

be promoted with selective use of artificial lighting, the complexity of the circadian system dictates careful use of lighting techniques that can effectively entrain our day night circle.

Author's CV

Alexandra KALIMERI

Alexandra Kalimeri studied Electrical Engineering in Athens. She was introduced to the fascinating world of lighting through the Photometric Laboratory in NTUA and decided to continue her studies with the MSc Light and Lighting at UCL.

Alexandra has been involved in various different projects, from rail stations with rigid Lighting Standards to extremely creative high-end retail lighting installations. This has spiked her interest to research the variables of a holistic Lighting Design approach.

Currently, she continues her studies in Interior Design and tries to inspire the next generations of engineers through STEM activities.

Organisation

ME Engineers

OUR VISION: We shape buildings into places where people have unforgettable experiences. We design environments to live, work, and perform in, led by technical expertise and inspired by genuine innovation. We do it through talent and technology, hiring the best engineers who can get the most out of our state-of-the-art systems.

Working in a design-led, creative environment, we collaborate openly with the world's top architects and builders to develop responsive, cutting-edge engineering. It's not about doing what's been done before – it is about creating a new possible.

WHO WE ARE: We combine exceptional talent and creativity with a real understanding of what people need from their environment. Our teams are made up of hard-working, uniquely experienced engineers who have complete command over the sophisticated technology essential for modern design.

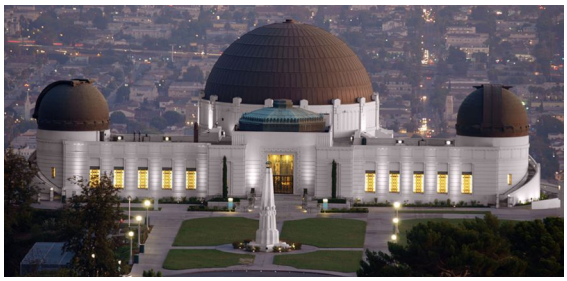

Figure 1: GRIFFITH PARK OBSERVATORY, LOS ANGELES, CA, UNITED STATES. Complete renovation of iconic landmark.

Yet advanced systems and the smartest minds will only get you so far – the only way to make a real impact is to cultivate a culture of service, to our clients, to our buildings, and to our communities. Our engineers are licensed throughout the United States as well as internationally.

HUMANIZING BUILDINGS: How do people feel inside a building? Are they thriving? Are they relaxed? Are they productive? Architects design for people, yet the work of engineers can also affect experience in just as powerful a way. Everyone needs an engaging environment.

A place that responds to their needs so they can make a strong emotional connection to where they spend their most important moments. We turn square footage into human experience.

Good Night = Good Light. New Ways to Reduce the Use of Artificial Lighting - Especially During Night

Ofer KEREN
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Keren Energy
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Israel

Abstract

We are addicted to artificial light.

The main goal of artificial Lighting development was clear: Extend the hours of “day light”

Today we use to shine every office and our own home during the day.

The goal of my workshop will by regarding 10 responses that can help us reduce artificial lighting during the day.

Completely stop lighting when there is enough natural light – Each room or space need at least five levels of lighting:

Daylight: – 1/3 of the install lighting - 2/3 of the lighting - All lighting on - And all lighting completely off

Night fell - at the base - the same feeling that we have on the sea sure the night is falling, is necessary to any human being every day in every building. Without the daily feeling of sunset, we are challenged by the lighting and it is not really safe for our health. At our home - when there is no feeling that the sun set - the situation is worse - the lighting threatens our security and our mind-set. Avoid light Invading - Invasive light is caused by light fixtures that allow us to read a newspaper ad outside the building - Invasive light block our option to see from our window and act like blinding Our own security damage it is worse than any reasonable logic - the “enemy” can see us and our actions. Our goal is exactly the opposite. As kids we learn that no one can sail against the wind and fight against the sun. Lighting at a constant tiring intensity - at night being inside a structure with constant intensity - is really unhealthy. It can be easily solved by clever use of varying intensity. It is unnatural and inhuman to be in the light with a constant intensity for a whole night.

The purpose of the workshop is to find new ways by using the power of consultants and professionals to reduce the use of artificial lighting during the evening and night hours. The goal of our workshop to identify smart solutions and better use of environmental resources. In conclusion, it is clear to us that more accidents are caused at home during the night. The children who are playing in the living room and do not see the sun set do not feel the fatigue and at one point they crash on one of the furniture. Together in the workshop we will find a way to prevent the accident. and on the road we will improve the quality of life for all of us/ Rules of thumb – not everything that shine is gold it can be just light pollution that costs us energy - and not really healthy.

Author's CV

Ofer KEREN

Ofer Keren founded Keren Energy a leading company in changing the culture of energy consumption:

Ofer brings over 30 years of experience in the Energy Efficiency field, Ofer is an expert in utilizing knowledge, experience and a great deal of creative thinking in finding diverse solutions and tailor making them for each organization. Ofer has developed a clear systematic methodology for the reduction of energy use and has proven over the years that every organization can reduce a third of the energy consumption by means of simple technology and behavior change. Ofer is considered an expert in methodological creative thinking.

Organisation

Keren Energy

Ofer founded Keren Energy Ltd. as a leading company in changing the culture of energy consumption, and management of energy resources. Keren Energy Ltd. is working within the R&D framework of the Ministry of National Infrastructures, Energy and Water Resources, Strategy Fund, Office of the Chief Scientist. Ofer brings more than 25 years of experience in the Energy Efficiency field, in industry and in many different organizations throughout Israel. Ofer is an expert in utilizes knowledge, experience and a great deal of creative thinking in finding diverse solutions and tailor making them for each organization. He has developed "Nidan's systematic methodology for the reduction of energy use" and has proven over the years that every organization can reduce a third of the energy consumption by means of "good behavior". In the past, Ofer founded and co-partnered for over 10 years "Nidan" company, working in diverse positions in the industry field in Israel (automation and robotics, management development and integrations, managing electricity and more). Ofer is considered an expert in methodological creative thinking (SIT – Tel-Aviv Uni.), a certified electrician licensed for high voltage, has degrees in Business Administration (Israeli institute of Technology – Technion), and Mechanical and Electronics practical engineering (Ruppin). Ofer served in the IDF Armored Corps as a commander's trainer and instructor. Ofer is married and a father of three.

Yet advanced systems and the smartest minds will only get you so far – the only way to make a real impact is to cultivate a culture of service, to our clients, to our buildings, and to our communities. Our engineers are licensed throughout the United States as well as internationally.

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The Process of Modern Lighting Designs

Stakeholders: How can They be Organized in Order to Achieve the Desired Quality of Public Lighting in 2030?

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Abstract

High complexity in the 'engineered' Lighting Business was so far preventing similar competition levels and disruptions in the concerned industries. According to the author of this paper, Engineering Businesses and lighting Business in particular are the next field for disruptive developments in their business structures - and this not because of the LED-Technology driven disruption but because of a completely different setup of competing structures in the markets.

"HOW DO STAKEHOLDERS WORK TOGETHER AND HOW CAN THEY BE ORGANISED IN ORDER TO ACHIEVE THE DESIRED QUALITY OF PUBLIC LIGHTING IN 2030?"

Frogs have the peculiar characteristic that they do not perceive subtle changes in the temperature: they will forget to jump out if you slowly bring water to boiling point. This "Boiled Frog syndrome" is also happening within the field of public lighting; subtle risks and changes are not noticed; it is more comfortable to keep the status quo.

It is important to periodically evaluate and monitor developments and trends, as these will affect the quality of public lighting in the future ahead. The 'Roadmap Public lighting 2030' provides a basis for working on specific situations: to be able to ask the right questions and to anticipate choices. Only municipalities and companies that understand future scenarios will understand how to act now and in the future.

This process was led by Iris Dijkstra (Atelier LEK) and Kirsten van Dam (Out Of Office). Both are qualified industrial design engineers, now specialised in lighting design and trend analysis. This combination connects the developments outside with the needs within the field of public lighting. Together with a team of different disciplines platform-meetings were organized where consultants, contractors, designers, municipalities and participants from outside the field of Public Lighting discussed different relevant topics. At the moment several spin-off projects are underway, which go deeper into the specific subjects.

FROM TRENDS TO TRANSITIONS:
RE-DEFINING THE QUALITY OF URBAN LIGHTING

The market is changing on many fronts: the advancement of LED technology, telematic monitoring, the growing demand for safety in urban environments, intelligent controls and the integration of light with monitoring. Furthermore, there is a call for less light pollution and

municipalities want to achieve the integrated management of other lighting qualities. This amounts to cooperation with new players. Companies and governments no longer decide what is good for the citizen; new values such as sharing, locality, solidarity, sustainability and human scale are becoming more central.

The investment climate and the financial capabilities of the parties that traditionally played a major role in the development of public space are under pressure. The government takes a step back and in this context other financial models and methods arise.

It is important to find a new balance and move closer to the “new advisors” and designers of public spaces. There are many opportunities, provided that all parties are familiar with terms such as social capital, smart grids, crowdfunding, sharing-economics, I-beacons, Internet of Things (IoT), 3D printers, and pop-up public values.

Summarizing the trends leads to four future scenarios in the field of public lighting. Here we see that not only the definition of traffic safety changes (imagine the city full of intelligent, self-driving cars), but also other issues and themes emerge. There is confusion about frequently used terms such as participation, innovation, social safety, ecological demands and (local) energy-grids. More content and nuance needs to be created that will lead to a better understanding of these terms. The values and interests of citizens, private parties and government play an important role in this process.

RE-DEFINING THE WAY PUBLIC LIGHTING IS ORGANISED

Every municipality is organised differently when it comes to the design, management and maintenance of public lighting. Self-knowledge is power: by understanding their own organisation and their context, they will be better prepared to foresee what the impact of the trends will be.

Experts in the field of governance, have given their view on the changes taking place in the roles of the government, the private sector and society, respectively. They foresee a rapid development of citizen participation in government through interaction, co-creation, and in many cases even by taking initiative. Also new ways of organisation are emerging, like the experiments undertaken in Eindhoven and other cities in Europe. They approach the market with a long-term vision, looking for a way to outsource the content to the market. It is then up to the market to translate the vision into requirements and substantive choices.

But all forms of government organisation should take into account the issues of 1. Lawfulness, 2. Efficient use of all resources and 3. Legitimacy. If these issues are not balanced, there is the inevitable risk of developing the ’principal - agent problem’ – when municipalities have too little knowledge compared to the contractor. Another risk is limited scope for other creative and innovative companies, other interests, when municipalities enter into long-term contracts with large all-in-one consortia.

The teams of professionals who ask the right questions and make the right choices comprise people and knowledge from the social, creative and technical fields. They connect industry, municipalities / developers, architects and users and combine knowledge of (light) technology and creativity to create practical manageable lighting applications. Furthermore, they know how to start a dialogue with users through a process, by approaching light not as a goal but as a means for creating an experience for the users. And finally, their choices are made independent of commercial interests or arguments, and thereby can achieve maximum results with minimum resources.

Team members will find each other through platforms and networks. More and more people from different backgrounds will participate in the team of public lighting professionals, and guidelines should therefore be made accessible to a wider and different audience.

CONCLUSIONS:

This process started with the question: How do the stakeholders work together and how are they organised in order to achieve the quality laid down for public lighting systems in the Netherlands by 2030? During the process a number of opportunities have emerged to link new and existing parties and to ensure the quality of public lighting in the future. The three main opportunities are: A. Platform for inspiration: exchanging experiences, inspiration, trends and best-practice examples B. Professionalisation of the discipline of public lighting by: 1. Creating a faculty to train lighting professionals, and 2. Ensuring “independent lighting professional” is a protected

title C. Creating flexible management teams for public lighting in the future, teams who are flexible, open and critical, understand their position and context, and know when and who to involve. They also remain updated on the know-how required for good quality lighting, and they use the choice-making matrix for participation and the five other new definitions before embarking on a project.

Author's CV

Iris DIJKATRA, MSc

Profession: Industrial Designer, Lighting Designer

Current position: owner Atelier LEK, ind. lighting des., Member of PLD-A 2006-2012 (end of PLD-A)

Years of professional experience: 12

Qualifications: TU Delft, industrial design engineering, 1995-2003 (MSc), Specialisation: Design for Sustainability (DfS), Lower dauphin Highschool, PA (USA) 1992-1993,

Career: Atelier LEK, 2004-now, Alfa Romeo university design intern-ship, 2001

Specialitions: Design and realization of complex assignments in public space, exterior and interior of buildings, working in co-crea- tion with a multi-disciplinary team of architects and engineers and focussing at all times on the demands of the end-user and sustainable parameters.

Organisation

Atelier LEK

Iris Dijkstra finished her Masters degree in Industrial Design Engi- neering at the Technical University of Delft ("Design for Sustain- ability") and since has specialized in lighting design. In 2004 she founded Atelier LEK (Light & Color) a widely-oriented, independent lighting design company that focusses on the quali- ty of lighting experience: in public spaces, exterior and interior of buildings.

Atelier LEK works at a variety of levels: master plans (Arnhem City Centre), illuminating architecture and art (Janskerk in Utrecht, Witte de With, Rotterdam) and interior lighting. (Headoffice Rands- tad, Theatre LantarenVenster, Library Rotterdam). But also corpo- rate identity and product-design are part of the palette of skills of our Atelier, such as the design of the Bicycle Chain for the 11 km cycling route on the RijnWaalpad and the award winning Central Plaza Rotterdam. Our Atelier is furthermore specialized in working with a range of dif- ferent disciplines in an integrated design process. Light represent- ed many values and is part of a larger whole. We therefore believe it is very important to work together with all involved disciplines and stakeholders to achieve the best quality and sustainability in the lighting plans.

Figure 1: Atelier LEK Project

Light Designer's Role in Complex Projects

Diana GALIC, M. Light Design, M. Econ.
Principal Light Designer
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Abstract

Space is defined by light. An atmosphere is created by light. Therefore, the deep understanding of the architectural content of the space, the purpose and the integrative complexity of the project is the focal point from where light design should be created.

Multilateral cooperation with the Client, Investor, Architects, Interior Designers, Architectural conservators, Engineers, the final users of the space and other subjects, makes the final results well-balanced and successful, adding the users' comfort all together.

Light concept as the most creative phase is developed by combining experience and open-minded approach to each project. In order to explain the initial light concept, a high quality lighting visualizations on 3D model of object may be created in order to show realistic future effect of the light. How to use this method and have even more powerful tool? This paper will show a specific method in the form of a special software, which include interactive elements i.e. possibility of changing various lighting scenes by the user in real time.

A lighting concept is afterwards crystallized through the analytic approach into drawings, schematic design, electrical design, specifications etc. But, during that process, from the design phase until implementation, it is necessary to have a good coordination with architects, interior designers, city government and city authorities, UNESCO, architectural conservators, sometimes even hundreds of subjects involved in project designing process. How to find the best solution for all if interests of various subjects are in contradiction? How to deal with endless changes in design inputs? How to insist on some great ideas when there is no understanding for your points? Some interesting examples from our practice will show how this problems can be resolved, sometimes by using a special tactics, sometimes with a simple humor.

Finally, we light designers, are just a small particles in a bigger, complex system in a given time. But, only if we create a great light design solution, than the work of all other subjects will be visible. If we don't lit a clock hands and all 12 numbers, than even the best clock will not accomplish its purpose to show the time when daylight disappear.

Author's CV

Diana GALIC, M. Light Design, M. Econ.

Diana Galic holds a Diploma in Master studies of Light design gained at Istituto Europeo del Design in Milan, as well as Diploma in Master study in Economics in the filed of Cybernetics. She is a principal light designer and co-owner of a company Nova-lux founded before 16 years with her husband Zlatko, Master in Electrical and Electronics Engineering. Their team of 16 people are working internationally on mega projects in Qatar, Oman, Kazakhstan, Turkey, Belgium, Austria and other European countries, they are specialized in architectural light design of stadiums, shopping malls, hotels, bridges and ancient city cores.

Organisation

NOVA-LUX

Creative and unique solutions

If you search for better and different light design and/or electrical design solutions, as a result of really creative approach.

Top quality

If you want a top service in light design and/or electrical engineering, without being worried about the final result.

A complete service

Our multidisciplinary team can take care of any task and problem in the area of light design and electrical design.

Figure 1: City of Crikvenica, Croatia. Light design of this walking area near center of Crikvenica city transform it to a romantic oasis for walking. Today, this area is a tipical street with parking slots which is not attractive during night, and the area that is supposed to be walking paths, today nobody is using. The investor wish to revive this area, to create an invitational atmophere to attract people to walk here in evening hours. By this project, they want to create a huge central area for evening walking, since between the city center and this area only a green park is situated. With the new architecture redesign made by Rechner Architects, a soul is given to this space.Our light design simple follows a story of the architects, with creating a cosy space for resting and enjoying in the view. Therefore, a simple and sophisticated architectural lighting is created for two bridges, an old one and newer walking bridge. No glare was an imperative here. Just an atmosphere.

Digitalization in Lighting – Impacts on Users and Usages

Light Connects – The Symbiosis of Light and Digital Content Creates New Levels of Customer Experience

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Abstract

Light is a transmitter of information. Initially carrying virtually no information it receives its informational content not before it reflects from material surfaces. The informative picture of our environment is generated through the interpretation of countless data received by reflected light. Neutral or uncoded light was used in the beginning of the communication between ships through using the morse alphabet in the way of short or long light signals to exchange messages on the oceans. Light as language so to speak.

Today light can offer extended informational possibilities especially in retail environments. Light directs people, i.e. through the navigation with Visual Light Communication (VLC). In comparison VLC driven navigation in interior space gives the same orientation as GPS driven navigation systems in the exterior environment. The satellites in interior space are already existent: luminaires. VLC enabled luminaires are sending out light with modulated digital signals via the LED modules. Beside those signals additional parameters are detected and adjusted with previously stored cloud data by smartphones. The identification of the position occurs with a preciseness of up to 20 centimeters. To use this system a VLC conform lighting scheme is required finalized by an on sight venue enablement. As a result a Software Development Kit (SDK) is generated as a precondition for further software extensions.

This second software component can create digital functions which lead to an enhanced customer experience. As the SDK is integrated into the customer addressing App of the retailer, additional functions can be added to the pure navigation functionality. Product search, product- and price information, shopping lists, advertising or incentive and loyalty systems with coupons can complete this kind of connected full service.

Through the optional recording of customer movements in the form of heatmaps or viewing directions operators can grasp streams of customers or goods as well as customer behaviours. Beside individualized offerings the amount of data can be used to optimize placements of goods or store layouts. In addition a targeted timing of offers can be set as well as the specific operational planning of staff. Furthermore deeper product information could be made available such as nutrition details, raw material content, or certificates of origin. Personalized offers are generating a satisfactory user experience and bonding.

The options of indoor navigation accompanied by digital services are not limited to retail at all. Applications in large infrastructure projects like airports of educational facilities as universities can be enriched by better orientation through indoor navigation as well as through extended information and communication proposals. Beside its basic function to allow a functional and emotional perception of space light can be used in the digital age to guide precisely and to connect people better. The presentation will show how VLC will work in conjunction with digital services and functionalities and will point out future applications.

Author's CV

Andreas HENRICH, Diplom Designer

Andreas Henrich has operated over ten years in the areas of product management, innovation, design and marketing in leading positions, mainly for the lighting manufacturer WILA. After taking over the company together with two partners in 2005 he lead the german entity as Managing Director until the beginning of 2017. After WILA became part of the Nordeon Group he was responsible for strategic innovation and marketing projects for the brands Nordeon, Schmitz and WILA. Furthermore he works as consultant for fh+p (Faust Henrich and Partner), a brand and innovation agency.

Organisation

fh+p (faust henrich and partner) / Schmitz WILA

fh+p is a creative office for brand architecture. That includes the development of distinctive company profiles, coherent brand strategies, innovative product-, design- and service concepts as well as marketing communications. To shape meaningful and relevant brand identities. The team works cooperatively together with a multidisciplinary network of specialists.

Lighting Control - Truly Wireless

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Abstract

Wireless lighting systems based on accepted open standards have the potential to bridge the gap between lighting control and building automation. They can collect, use and forward data from connected sensors making it usable for a wide variety of applications. The promise of wireless flexibility is especially attractive in office environments where changing usage models become increasingly common. Today, the construction of shared office spaces has surpassed that of traditional, fixed-tenant constructions in many markets. The dynamic usage model of such flexible office spaces places high demands on the flexibility of the underlying building infrastructure as the boundaries between the different areas – individual offices, shared offices, common spaces – are constantly changing. Simplified speaking, the floor and the ceiling are the only constant in such environments and infrastructure deployed there is an obvious candidate to provide automation network functionality. Wireless lighting control systems – where switches and sensors communicated with dedicated controllers connected to a number of lights are increasingly replaced by wireless lighting systems where the only connection to the light is the power supply. This naturally creates a high density wireless network. Both Zigbee and – increasingly – Bluetooth Mesh based solutions are positioning themselves to take this crucial role by advertising their credentials to be the backbone of building automation.

Wireless communication versus wireless product

Many crucial factors exist for the success of such lighting as low power wireless network. An often overlooked issue is that most wireless solutions in fact require wires. This is both expected and accepted for the case of wireless lighting where wiring is required to provide power to the light in the ceiling. For the case of the connected sensors and input devices - often located on the walls – there is however limited benefit in wireless communication if the device still requires wires to supply power. Such devices fail to fully address the specific needs of flexible and adaptable office spaces. Only truly wireless devices would do so.

Impact of batteries

Many devices that communicate without wires can be truly wireless devices. To do so, supplying power via batteries seems to be an obvious choice. The increasing adoption of operator models such as Lighting as a Service (LaaS) however shifts operational responsibility from the building owner to the company installing and operating the lighting network. Total cost of ownership and maintenance cost thereby become critical factors for profitability. Maintenance events – especially in conjunction with unplanned downtime due to battery failure - typically result in significant cost for maintenance personal and possibly tenant compensation. Battery-powered systems therefore resolve the issue of flexibility but have an impact at operational cost.

Truly wireless, truly maintenance-free

Energy harvesting wireless devices generate all energy required for their operation from their environment. The most obvious example is the energy harvesting wireless switch that generates its energy from the kinetic movement of being pressed. Energy harvesting devices by their nature do not require maintenance and can therefore have a positive impact on total cost even

though they are typically more expensive than their battery-powered counter parts. In the talk, we will present specific examples how energy harvesting sensors can meet both well-known use cases but also support new applications – such as demand-based services based on the existing lighting infrastructure.

Author's CV

Matthias KASSNER, DI

Matthias Kassner is in his role as Vice President Product Marketing at EnOcean GmbH responsible for leading the product management team, defining new products and coordinating the product marketing activities for the existing portfolio. In this function he directly was responsible for defining the new EnOcean 2.4 GHz zigbee and Bluetooth product portfolio, the EnOcean LED lighting product family and the next generation of EnOcean radio products for building automation. Prior to joining EnOcean GmbH in 2013, Matthias worked for 12 years at Texas Instruments in various positions from Wireless Field Application Engineer to Product Marketing Manager. Matthias Kassner holds the degree of master in electrical engineering (Diplomingenieur) from Technical University of Ilmenau with a specialization in high frequency radio electronics.

Organisation

EnOcean

EnOcean - the originator of the patented energy harvesting wireless technology

EnOcean GmbH is the developer of the patented energy harvesting wireless technology marketed under the brands Dolphin and Easyfit. Headquartered in Oberhaching, near Munich, the company produces and markets self-powered wireless sensor solutions for batteryless applications in the Internet of Things, which are used for building and industrial automation, smart homes, LED lighting control and outdoor environmental monitoring. The EnOcean products are based on miniaturized energy converters, ultra-low power electronics and robust radio technology in open standards like EnOcean, Zigbee and Bluetooth®. Leading product manufacturers have been relying on EnOcean wireless modules for their system solutions for the past 15 years and have installed the products in several hundreds of thousands of buildings around the world.

The self-powered Internet of Things

The Dolphin modules and Easyfit products use the energy harvesting principle, in which energy is obtained from the surroundings, to supply self-powered wireless sensor networks. The modules are based on miniaturized energy converters that convert motion, light or temperature differences into electrical energy. Together with an efficient energy management system, the energy harvesting technology facilitates communication between maintenance-free IoT devices based on open wireless standards, such as EnOcean, Zigbee and Bluetooth. The solutions are used in building automation, smart homes, LED lighting control systems as well as industrial applications.

Networked devices form the basis of the Internet of Things. They process large volumes of sensor data to make our everyday lives easier, safer and more comfortable. EnOcean's Dolphin modules are a key component of this extensive network: self-powered, wireless sensors that provide reliable sensor data for IoT systems.

The Dolphin portfolio – energy harvesting wireless modules for maintenance-free sensor solutions
The product lines "868 MHz EnOcean" for Europe, "902 MHz EnOcean" for North America and "928 MHz EnOcean" for Japan consist of batteryless, radio-based switch, sensor and receiver modules as well as various tools. They are based on the EnOcean wireless standard introduced by the EnOcean Alliance (ISO/IEC 14543-3-1X) on the sub 1 GHz band, which has proven to be a resounding success in building automation and smart homes, due to its high reliability and a radio range of up to 30 meters. Standardized sensor profiles help ensure the interoperability of more than 1,500 products from the EnOcean ecosystem, which makes it possible to develop interoperable system solutions.

The Dolphin portfolio also includes the "2.4 GHz zigbee" product line with energy harvesting wireless switch modules as well as a wireless receiver for zigbee systems in the 2.4 GHz band, which can be used in smart home applications all over the world. Moreover, the "2.4 GHz BLE" portfolio includes a wireless switch module for Bluetooth® systems for modern lighting control.

Radio-based 2.4 GHz Bluetooth® Low Energy (BLE)-based sensors will follow in 2017.

Best Practice in Wireless Lighting Controls

Antonio ARTECHE
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Abstract

Antonio Arteche of Casambi will explain how many different lighting design projects have been implemented using a new advanced wireless control system. The lighting controls market is experiencing a boom, thanks to the demand to save energy, and the exciting new control capabilities on offer. But controls can still be complicated to design, difficult to install and fraught with compatibility issues. In many cases, controls never quite meet the user's needs or expectations.

Now, a new generation of wireless controls is changing all that. It has long been possible to dim and switch lights from portable controllers, but today's controls are wireless from end-to-end, and are compatible with the mobile devices including smartphones, tablets and smart watches. This makes it possible to bring seamless, user-friendly wireless control to an ever greater variety of projects. The rise of Bluetooth Low Energy (BLE) – which comes as standard on most mobile devices today – provides an ideal basis for wireless lighting control. Casambi's control system, developed by a Finnish company whose founders cut their teeth at Nokia, is based on BLE. This presentation will outline the key advantages of wireless control, arguing that wireless represents a paradigm shift in lighting control and will soon be deployed everywhere. The presentation will refer to high-profile real-life international installations and provide a planned live remote-control demonstration.

Easier to set up and use

Wireless light fittings and control devices with connectivity built-in are easy to install, with no extra wiring, planning or special instructions required. The days of clunky dedicated controllers are gone - user-friendly apps on modern smart devices mean commissioning and controlling the lights is easy too – and end users can easily make changes themselves. Commissioning can even be done remotely.

More cost effective

On top of the energy savings made possible by occupancy and daylight controls, wireless solutions unlock major cost efficiencies by eliminating the need for new cabling or specialist help with commissioning.

More flexible

Because no new cabling is needed, wireless solutions are particularly attractive for retrofit applications, sensitive buildings and installations that change regularly. But users are now waking up to the wider benefits for all kinds of applications. Wireless controls are simple to reconfigure at any time, so installations can easily be tweaked as areas are repurposed or business needs change. And switches and sensors can be placed wherever you like, allowing users to make the most of a space. More robust Today's wireless controls are robust by design. Casambi, for example, creates a self-organising and self-healing mesh network of luminaires and control devices. It does not rely on a gateway or router to communicate, so there's no single point of failure, and your lights do not need to be connected to the internet. The free Casambi

mobile app is regularly updated, and firmware can be updated wirelessly.

New capabilities

Wireless controls open up the possibility for more users to take advantage of the internet of things (IoT) and to benefit from features such as tuneable white lighting and dynamic beam shaping.

Author's CV

Antonio ARTECHE

Antonio Arteche is the Business Development Director at Casambi spearheading specification promotional activities around the world. Based in Madrid, he also has direct sales responsibility for Argentina, Chile, Spain and Portugal.

With over 25 years' experience of developing business for leading global brands within the building management systems (BMS) sector including Honeywell and Johnson Controls, Antonio joined Casambi having served as Managing Director of Zumtobel Group Spain and Portugal, focusing on the sales of lighting control systems.

Organisation

Casambi

Background

Casambi was founded in summer 2011 by Timo Pakkala, CEO, and Elena Lehtimäki, CTO, with the belief that smartphones and wireless technologies can fundamentally change the way we interface with everyday objects around us. Timo and Elena have a long history of creating innovative software solutions both in Nokia as well as in start-ups.

Bluetooth Low Energy

The Casambi solution is based on Bluetooth Low Energy, the state-of-the-art wireless technology and the only low power wireless technology in all modern smartphones, tablets and even smart watches, making it the only mainstream and future proof low power radio technology in the world. Bluetooth Low Energy was developed at Nokia Research Center where both Timo and Elena worked. That's why Casambi has had the unique advantage in realising the potential of Bluetooth Low Energy early on. Casambi started the development of the solution before there were any Bluetooth Low Energy devices on the market.

Market leader

Today Casambi is the clear leader in modern wireless lighting control solutions based on Bluetooth Low Energy. Key aspects of the Casambi solution are great user experience, high performance and scalability from basic individual fixture controls to industrial scale solutions with cloud based remote control, monitoring and data logging.

Business Model

Casambi's business model is to be a technology and solution provider for our partners. Casambi technology can be integrated into fixtures, LED-drivers and even with the LED-modules, creating an optimal solution in terms of ease of installation and functionality with minimal additional hardware and deployment costs.

Latest LED Technology Trends

Morning to Evening - Healthy Lighting

Sangwook JUNG, PhD
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Germany

Abstract

The light is the most important modulator to regulate human circadian rhythm. The change of exposure to lighting would affect the intrinsic human circadian rhythm. The changed circadian rhythm over time can be associated with health problem such less sleep or reduced cognitive performance. Light detection plays an important role in being involved in both image and non-image forming functions. Among retinal ganglion cells, intrinsically photoreceptive retinal ganglion cells (ipRGCs), are known to integrate both photo-entrainment and reflexive responses to the brightness of light. Specially, it should be noted that ipRGCs play a major role in regulating circadian rhythms such as 24-hour light/dark cycle to transduce a light stimulation directly to the suprachiasmatic nucleus (SCN) of the hypothalamus, the circadian pacemaker of the brain. The ipRGCs have a specific photoreceptor pigment, which is a melanopsin. The melanopsin with an unique action spectrum is known to be excited by mainly the blue part (460nm 500nm) of the visible light (absorption peaks at 480 nm). The control of circadian rhythm through ipRGCs has been shown to be tightly associated with sleep, alertness, and cognitive performance.

It is interesting that the blue light in natural light spectrum is clearly changing over time for a day. The blue light part begins to increase in the morning right after sunrise, and it goes and keeps its high level for the whole afternoon, then decreases rapidly in the evening after sunset. Therefore, ipRGCs detect these changes in blue part over time from natural light, and send biological signals to SCN, the circadian pacemaker of the brain. This signal transduction would directly associated with the regulation of circadian rhythm.

Here, it should be noted that these days most of people spend their time indoor such as office and classroom during day and night under the artificial lighting. SunLike light is close to the spectrum of natural sunlight to the greatest extent. Further, its blue part is also similar to natural sunlight. Thus the SunLike lighting system with dynamic and continuous CCT simulating a natural light from morning to evening might contribute to keeping a natural circadian rhythm in human and finally positive effects on human health.

Author's CV

Sangwook JUNG, PhD

2014. 07 – Current Principal Research Investigator, SeoulViosys Co. (SVC), Ansan, S. Korea

2013. 08 – 2014. 06 Research Fellow, Seattle Childrens Hospital Research Institute, Seattle, USA

2005. 09 – 2013. 08 Senior Fellow/ Acting Instructor (Faculty level), Neurology, University of Washington, Seattle, USA

2000. 08 – 2005. 08 Ph.D. Molecular Biology Program, University of Texas at Austin, USA

Organisation

Seoul Semiconductor

Seoul Semiconductor develops and commercializes light emitting diodes (LEDs) for automotive, general illumination, specialty lighting, and backlighting markets. As the fourth-largest LED manufacturer globally, Seoul Semiconductor holds more than 12,000 patents, offers a wide range of technologies, and mass-produces innovative LED products such as Wicop – a simpler structured package-free LED which provides market leading color uniformity, cost savings at the fixture level with high lumen density and allows design flexibility; Acrich, the world's first high-voltage AC-driven LED technology developed in 2005, includes all AC LED-related technologies from chip to module and circuit fabrication, as well as multi-junction technology (MJT); and nPola, a new LED product based on GaN-substrate technology that achieves over ten times the output of conventional LEDs.

Tunable Lighting Systems for Optimal Health in Humans and Plants

Tom JORY, MBA/EE
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Luminus Devices
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Abstract

One of the emerging benefits of LED lighting is that the technology can be leveraged to create tunable light sources, thus enabling luminaire manufacturers to deliver human centric lighting and horticulture lighting systems which can be tuned for optimal spectral benefits during a daily or seasonal cycle. This workshop will demonstrate best practices involved in designing such systems from the optimal choices in LEDs, power supplies, optics, thermal management, control systems, and user interfaces. The workshop is a collaboration involving subject matter experts in each of these areas. Come and enjoy an interactive workshop where teams will collaborate on the design of a horticultural lighting system delivering the full range of visible wavelengths and even UV and infrared. Another team will focus on human centric lighting, where we'll go beyond CCT and CRI by creating a luminaire with high and low melanopic over photopic ratios enabling health, well-being, alertness, and preparation for sleep. Attendees will be given a brief presentation from the subject matter experts, and then teams will enjoy a plug-and-play workshop where various system options can be assembled and tested in a hands-on environment.

Led by Tom Jory with other partners to be confirmed, such as Opulent, Cuvee Systems, Casambi, Ledil, and Versalux.

Author's CV

Tom JORY, MBA/EE

Tom Jory has 25+ years of experience in the LED industry, and he manages the team responsible for Luminus' general illumination business. His prior roles have included: VP of Marketing at Swarco Traffic Americas, several key roles at Philips Lumileds Lighting, VP of Marketing and Sales at BridgeLux, and VP of LITE-ON's Optoelectronics Division in the US. In these roles, Mr. Jory has built a consistent track record of creating profitable business and winning major supply contracts with large customers. He received his BS in Electrical and Computer Engineering from UC Santa Barbara his MBA from Santa Clara University.

Organisation

Luminus Devices

For almost two decades, Luminus has worked with the community of light to solve its most challenging problems. For much of its first decade Luminus focused on improving energy efficiency, light output, the quality of light, and longevity, and developing new form factors to address the needs in many different application areas including architectural and urban, displays and projection, horticulture and illumination.

Over the last several years, having successfully addressed technology challenges, Luminus has been working with lighting designers to make sure that our LED technology can replace CDM, halogen and other conventional technologies without sacrificing color quality, center beam punch, sparkle, and dimming capability and quality.

We have worked with farmers and growers to refine our LED technologies so that our horticulture LEDs can enable optimum growth and crop yields for a variety of agricultural products including livestock and plants.

Industrial, medical and entertainment companies that are advancing diagnostic, healthcare, infrared and automated systems and have unique requirements for both form factor and light specifications and Luminus deploys specialists who understand the challenges and needs of these markets so that our products solve problems.

Our teams are working hand-in-hand with the automotive, display and projection industries most innovative companies to illuminate everything from heads-up displays to projection systems for the next generation of vehicles and consumer technologies.

While on first glance, Luminus may look like a LED company, we're really a company that's focused on solving lighting problems inside, outside, for living and for working.

CHAPTER C

PANELS & WORKSHOPS

Women in Light – The Digital Era

PANEL: Women in Lighting – The Digital Era, a Step Back a Step Forward

Mahdis ALIASGARI, Barbara Rodriguez PANDO
Lighting Designer
LIGHTING DESIGN COLLECTIVE
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Spain

Abstract

This panel seeks to explore the means and ways of meaningful lighting design proposals in the digital era. The topics cover the full design process from the very early phases of the design till the technicalities and realization of a project.

1. What are your incentives when it comes to choose between an 'analog' vs. digital lighting design concept?
2. In case, you need to convince your client, what's your argument?
3. Have you ever had a project where you were not convinced a digital approach would be a meaningful solution for a certain project?
4. Can you unfold the conceptual design process within your design practice?
5. When it comes to apply new technologies, where is your source of inspiration?
6. What kind of technical challenges have you faced within the digital lighting proposals?
7. How have you overcome these challenges?
8. What is your experience in establishing a link between digital and physical worlds in your designs?
9. What would you share with the audience about your most valuable learning in designing digital lighting?

Author's CV

Mahdis ALIASGARI

Lighting Designer

Masters degree in Architectural Lighting Design; KTH, Sweden; 2013

Masters degree in Architecture; Art & Architecture University, Tehran; 2010

2015 to present: Lighting Design Collective, Madrid, Spain; Lighting Designer/Researcher

2013 - 2015: Interactive Institute of Sweden (RISE), Madrid Spain; Design Researcher

2009-2010: Abmis Pars Architects, Tehran, Iran; Architect

2008-2009: Farbod Consultants, Tehran, Iran; Assistant Architect

2005-2008: DTO, Tehran, Iran; Research Assistant

Barbara Rodriguez PANDO

Lighting Designer

Masters degree in Architectural Lighting Design; Technical University, Madrid; 2013

Masters degree in Architecture; Technical University, Madrid; 2010

2014 to present: Lighting Design Collective, Madrid, Spain; Senior Lighting Designer

2013 - 2014: Vbo Spagna, Madrid Spain; Lighting Designer

2013: Amid Cero9, Madrid, Spain; Architect

2010-2012: Suma Arquitectura, Madrid, Spain; Assistant Architect

2005: Solid Arquitectura, Madrid, Spain; Architect Internship

Organisation

LIGHTING DESIGN COLLECTIVE

Lighting Design Collective (LDC) specializes in customized architectural lighting solutions and applications with a uniquely integrated portfolio covering cutting-edge services such as digital content creation, software development and innovative design strategies.

We create imaginative, state-of-the-art lighting schemes for architecture and built environments using design research based on high tech applications, digital content and artistic assets. Our multicultural team of lighting designers, software coders and digital artists has created world-class projects in more than 20 countries. Our professional and artistic experience covers cultural, hospitality, retail, office, and mixed-use schemes as well as residential, landscape and infrastructure developments. As a complementary service, we design contemporary luminaires that capture the essence of our design philosophy. Based in three studios in Europe, we operate globally with a network of collaborators stretching from Madrid to Miami, London to Mexico and Hong Kong to Helsinki.

LIGHTING DESIGN: We strive to achieve a sophisticated dialogue between light, space and time. We combine observation and study of natural light with cutting-edge insights into the latest technical possibilities of artificial lighting. Our work showcases how light can take on a multitude of roles in architecture, built environments and cities through innovative combinations of art and commerce. This ranges from improving functionality and aiding orientation for increased usability, to the experiential reinvention of visual space for revenue, and from the improved recall to strategic value of creating identity.

DIGITAL CONTENT: Media, screens and projections are the facades of this century. Our dedicated visual professionals, software coders and artists have the talent and flair to meet project needs from custom software development to generative visual code, from interactive light installations to brand-related content libraries and digital art collections. We create time-based design interventions through skillful integration and sophisticated scenography that only truly multidisciplinary teams can achieve. We have written over 20 custom software packages for interactive lighting control.

LIGHT ART: Rooted in a fascination with natural light in movement and the infinite ways light relates to time, space and context, our design work extends into explorations of lighting as a form of art.

Our site-specific light art has been recognized by numerous international awards and included in public, private and museum collections.

RESEARCH: We engage in international research and professional debate about the role of lighting design, digital content and light-art in built environments. We lead our own research program based on yearly learning cycles combining humanities, high tech and design experimentation. This varies from multidisciplinary dialogs with thought leaders to the prototyping of advanced solutions that embody our future visions in our customer projects.

www.ldcol.com

Visual Perception and Health Demonstration

WORKSHOP: LED Lighting Concepts: Visual Perception and Health – Demonstrations

by Wilfried POHL, Mag., Bartenbach

WORKSHOP: LED Lighting Concepts: Visual Perception and Health – Demonstrations

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Co-Author(s): Siegmund Staggl

Abstract

Workshop Description

The knowledge about light impacts on human and about human needs has increased significantly over the last two decades, but recommendations and guidelines for lighting design are missing. In this workshop practical recommendations for planners and the most important features regarding visual perception and non-visual effects which have to be respected for LED applications are demonstrated. Answers to the questions “which lighting designs represent HCL lighting solutions today” should be given. In a 1:1 demo-booth different lighting scenarios with diffuse panels, accent light, direct (task) light and wallwashers can be shown. The retinal illumination (one of the parameters for non-visual light effects) can be measured and compared (e.g. the difference between vertical illumination at eye level and retinal illumination can be demonstrated).

Other photometric parameters and their influence on humans are also considered:

- Glare, discomfort, light pressure

- Spectral quality (color rendering, fidelity, and preference; whiteness, color mixing white – white and black body line, etc.)

- Light directness and shadowness (radiation field)

- Flicker and stroboscopic effects

Recommendations will be given to quantify these effects.

Lessons Learned

Awareness for the critical features of LED applications will be increased, and (some new) quality criteria (measures) with value ranges will be given. Proposals for solutions will be made.

Author's CV

Wilfried POHL, Mag.

Studied mathematics and physics, started 1985 at Bartenbach, since 1998 Member of Managing Board and Director Research, dealing with artificial lighting, daylighting and building physics, visual perception and light and health. Leader of various international planning and R&D-projects in these fields. Lecturer at different universities, university teaching position at the Lighting Academy Bartenbach (a branch of the University of Innsbruck), several scientific papers and presentations, participation in international advisory boards.

Papers/Presentations: • Spectral Quality - Einfluss des Spektrums auf den Menschen; LICHT 2014, Den Haag • From Digital Lighting to Smart Lighting Smart Lighting; Smart Lighting Conference, Barcelona 2014 • Lighting with LEDs – More than just Illuminating Objects; LpR50, July 2015 • Licht und Technologie: Licht im Wandel; Architekturjournal wettbewerbe, Juli 2015 • Light and Health – newest research findings and its applications; LpS 2016 Bregenz • Energieeffizienz und Helligkeitseindruck im Verkauf; Licht 2016 Karlsruhe • Biodynamische Beleuchtung – Anwendungen und wissenschaftlicher Hintergrund; Licht 2016 Karlsruhe • HCL – Just a phrase?; Tagung Smart Lighting 2017, Hamburg • New daylight solutions for energy and health; Tagung Luxeuropa 2017 Ljubljana • LED-Beleuchtung – Demonstration der Chancen und Risiken; Kongress lighting technology, Essen 2017 • Trends in Lighting – Demo Quality; Kongress LpS 2017 Bregenz

Organisation

Bartenbach

"Not from the luminaire to the overall ambience but from the desired effect to the lighting concept using the findings in perception psychology. And then applying physics and photometry to arrive at the optimal luminaire type respectively lighting system." Prof. Dr. h.c. Ing. Christian Bartenbach

Lighting Design in Digital Times

WORKSHOP: Evolution of Lighting Design Processes in Digital Times

by Holger LEIBMANN, DI Architect, Zumtobel

WORKSHOP: Evolution of Lighting Design Processes in Digital Times

Holger LEIBMANN, DI Architect
DI Architect
Zumtobel
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Austria

Abstract

Workshop Description

Due to the digitalization of building design process 3D geometry is available for an increasing number of projects. The purpose of this geometry is not predominantly the visualization of spaces but for the generation of 3Dimensional Database (Building Information Modelling). Nevertheless this information is also used to evaluate the quality of the spaces.

There are software solutions to visualize BIM models in real time and even allow the presentation with high end VR Devices, but they do focus on the presentation of the architectural spaces and are optimized for visual quality rather than for the evaluation of the lighting concept.

HILITE is a lighting simulation technology that was developed in a research project together with VRVIS in Vienna and it offers a simulation technology with the main focus on lighting simulation while still using elements that are bases on visualization technology initially developed for video games.

It is possible to place and manipulate luminaires, objects and materials whilst seeing instantly how this affects the lighting situation in the space. Due to the instant feedback, the lighting design process becomes less iterative but more intuitive.

We developed a workflow that allows the efficient generation of 360 degree panorama images for different locations and for different lighting scenarios and to combine the different panoramas into a virtual tour. The result can be uploaded to a web server and therefore viewed via web browsers but of course the tours are optimized for mobile devices that can also be inserted into basic VR devices (Cardboard Type).

In the workshop the participants will have the opportunity to use HILITE on training laptops and to create their own lighting solutions for a small lighting project. Once the lighting design is finished they can generate a 360 degree panorama tour which we will make available online so that it can be viewed on mobile devices after scanning a QR code. Basic Cardboard devices will also be available for the participants.

Due to the interactive nature of the workshop and the necessary hardware the maximum number of participants should be limited to 15 – 20 who will work together in groups of 2-3 participants.

Author's CV

Holger LEIBMANN, DI Architect

Holger Leibmann studied architecture at the Technical University Darmstadt in Germany until 2005 subsequently working as an architect in London and Berlin. He joined Zumtobel Group in 2011 focusing on explaining the advantages of good lighting solutions. This happens on the one hand supporting lighting projects and on the other hand supporting the development and training of lighting design tools and methods.

Organisation

Zumtobel

Zumtobel Group Services (ZGS) offers a service portfolio for the entire lighting sector. ZGS brings all the services of the Zumtobel Group together under one roof, helping us to redefine the connected lighting and services market. The Zumtobel Group is an international lighting group and a leading player in the lighting industry. With its internationally established Thorn, Tridonic and Zumtobel brands, as well as acdc and Zumtobel Group Services, the Zumtobel Group offers customers all around the world a full range of products and services.

LED World Market Leader Showcases the Latest Trends

WORKSHOP: Experience How New LED Technologies Raise the Bar in Human Centric Lighting
by Giovanni Vecchio, Nichia

WORKSHOP: Experience How New LED Technologies Raise the Bar in Human Centric Lighting

Giovanni Vecchio
Head of Sales & Marketing
Nichia
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61476 Kronberg
Germany

Abstract

Workshop Description

In this workshop the audience will experience light based on optimized spectrum and other LED innovation. This interactive session lets the audience “see, touch and feel” the new technologies discussed in the LpS lectures; “LED Spectrum Optimization for Improvement of Human Performances and Psychophysiological Responses” and “LED Innovations for the Improvement of HCL Luminaires”.

Author’s CV

Giovanni Vecchio

Giovanni Vecchio is Head of Sales and Marketing for General Lighting, Nichia Chemical Europe GmbH. Mr. Giovanni Vecchio has 20 years’ experience in the semiconductor industry and has been with Nichia for 7 years. He took the position of Head of Sales and Marketing for General Lighting, in March 2018.

Organisation

Nichia

Nichia Corporation (Nichia Kagaku Kōgyō Kabushiki-gaisha) is a Japanese chemical engineering and manufacturing company headquartered in Anan, Japan with global subsidiaries. It specializes in the manufacturing and distribution of phosphors, including light-emitting diodes (LEDs), laser diodes, battery materials, and calcium chloride. The Nichia Corporation comprises two divisions — Division 1, responsible for phosphors and other chemicals, and Division 2, responsible for LEDs. In the field of phosphors the company has 50% of the Japanese market and 25% of the world market. Nichia is the world’s largest supplier of LEDs. It designs, manufactures, and markets LEDs for display, LCD backlighting, automotive and general lighting applications with the many different leds across the entire visible spectrum. Nichia’s invention and development of white LEDs have spanned several accomplishments throughout the history of the company.

How to Install a Bluetooth Mesh Lighting Control System

WORKSHOP: Setting up a Robust Lighting Control System with Bluetooth Mesh - From Commissioning Basics to Troubleshooting

Michal HOBOT, MSc
VP of Product
Silvair
Jasnogorska 44
Krakow 31-358
Poland

Abstract

Workshop Description

Since its adoption in 2017, the Bluetooth mesh standard continues to gain momentum in professional lighting applications. Gearing up for a widespread rollout of Bluetooth mesh lighting networks, we will have a hands-on workshop on setting up such wireless lighting control systems. From commissiong basics, through best practices, to troubleshooting - we will cover all relevant areas to make sure attendees leave with practical knowledge that can be applied to real-world experiences.

Lessons learned:

1. What components are needed to set up a Bluetooth mesh lighting network? What are the possible integration options for luminaire manufacturers?
2. How to commission a mesh lighting network? What tools are needed? What the entire process looks like step-by-step?
3. How to add a gateway to a Bluetooth mesh network? What maintenance and diagnostics data can be obtained through it? How to manage that data to generate value?
4. What are the lessons learned from the first real-life implementations at office, warehouse and school environments?
5. Bluetooth mesh troubleshooting: how to avoid potential difficulties and how to optimize network performance in radio-dense environments?

Author's CV

Michal HOBOT, MSc

VP of Product at Silvair, member of the Mesh Working Group at Bluetooth SIG.At Silvair, Michal has been defining smart lighting control platform-as-a-service based on the interoperable Bluetooth mesh networking standard. He has been involved in a number of product and project management roles for both cloud and mobile software.

Organisation

Silvair

Silvair is an American company with Polish roots that builds software solutions for the Internet of Things (IoT). Operating on the global market, Silvair is pursuing its strategic goal of becoming a leading supplier of modern technological tools for IoT applications. Currently, the company is focusing on developing a technology for lighting manufacturers and providers of intelligent building management systems. It offers the Silvair Lighting Firmware, as well as digital tools based on the Bluetooth mesh standard that allow for building the Silvair Platform.

Silvair's product range includes firmware for smart lighting components manufactured by third-party companies. In addition, the company provides tools for configuring, controlling and managing the lighting infrastructure, as well as tools for analyzing and using the data collected by sensors installed as part of lighting systems: Silvair Firmware is software that can be installed by lighting manufacturers in their components. It allows devices to wirelessly communicate with each other. This in turn enables autonomous control over the intensity and color temperature of light, while also making it possible to collect data on the ways the space and devices themselves are used. Silvair's firmware is offered to manufacturers of lighting components, including drivers, sensors, fixture controllers, switches, etc. platform developed by the company. It includes digital tools for commissioning, configuring and managing smart lighting networks, as well as an infrastructure enabling the company to provide a range of innovative services, e.g. the ones related to property management. These services will be associated with the collection, processing and visualization of data generated by sensor-driven smart lighting networks. They will be provided remotely through a dedicated website and cloud-based solutions.

Silvair Platform is a technology and service platform developed by the company. It includes digital tools for commissioning, configuring and managing smart lighting networks, as well as an infrastructure enabling the company to provide a range of innovative services, e.g. the ones related to property management. These services will be associated with the collection, processing and visualization of data generated by sensor-driven smart lighting networks. They will be provided remotely through a dedicated website and cloud-based solutions.

Light-Guides and OLED Workshop

WORKSHOP: Next Generation Lightguides, OLED and R2R Manufacturing

by Jose POZO, PhD, EPIC – European Photonics Industry Consortium

WORKSHOP: Next Generation Lightguides, OLED and R2R Manufacturing

Jose POZO, PhD
Director of Technology and Innovation
EPIC – European Photonics Industry Consortium
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France

Abstract

Workshop Description

This meeting addresses both manufacturing achievements around roll-to-roll production of flexible optoelectronic products, such as OLEDs for lighting and displays, next generation light guides and light panels. Until very recently, these applications have had as common drivers that their markets were very large (requiring several millions of square meter/year) and that they needed to be produced very cost-efficiently. However, new market demands go beyond the high luminance uniformity, and claim customized features such as colors, shapes, lightweight, wearability,.... The purpose of this workshop is to study what are the key markets and applications that demand R2R and R2S manufacturing for customized lighting solutions.

Author's CV

Jose POZO, PhD

Dr. Jose Pozo is Director of Technology and Innovation at EPIC (European Photonics Industry Consortium). As EPIC's CTO, he represents 350 companies active in the field of Photonics. His job consists on actively engaging with them and provide them with tools to strengthen their position in the supply chain; such tools are the organization of 20 technology workshops per year, provision of market intelligence and finding B2B leads. He has the vision that the future of optoelectronic manufacturing can take place in Europe to a large extent, and as part of that vision he is actively involved in the EU-funded pilot lines. He has 20 years' background in photonics technology, market knowledge, and a large network within the industrial and academic photonics landscape. Dr. Pozo holds a Ph.D. in electrical engineering from the University of Bristol, U.K., and a M.Sc. and B.Eng. in telecom engineering from UPNA (Spain) / VUB (Belgium). In addition, Dr. Jose Pozo has worked as post-doctoral researcher at the Eindhoven University of Technology (The Netherlands), EU proposal coordinator at TNO (The Netherlands), and Sr. Photonics Technology Consultant at PNO Consultants.

Organisation

EPIC – European Photonics Industry Consortium

EPIC is the industry association that promotes the sustainable development of organisations working in the field of photonics in Europe.

Our members encompass the entire value chain from LED lighting, Photovoltaic solar energy, Photonics Integrated Circuits, Optical components, Lasers, Sensors, Imaging, Displays, Projectors, Optic fiber, and other photonic related technologies.