Intelligent Lighting Institute | Edition 15, November 2021

ILIGLOW

> GLOW COMES FROM WITHIN THE CITY

> GLOW AT TU/E

> LIGHTING UP THE 'GREAT PLACE TO WORK'

> DEVELOPMENT OF A NEW ROAD LIGHTING CONCEPT

TU/e

EINDHOVEN UNIVERSITY OF TECHNOLOGY

Content

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HAROLD WEFFERS | OPERATIONAL MANAGER

Welcome

I am very pleased to once again be able to present to you a new GLOW edition of our ILI Magazine. As you will see, we have been able to establish new partnerships further strengthening ILI and we have been able to successfully complete several new R&D and (technological) innovation projects as well as start several new ones, hire several new talented researchers, and are still very active in various education programs as well as in TU/e innovation Space.

In this edition, we also have a number of relevant interviews shining a light on related work on light & lighting to the benefit of society at large and we share with you some details of the installations students and staff of TU/e have been developing over het past months for the 2021 edition of the GLOW Light Art Festival showcasing aspects of the results of R&D and (technological) innovation on Intelligent Lighting.

Pleasant reading!

Harold Weffers
Operational manager

ILI PhD theses

Learning Sensory Representations with Minimal Supervision Aaqib Saeed (Department of Mathematics and Computer Science, Interconnected Resource-aware Intelligent Systems), 24 June 2021. Advisors: Johan Lukkien and Tanir Özçelebi

Modeling the Temporal Behavior of Human Color Vision for Lighting Applications. Xiangzhen Kong (Department of IE&IS, Human Technology Interaction), 5 July 2021. Advisors: Ingrid Heynderickx, Ingrid Vogel and Dragan Sekulovski (Signify).

Advanced freeform optics for illumination applications Karel Desnijder (Faculty of Engineering Technology, KU Leuven) September 2021. Advisors: prof. dr. Youri Meuret and prof. dr. Wouter Ryckaert (co-promotor)

Generated Jacobian Equations in Freeform Optical Design: Mathematical Theory and Numerics Lotte Romijn (Department of Mathematics and Computer Science, Computational Illumination Optics), 19 October 2021. Advisors: Wilbert Ijzerman, Jan ten Thije Boonkkamp and Martijn Anthonissen

Integrative Lighting Illuminated: Reconsidering manipulations, measurements, and quantification of light. Samantha Peeters (Department of IE&IS, Human Technology Interaction), 20 October 2021. Advisors: Yvonne de Kort and Karin Smolders

Light directionality in design of healthy offices, Exploration of two methods Parisa Khademagha (Department of Built Envionment, Building Lighting). Advisor: Marielle Aarts

"Important for ILI is that with a Lustrum the TU/e campus is part of GLOW. "
Ingrid Heynderickx
Scientific Director

INGRID HEYNDERICKX | SCIENTIFIC DIRECTOR

ILI celebrates

ILI has several reasons to celebrate. The first one is that we are happy to join the 65th Lustrum of the Eindhoven University of Technology with its theme "Heroes Like You". We congratulate the university with its anniversary!

Important for ILI is that with a Lustrum the TU/e campus is part of GLOW. Around 60 heroic students are working like hell to prepare 10 exciting installations for GLOW on the campus. In the second week of November, from November 6th till November 13th, ILI and the student community will show what they are capable of. Stories accompanying the installations will provide more background information at GLOW. As a regular reader, you find a glimpse of what you can expect in the Magazine.

A second reason to celebrate is that ILI welcomes two new partners: the group of Prof. Pont of the Delft University of Technology and the group of Prof. Hanselaer of the Catholic University of Leuven. Now that hybrid meeting has become widespread, it is easier for representatives of both groups to join our regular meetings and events. As ILI we are very happy to have their complementary fields of expertise represented in our broadly recognized lighting research institute.

The Covid-related situation in the Netherlands right now allows ILI to organize its yearly outreach ILIAD event on campus again, after one year of absence. That is a very celebrative moment as well! Building further on the interviews we printed in our last edition of the ILI Magazine, also ILIAD will focus on the effects of light on humans, animals, and plants. We will have interesting external speakers on these topics and hope to establish new relations for researching these topics in a more orchestrated way.

#TUE65 HEROES LIKE YOU 1956★2021

INTERVIEW | TOM WEERTS (MANAGER PRODUCTION, DEVELOPMENT & FOREIGN AFFAIRS AT GLOW EINDHOVEN)

By Michiel de Boer (MOESASJI)

GLOW comes from within the city

Tom Weerts shares insights on the development of GLOW, safeguarding artistic exclusivity and crowd management.

"In a sense, Corona was a blessing. It forced us to take measures and to develop another approach," says Tom Weerts, Manager Production, Development & Foreign Affairs at GLOW Eindhoven. The enormous popularity of the light art festival raised numerous challenges. Tom Weerts shares insights on the development of GLOW, safeguarding artistic exclusivity and crowd management.

After years of rapid growth, GLOW celebrated its absolute peak with the 2019 edition. Tom Weerts: "The visitor numbers were really over the top. Around 770.000 people walked the walk, causing enormous swarms of people in the streets, day after day. We concluded: a single route through the city center was no longer possible to keep the festival safe and fun! And after 14 years, we were ready for a new approach as well. Then, Corona emerged."

JOURNEY TO A NEW SET-UP

With COVID-control measures becoming increasingly strict mid-year 2020, the GLOW organization was scratching its heads. It didn't want to cancel the festival completely, especially since it would be more than welcome for the city to bring some light in the darkness of the second Corona wave. Tom: "We had to come up with a complete other set-up. Something that was not a festival. An event with no public, no route, no program. After some explorations, we figured out a unique approach. In collaboration with artists and GLOW-veterans Ivo Schoofs and Kari Kola, we decided to make one work, one message throughout the city. 'Connecting the Dots' turned out to become the largest light artwork in the history of humankind. Where we usually have to

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GLOW 2016

manage around 30 locations, we now scaled up to 600 locations!" The streets, corners, buildings, facades, and trees of Eindhoven turned in deep blue light from around 2500 mega lighting units. 1000 large helium balloons - red dots - were positioned in the streets one by one.
"It was enormous by its scale alone. People, cities, and media worldwide were flabbergasted. Connecting the Dots was an artwork you could experience without even visiting it. It was just everywhere. When I heard a lady in the street say 'it is so beautiful, so soothing to experience the city like this!', we were convinced: breaking with the old GLOW route pays off."

4 AREAS

GLOW 2021 has a more modular concept. GLOW appointed 4 areas in the city that each will bring several works: the center, Strijp-S & Strijp-T, TU/e Campus, and the Campina Complex. Next to that, there are two satellite locations: High Tech Campus and Nuenen. Tom: "This way the works will be spread throughout the city, each with a different charm and offering visitors the opportunity to maintain distance towards each other if they want to."
The locations match the character of the city ranging from design and creative industry to technology and industrialization. Tom: "What is truly unique for GLOW is that all the works are exclusively created for the festival. We do not feature artists that display traveling artwork in different cities in the world. GLOW brings works that have been created for their specific location in Eindhoven. The city makes GLOW! As the organizing committee, we are involved in guiding the artists to the character of the festival and the possibilities Eindhoven has to offer. Moreover, we support them with all sorts of practicalities: location search, technical and construction support, and of course communication, hospitality, and crowd management."

DEVELOPING WITH STUDENTS

For 8 years GLOW is connecting with education. Over the years a number of works have been developed by enthusiastic groups of students from Sint Lucas, Fontys Hogescholen, and TU/e. Tom: "It started rather experimental and fragile. As a sort of side dish. But over years it has developed into full-fledged participations. Within GLOW Development we provide consultation and support for the student teams. In GLOW Lab sessions we discuss their plans at an early stage and we follow their developments throughout the year. This approach has seriously evolved the level of student artworks and the drive of the students. More and more we succeed in bringing them together. It is great to see students from different disciplines and levels unite and bringing each other forward, with a technical solution, creative or with practical solutions for occurring challenges."

WHAT TO EXPECT AT GLOW 2021?

"This year's theme is 'Moved by Light', a somewhat feel- good modus which is adequately represented by Valerio Festi in his Porte Celeste, amazing gates of light. In contrast, the Carbon Arc of Ivo Schoofs will bring an extremely solid spindle of light over the canal at Campina Complex. Light in its bare essence. And Gijs van Bon is back with two works. Together with Nighi Zhu he will show a succession of his renowned Ping artwork at the new Chinese Pavillion (Strijp-S). And Gijs is also participating in a project with ASML in a sort of machine that beams drops of liquid with lasers. Each falling drop is calculated exactly to perform an amazing dance of light resembling the core process of ASML's EUV-machine. And we have more company participations. TMC has a group of engineers that takes led-light to a new dimension at the High Tech Campus. We are exactly where we want to be. The city makes GLOW and the city enjoys GLOW. I am certain that this year we will again be 'Moved by Light'.

gloweindhoven.nl


GLOW 2020

PHILIP ROSS (STUDIO PHILIP ROSS) | PROJECT- AND ARTISTIC LEAD GLOW AT TU/E

This anniversary year, TU/e converts its campus into one of the main Glow areas in the city of Eindhoven. The Intelligent Lighting Institute took on the challenge to create a collection of light artworks that breathe the innovative character of the university. This article reveals thoughts and strategies behind this year's contributions to Glow.

Glow at TU/e: Transforming light research & education into light art

Early 2021, we devised an initial plan based on the theme Transformation by Light. This theme fits naturally with the rich variation of research and education around light at TU/e. It refers to research on how light influences health and wellbeing, how light changes perception of the environment, how light makes people move, how light changes objects into information and how light is turned into energy.

It was clear from the beginning that realising a grand project like Glow would require a large interdisciplinary community of students, researchers and staff. In the middle of the second Corona lockdown, we organised the first community events and instantly noticed the great enthusiasm from students and staff to contribute. Together with researchers we facilitated courses for students so that they could contribute to Glow while receiving credits. With Glow Eindhoven and TU/e Innovation Space we organised three Glow Academy sessions throughout the year, online while required and physically when possible. On these occasions, experienced experts from the lighting field gave feedback on the students' progress, students got inspired by each other's work and, importantly, students felt connected.

With 80 students from 8 different departments working directly on the installations, 71 students participating in Glow-related courses, 87 students participating with their study- or student association and 7 research groups and institutes working together on Glow we can truly speak of a TU/e wide joint effort. And this is without mentioning the generous support of several TU/e service departments. We also happily welcomed 15 students from the Fontys University of Applied Sciences, also located and exhibiting at campus.

Another important element of our strategy was to connect to longer-term lines of development in and around Glow. So, instead of starting from scratch, we built on concepts, lessons and technological developments

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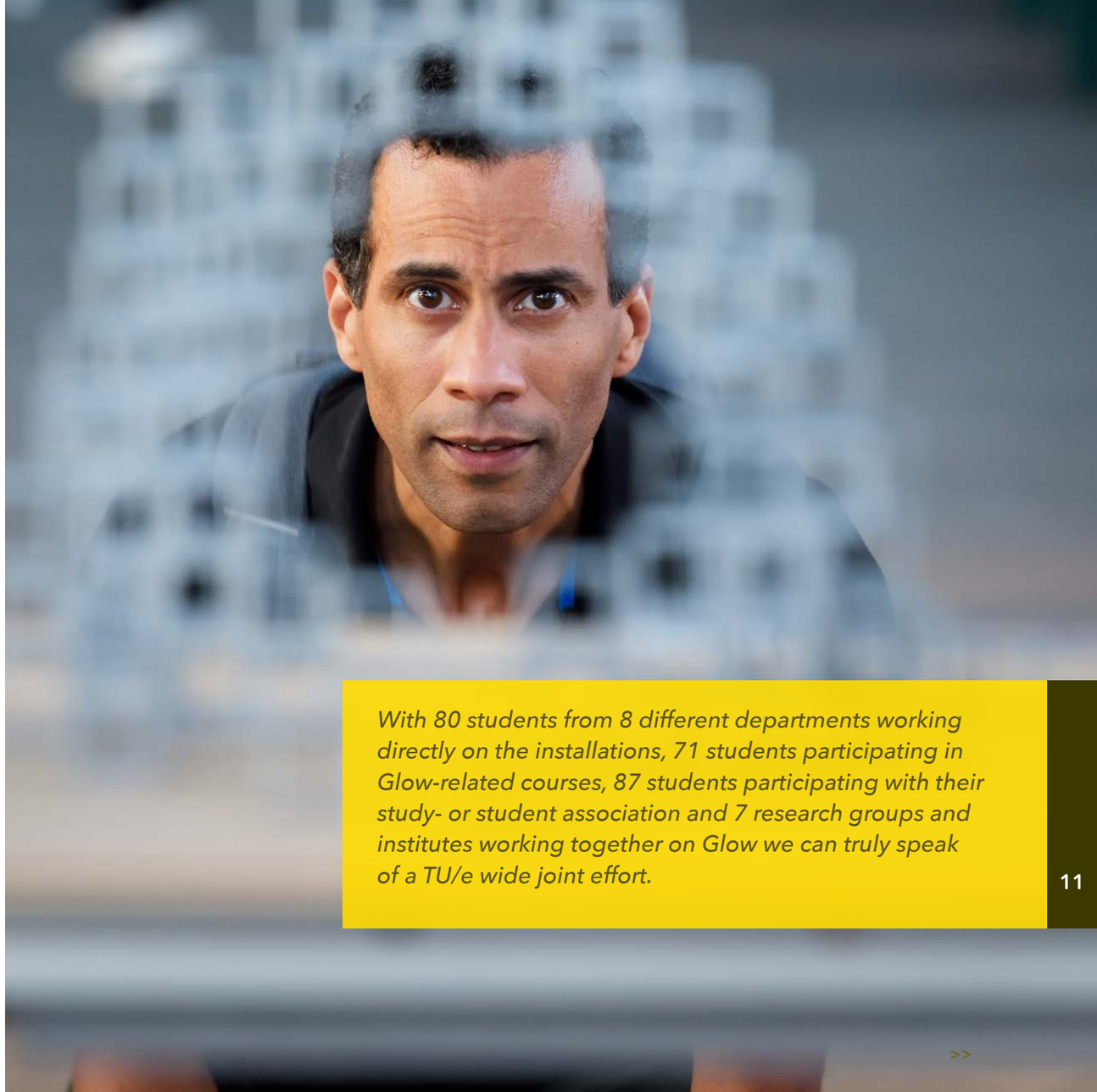

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from previous ILI contributions. A direct line, for example, can be drawn from Gibson (2018) to The Ballroom and Experience LiDAR. The latter re-uses some of Gibson's sensing technology. The Ballroom combines Gibson's animate light beams with the sensing infrastructure of the Crowdflow Research Group, which in turn was used earlier in experiments at Glow 2016, 2017 and 2019.

In line with the longer-term strategy, we made sure that many of this year's efforts can stay relevant after the festival. For example, The Ballroom's sensing infrastructure will remain as a structural addition to the Markthal Living Lab, so that it can be used for new research and education projects. The Wayfinding & Storytelling project is part of a longer line of Innovation Space projects about wayfinding at festivals in general. And of course, the rich learning experiences that the students gained from working on the innovative light art at Glow will last a lifetime!

We from ILI's working group Glow are very proud of the results of everyone's hard work and we thank all students, staff and external parties for their contributions. If you are interested in more background, please check out our podcasts, background movies and the information at the ILI website. We hope to see you at Glow!

ILI's working group Glow consists of dr. ir. Philip Ross (Studio Philip Ross, project- and artistic lead), dr. ir. Elke den Ouden (community), drs. Marlies Bergman (communication and support) and student members Tim de Jong, Sietse de Vries and Iza Linders.

tue.nl/glow

Experience LiDAR

What does the world look like through the eyes of technology?

We increasingly use sensors as our eyes to the world. Cutting edge sensors provide us with input for our devices, for our knowledge and much more. Sensors have become essential to modern life. But at the same time, these sensors can be elusive as a black box. What do they see? When are they watching? What are they paying attention to?
Experience LiDAR is inspired by these questions. It makes you part of the data gathering process of a high-tech sensor that normally does its work invisibly, namely LiDAR. This sensor uses invisible light to measure the distances of objects, things or people surrounding it. In short, it uses light to transform its surroundings into 3D information. LiDAR is incredibly useful, especially in automotive technologies.
For Glow, we make the data gathering process of LiDAR visible, interactive and colourful. Step into the LiDAR sensor's field of vision, let the sensor take a good look and use your body to creatively add to its colourful 3D world.

ABOUT THE TEAM

Artists are Rui Hu (Zoe), Luca van Breda, Wessel van der Heijden and De Fabel Fabriek (Niek Rutten, Peter Roosen, Sanne Bassant and Loïs Lentz). Concept by Philip Ross. Partners are Eindhoven Hendrik Casimir Institute and Studio Philip Ross. Student Coordinator: Tim de Jong

De Fabel Fabriek is a young experience design company in Eindhoven. They create experiences, wherein they focus on tangibility, interaction, storytelling and wonder. Their team consist of 4 Industrial Design students and theatre enthusiasts, all with different expertise and skills. Together with three other enthusiastic students from the Industrial Design and the Computer Science departments, they have developed this installation over the past half year. So far, de Fabel Fabriek have had the opportunity to make multiple light exhibits for the Luna Festival Eindhoven and an interactive festival exhibit at Fantasy Court.

Hendrik Casimir instituut: The Eindhoven Hendrik Casimir Institute (EHCI) carries out research in materials, devices, circuits and systems enabling novel applications in communications, computing and sensing. One of the prominent applications is LiDAR (Light Detection and Ranging) on chip. LiDAR uses steerable laser beams for measuring the position and velocity of objects. Future applications of this technology include autonomous driving, robotics, industrial metrology.

GLOW PROJECT

Sketch your Light

You probably don't give it much thought, but the way we light up public space at night has a profound influence on how we experience and use it. But is the one-size-fits-all way we light up public space the best and most meaningful way? What if we use new lighting possibilities like colour, different light patterns and dynamics to tailor public lighting to needs and wishes of people in their neighbourhood? How would you shape the light in your neighbourhood if you had full control?

To tackle these questions, Philip Ross developed the Light Sketching system: Custom developed intelligent streetlights with new lighting possibilities and a tablet interface that allows people to sketch the light they desire, live in their own neighbourhood. For Glow, TU/e students have developed an exciting new way to sketch light with this system: By means of hand gestures you can create colours and patterns of light where you want them. As if you sketch light directly with your hand. The system is integrated in the landscape art of Ad Dekker and Jean Leering at TU/e campus. You are invited to take place on one of the sketching stations and together with the other Light Sketchers transform this landscape artwork into light art made for and by Glow visitors.

ABOUT THE TEAM

Oriana Ferrari, Wesley Hartogs, Jesper Kapteijns, Panteleimon Katsis and Isidoros Kotinis are TU/e bachelor students with studies ranging from Industrial Design, to Electronical Engineering to Applied Physics. They took on the challenge to develop a new interface to the Light Sketching system designed by Philip Ross. More background of the Light Sketching system is available at the project Slim Licht Maakt Plaats.

Partner: Studio Philip Ross

GLOW PROJECT

The Ballroom

The social cohesion between individuals in public spaces has decreased during the pandemic. Through our light artwork "Ballroom", we from team IGNITE investigate reigniting the feeling of social cohesion amongst the GLOW visitors.

We invite you to experience our modern "Ballroom" situated in "de Markthal" on the TU/e campus. This installation does not only offer the possibility of dancing with each other, but also to dance with twelve shining dance partners, embodied by beams of light, gracefully in search of a partner to dance with on the music of the student orchestra of Quadrivium.
The visitors are anonymously tracked based on infrared imaging, so the light beam chooses its dance partner on the fly. This happens in real-time thanks to state-of-the-art sensing system and algorithms provided by the TU/e Crowdflow Research Group. The light beam will move around its chosen dance partner so that a dance between the two begins. The result is an actual ballroom festively filled with color, music, and dance. Enter the Ballroom and experience the long-expected feeling of connectedness again.

ABOUT THE TEAM

TeamIGNITE was founded in 2016 as a committee of study associations Lucid (Industrial Design) and CHEOPS (Built Environment) from the TU/e to create an installation for GLOW 2016. After this first year, the committee ended. However, the students did not feel ready to let go of designing with light yet. They decided to become a TU/e innovation Space team and continue their journey within lighting design. In 2018, team IGNITE presented "Loop," which was a pilot for "Hypar," the installation made from luminous cubes, that they presented in 2019. In September 2020, the team decided the era of the cubes had come to an end. A new generation of team IGNITE was brought together. For the past one and a half years, this new generation of 15 enthusiastic students has created a new mission and vision for the team. This new stance is proudly presented this year through "Ballroom," an installation realized with the tracking infrastructure provided by the TU/e Crowdflow Research Group from prof. dr. Federico Toschi, with dr. Alessandro Corbetta. The installation is developed together with Philip Ross and his experience with designing light installations for crowds; one can recognize several aspects of his work "Gibson" (2018) in "The Ballroom".

TeamIGNITE: Tim de Jong, Lynn Visser, Timon Adriaanssen, Samuel Oosterholt, Thom Smits, Jente Vermeer, Floris Thoonen, Maarten van den Elshout, Tianyi Chen, Tristan Trouwen, Noortje van Velzen, Quinn van Rooy, Ymke Verspui, Robbie Melaet, Katja van Weert
Concept by Philip Ross en Tim de Jong.
Partners: Crowdflow Research Group, Studio Philip Ross and ESMG Quadrivium

Eye of Atlas

How do we see?
How does light contribute to sight?

Humanity has researched these questions for millennia, and the answers have continuously changed. In Ancient Greece, nearly 2500 years ago, Empedocles answered this question as follows: We see through sending a special kind of light, "Visual Fire", out of our eyes. When this light touches an object, our eyes feel this touch, and this makes us see the object. For Glow, we gave the Atlas building, named after an ancient Greek figure, this kind of sight. Atlas' radiant eye is eager to make connections and curiously explores all activity at campus. The Visual Fire from the eye lights up everything it touches, including the streets, artworks and visitors. Follow his glowing gaze, and experience how it continuously transforms campus. Can you grab his attention?
Realizing this ancient concept of vision could only happen using the highly modern lighting systems at TU/e campus. The intelligent lighting system in Atlas, called Smart Energy saving Lighting, contributed to Atlas' title of most sustainable education building in the world (BREEAM). It is also used for research into the impact of light on people, just like the computer-controlled street lighting featured in this project.

ABOUT THE TEAM

Philip Ross (concept and design), Max Frimout (sound design), Thijs Koenraadt and Kelvin Keultjes (Computer Science TU/e), Serge Offer-mans and Teun Vinken (Interactive Matter), Jesper Kapteijns (Industrial Design, TU/e) and Özge Karaman Madan (Architecture PhD, TU/e)

Philip Ross designs intelligent luminaires and lighting environments. Central in his work is the concept of Transformational Lighting Design: the idea that light has the power to positively influence people's experiences and behaviors. Philip is alumnus of TU/e (PhD Industrial Design) and combines his backgrounds as designer, researcher and light artist in his work at Studio Philip Ross. Philip is project- and artistic leader of this year's contribution to Glow of TU/e.

Max Frimout is a sound artist from Eindhoven, with a background in engineering physics at TU/e. He studies Sonology at the Royal Conservatory in The Hague, where he focusses on generative composition and algorithmic music. Max' compositions combine spatial descriptions of sound with storytelling in an improvisational manner. His methods for music production include the use of analog modular synthesis, field recording, composing with algorithms, digital processing of acoustical instruments and more.

Partners: Studio Philip Ross, Intelligent Lighting Institute TU/e, Interactive Matter, Signify, Unica, TU/e services.

EYE OF ATLAS

Wayfinding & Storytelling

A winding path of magical glowing mushrooms. Enchanting interaction. A unique and beautiful approach to wayfinding. That is how visitors of the Eindhoven University of Technology campus will be guided as they travel from one eye-catching installation to the next. In-between these installations, that is where the Wayfinding project shines. The mushrooms form an interactive system. Visitors can activate one mushroom, which will then light up and spread its 'spores', activating another mushroom near it. This creates a cascading effect of glowing mushrooms, magically enveloping the path in a sea of light.
As for the Storytelling part of the project, the team has collaborated with Barry Fitzgerald (Science Communication Officer at TU/e) to create a podcast, containing interviews with the teams responsible for the GLOW installations. Spokespeople of the teams give an exclusive insight into the process behind the scenes, describing motivations, technicalities, or other interesting remarks about their project.
Visitors can tune into the podcast by scanning QR codes printed on signs close to the installations

ABOUT THE TEAM

The team behind the Wayfinding & Storytelling project is made up of enthusiastic students from various backgrounds, each recruited by Elke den Ouden to work on an exciting extracurricular challenge. The multidisciplinary team includes students from a variety of study programs at the Eindhoven University of Technology, such as Electrical Engineering, Industrial Design and Industrial Engineering & Innovation Sciences. Elke den Ouden teaches at the TU/e and is a member of the Intelligent Lighting Institute.

Artists are Ilana van den Akkerveken, Ian Bezemer, Gijs Neerhof, Lotte Sap, Yueying Shi, Luuk Stavenuiter
Yueying Shi made the posters for all GLOW projects.

Hypar Collective: GROWTH

Everyone experiences growth in their life. Growing means investing time and effort into reaching your goals. By overcoming and mastering different elements in the process, you are able to keep on expanding yourself and flourish. Even though it might not always seem that the steps you are taking now contribute to your final goal, eventually it will all fall into place.

With this interactive light installation, Hypar Collective visualizes the journey of growth. When starting your journey, there is no clear coherent path that you can follow, which is shown in disordered and unconnected pieces of the installation. The expanding size of the installation represents how several smaller elements all contribute to growth. Visitors can activate these elements by interacting with the installation, making them a participant in the network that sparks personal development. When visitors have mastered the separate elements and reach the highest point of the installation, they are invited to look back at their growth process so far. The unconnected pieces now form a coherent shape, in which the separate elements visually contribute to the achieved goal. By using anamorphosis, Hypar Collective symbolizes its own growth as a team. In 2018 the team showcased her first installation, Loop, at GLOW Eindhoven. When looking back at the installation an outline of Loop can be spotted.

ABOUT THE TEAM

Hypar Collective consists of 11 members who currently study or previously have studied at the Eindhoven University of Technology. Their shared passion for interactive light is the main driver behind this team of young creatives. Hypar Collective has a strong vision: creating interactive light installations that make visitors part of the experience. The versatile nature of their modular cubes combined with a multisensory experience in the form of sound and interaction, allows them to keep reinventing their own possibilities.

GLOW PROJECT

The Cycle of Light

The light we are exposed to during the day influences our day-night rhythm.

The intensity, the spectrum, the duration, the time of day: all these factors have a positive, healthy or disruptive, unhealthy influence on our biological clock. Modern life involves exposure to large amounts of artificial light from screens and office lighting, often at the wrong time of day. At the same time, our exposure to natural daylight is low due to our indoor lifestyle. This is a recipe for disrupting our circadian rhythm (the roughly 24-hour rhythms of our bodily processes and activities), which can compromise our well-being in many ways.
It remains difficult to experience the effect of light on circadian rhythms. What does exposure to natural light look like during the day? How does this daily light intake differ between different occupational groups? And perhaps most importantly, how does this affect our sleep and health? With 'The Cycle of Light' we want to make these things "experienceable" and create more awareness about the effects of light in our daily lives.

ABOUT THE TEAM

When part of GLOW's route passes through the TU/e grounds, it calls for a fusion of research and art. At TU/e, a lot of research is conducted into the effects of light on our health. Thus, in February 2021, the idea arose to visualize one of these studies in a light installation during GLOW. In this research, Prof. dr. ir. Y. A. W. de Kort measured the daily light intake of people and monitored the effect of light on their circadian rhythm. In addition, Prof. dr. ir J.P.M.G. Linnartz and Dr. C. Papatsimpa developed algorithms that predict the effects of light on personal daily cycles. Based on these findings, we started 'The Cycle of Light' with a group of 5 TU/e students. We have now grown into a fully-fledged multidisciplinary team of 8 students with whom we proudly present 'The Cycle of Light' to you.

Artists are Kim Wentink (Project leader & Light programmer), Rianne Jurriens (Project leader & Light programmer), Femke Knaapen (Researcher User Experience & Visuals), Tom Kafoe (Light Programmer), Douwe Terpstra (Sound designer), Robin van Overbeek (Designer & Visuals), Pim Visser (Designer), Sanne Lieshout (Designer)

GLOW PROJECT

GEM-Stage

The 21-meter high GEM-Stage is a real eye-catcher due to its height and its colorful appearance. The GEM-Stage supplies 100% sustainable energy for performances at festivals and events. The energy of the GEM-Stage is generated by the wind turbine, the solar panels, the LSC panels and the hydrogen generator. Combining these energy sources with a battery ensures that the GEM-Stage is completely self-sufficient and can provide enough energy for a complete live performance in all weather conditions. In addition to the generation of sustainable energy, awareness is created about energy consumption and the generation of sustainable energy. During Glow 2021, the GEM-Stage will provide energy for the stage and the facilities around.

ABOUT THE TEAM

The GEM-Stage is an initiative of PowerVIBES, a European Interreg NWE project with nine different parties and festivals from the Netherlands, Belgium and the UK, led by the Eindhoven University of Technology. The GEM project started in 2018 with the design for a sustainable alternative for diesel generators. In 2019, the GEM-Tower was shown for the first time at Pukkelpop, after which various locations were visited throughout Europe. The GEM-Tower transformed into the GEM-Stage in 2021. The GEM-Stage could be seen during King's Day in Eindhoven, at Boomtown festival in Ghent and the DDW 2021.

Artists: Marius Lazauskas, Patrick Lenaers, Floor van Schie under supervision of dr. ir. S.P.G. Moonen
Partners: Eindhoven University of Technology, Double2, ZAP, Flexotels, Pukkelpop, Offgrid energy, RPS, ESNS, Democrazy

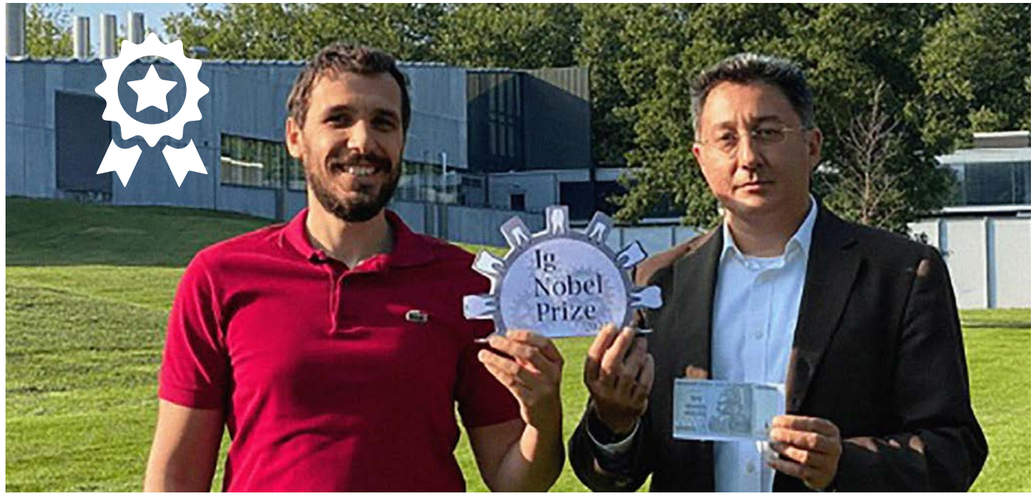
Photographer: Björn Comhaire

ALLESSANDRO CORBETTA | UNIVERSITY RESEARCHER AND NWO-VENI FELLOW (APPLIED PHYSICS)
FEDERICO TOSCHI | FULL PROFESSOR AT THE DEPARTMENT OF APPLIED PHYSICS (TU/E)

Author | Frans Raaijmakers Cursor

Ig Nobel Prize for TU/e research into crowd movement

Recognising pedestrian patterns might become essential in predicting and managing the active flow of pedestrian crowds in the future.



Professor Federico Toschi and university researcher Alessandro Corbetta have won a so-called Ig Nobel prize with their analysis of the pedestrian movements of 5 million passengers in Eindhoven's train station. The scientists discovered that on average people keep a minimum distance of 75 centimetres from each other to avoid collisions.

The alternative Nobel Prizes were created for achievements that first make people laugh, and then make them think'. The prize, which has been awarded annually since 1991, has a cult status among scientists. In the past, the Dutch-British physicist Andre Geim even managed to win an Ig Nobel Prize before receiving a real Nobel Prize in Physics ten years later.
Most scientists are very honoured with the prize, as are Toschi and Corbetta. "We are very proud of this prize. This recognition is nice," says Corbetta about his research, the results of which were also published in the journal Physical Review E in 2018. The prize was presented by Nobel Prize winner Professor Martin Chalfie.

AVOIDING CONTACT

For the research, Toschi and Corbetta installed four sensors under the platforms of Eindhoven railway station. For six months, they observed 5 million pedestrians within a measuring area of 27 square metres and discovered that, on average, people keep a minimum distance of 75 centimetres from each other. Pedestrians were found to be subconsciously constantly avoiding collisions with oncoming people by changing their footpath metres in advance if a collision was about to occur.
About 18,000 pedestrians were found to be facing each other in pairs. In other words; a potential collision hazard. Corbetta: "About 80 of these pedestrians actually collided with each other. The remaining pedestrians adjusted their paths until they were at least 140 centimetres away from each other and thus avoided a collision."

STATISTICAL MODEL

With this 'big data', the researchers developed a statistical model that can predict pedestrian movements very accurately. This way, you know in advance how many pedestrians will run, walk, dodge, turn around or collide in a defined area, such as a corridor or tunnel. Corbetta: "While building our model, we found two 'social forces': a long-range force based on sight, and a short-range force to prevent actual touch. These forces cause people to adjust their current walking path to avoid collisions."
Since its publication in 2018, both scientists have continued to develop their model and collect large scale data. Corbetta and Toschi's ultimate goal is to understand pedestrian movements.
"I dream of eventually understanding the dynamics of dense crowds," Toschi explains. Indeed, statistically speaking, there seem to be universal characteristics of pedestrian movements in a crowd, independent of the measurement location. Toschi: "For example, we see that about 1 person per 1000 people turned around and left the tunnel on the same side. Even if this person was alone and independent of motivation."

MANAGING CROWDS

Recognising these patterns may be essential in the future in predicting and eventually managing the natural movement patterns of pedestrians. Toschi: "This way, we can design safer and more efficient places where many pedestrians come together, based on the natural walking behaviour of people. Think of museums, but also festivals. How do we prevent congestion? How can we spread the crowds as much as possible over an area? We try to manipulate the social system, as it were, but with good intentions."
Toschi: "For example, we have tried in the past to see if we can send people in a certain direction by means of light. In that respect, our research fits perfectly in the Ig Nobel picture; at first it is research that people might be surprised by, but soon they see that we can set important changes in motion with it."

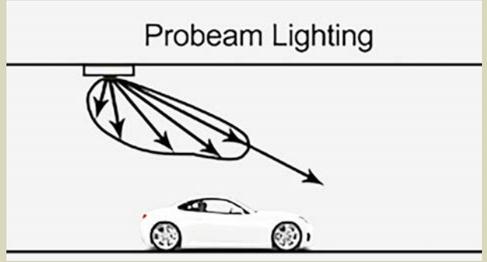
RICK SPIERINGHS | PHD STUDENT KU LEUVEN (ESAT)

Development of a new road lighting concept

An experienced driver knows that driving a vehicle on dark or poorly lit roads at night is considerably more challenging than driving that vehicle during daytime or on well-lit roads. In poorly lit circumstances drivers suffer more from fatigue, have a lower response time, and experience limited visibility of the road, its surroundings and any objects therein. Therefore, the task of driving at night is much more demanding and complex than driving during daytime.

Road lighting has brought a solution to the challenge of driving at nighttime and improved traffic safety considerably, however at the expense of an increased energy consumption and of harm of spill light to for example nocturnal animals. Replacing the old-days' low-pressure sodium light sources with currently available LED light sources addresses these disadvantages, since LED lighting has much better dimming capabilities and allows for better beam control. Thus, by generating LED light only when and where it is needed, we can better meet energy reduction goals, while preserving traffic safety.

To this end, the department *'Innovatie en Markt'* of the directorate-general of public works and water management in the Netherlands (Rijkswaterstaat) started a research project at the Light&Lighting laboratory of the KU Leuven and in joint at the Human Technology Interaction group of the TUe with the aim to investigate new LED-based road lighting concepts. One such innovative and promising road lighting



> ***Figure 1:*** *Illustration of Probeam lighting.*

> ***Figure 2:*** *Experiment set-up.*

concept uses luminaires that direct most of the luminous flux forwards in the viewing direction of the driver, and is therefore called 'Probeam' *(see figure 1)*. Since light is directed away from the driver's eyes and towards objects or markings on the road ahead, 'Probeam' leads to less glare, can allow higher illuminance on vertical objects, improves the visibility of road markings at distances beyond the reach of car headlights and reduces spill light in unwanted directions. Using 'Probeam' in combination with optimized retroreflective characteristics of the road marking material, one can further improve the visibility of road markings, and as such optimally guide a driver on the road.

An interesting research question is to determine the amount of luminous flux needed to realize the 'Probeam' concept; it should be as low as possible to reduce energy consumption, yet sufficiently high to have good contrast between a road marking and the background road. The knowledge of contrast thresholds is therefore key to bring Probeam into practice. We conducted a psychophysical experiment at the Light&Lighting Laboratory *(see figure 2)* to determine the minimal contrast needed for a road arrow to be recognizable.

In order to be able to fully characterize and accurately simulate road visibility, it is important to fully understand the reflective characteristics of the road surface and road markings when lit with 'Probeam' lighting. These reflective characteristics are measured in a large near-field goniometer, as shown in *figure 3*, and are used to determine the amount of light directed to the driver. These results can be used to generate renderings and simulations of road situations and lighting concepts.

In these simulations we can compare 'Probeam' with more traditional, symmetric road lighting concepts, for example when implemented on a (Dutch) highway, as shown in *figures 4 and 5* respectively. These simulations allow us to optimize 'Probeam' and measure the related visibility of road markings or other objects on the road. Obviously, these simulations still need to be compared to field measurements, for which we will execute perception experiments at the test centrum of Dienst Wegverkeer (RDW) in Lelystad.

> ***Figure 3:*** *Large near field goniometer (LNFG) used to measure the reflective characteristics of the road marking and road surface samples.*

> ***Figure 4:*** *Physically based rendered image of a (Dutch) highway scene where the scene is illuminated by Probeam*

> ***Figure 5:*** *Physically based rendered image of a (Dutch) highway scene where the scene is illuminated by symmetrical lighting.*

New partners of ILI:

Peter Hanselaer (Catholic University of Leuven) and and Sylvia Pont (Delft University of Technology)

ILI welcomes two new partners: the group of Prof. Pont of the Delft University of Technology and the group of Prof. Hanselaer of the Catholic University of Leuven. It is good to have their complementary fields of expertise represented in our broadly recognized lighting research institute.

PETER HANSELAER

He obtained his PhD in solid state physics in 1986 and currently holds a full professorship at KU Leuven university (BE). In 1997, he founded the research group *"Light&Lighting Laboratory"* at the KU Leuven campus in Gent (Department of Electrical Engineering, division WaveCore). Initially, his research was focusing on solar cells, but gradually shifted to LEDs and Lighting. Today, he is supervising a team of more than 20 researchers.

The actual main research topics are Indoor lighting (led by Wouter Ryckaert), Optical design (Youri Meuret), Appearance & Perception (Kevin Smet) and Hard&Soft Metrology (Frédéric Leloup). Within each topic, PhD research is combined with development and innovation projects with lighting companies. Several research papers have been published in journals and at conferences. We are also hosting *"Groen Licht Vlaanderen"*, an organization which gathers more than 70 companies involved in lighting. The vast measurement infrastructure offers numerous opportunities for industrial and academic cooperation.

He is involved in the educational program of the Faculty of Engineering Technology (Ba, Ma and PhD students) and teaches courses in photonics, optical fibers and lighting metrology. He is also member of the Academic Board of the Erasmus Mundus IMLEX program.
His actual research topic is the development of a *"Lighting Appearance Model"*. Starting from an absolute hyperspectral image of a scene (including light sources), an image-based approach to calculate the perceptual attributes of each element in the scene (brightness, hue, colorfulness, but also contrast and detectability) is targeted. This involves hyperspectral data calibration, the impact of pupil diameter, taking care of scattering and absorption in the eye, calculating receptor outputs and mimicking the retinal neural network. This is a very ambitious research plan and he is open to cooperate with other researchers to walk along this research track together. He is the Editor of CIE Division 1 and Academic Director of the Catholic University Leuven in Gent.

SYLVIA PONT

Sylvia Pont is Antoni van Leeuwenhoek professor of Perceptual Intelligence at the TUDelft Faculty of Industrial Design Engineering. Her main interests are lighting design, visual communication of light, material, form and space, the measurement and tuning of appearance, and art.

Sylvia Pont graduated in Experimental Physics (1993, Amsterdam University). She received her PhD (1997, Utrecht University) for a thesis on haptic perception. 1997-1999 she studied computer aids at Visio, and 1999 returned to Utrecht University to investigate realworld optics and visual perception. In 2008 she moved to TUDelft to work on applied perception for design and design for perception, developing design tools, practice oriented research methods, fundamental knowledge and design frameworks for lighting design and material and form communication. Her lighting design research is unique in its spatial approach to "the light field", studying the effects of interactions of lighting with spaces, shapes, and materials. She teaches BSc, MSc and PhD courses in perception, ergonomics, user experience, and a MSc elective in lighting design - involving many practicing lighting designers.

NOVEMBER 2021 - APRIL 2022

Calendar

6-13 November 2021
GLOW
Location: City of Eindhoven

22 November 2021
TU/e Vitality Week, Location Eindhoven and online, Lecture "Light up your workplace at home and/or at the office!" by Juliëtte van Duijnhoven

18 November 2021
Final Event of the Interreg Smart Space project
Location: Gent

16-17 December 2021
ENLIGHTENme Conference Shaping Light for Health and Wellbeing in Cities (online)

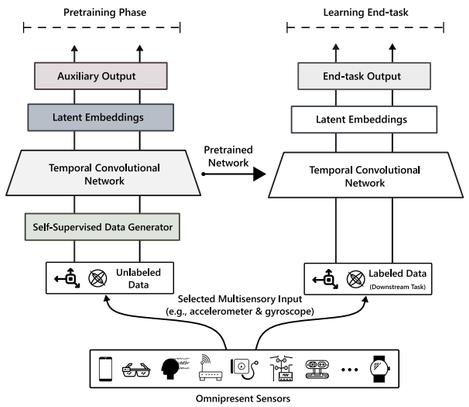
3 - 7 April 2022
Light Shaping Focus Session III, SPIE Photonics Europe. Co-organized by Prof. Youri Meuret (KU Leuven).
Location: Strasbourg, France

AAQIB SAEED | INTERCONNECTED RESOURCE-AWARE INTELLIGENT SYSTEMS
(MATHEMATICS AND COMPUTER SCIENCE)

Learning Sensory Representations with Minimal Supervision

Our ability to see, hear, and sense the environment provides us with remarkable prior knowledge to learn, reason, and adapt in an ever-changing world. It also equips us with situational awareness to better understand each other (e.g., through behavioral cues), places, things and whereabouts for making sound decisions [1]. One of the key characteristics of human cognition is the ability to learn from the world around us without explicit supervision [2]. Developing systems that can foster such capabilities in computational devices to recognize context, surroundings, human behavior, and other states of interest is a grand challenge in artificial intelligence.

Nowadays, the ubiquity of interconnected systems has given rise to a world enriched with ambient computing, where computing is ingrained in our routine such that mostly we do not realize an interaction with a computing platform. The proliferation of devices embedded with sophisticated sensors in our daily lives generates data at an unprecedented scale, providing valuable information about the environment and the people. Effectively harnessing and getting insights out of massive sensory data in a scalable manner can unlock opportunities to provide innovative solutions to problems in various domains ranging from healthcare, human-computer interaction, wildlife monitoring, and more. Data-driven predictive models are now at the core of embedded intelligence through leveraging advances in machine learning, especially deep learning methods. These approaches utilize a massive amount of manually labeled data to learn generalizable models.
Despite the fact that deep learning consistently achieves and even matches human-level performance on several tasks, deep neural networks lack the ability to learn from only a few semantically labeled examples of a concept in a way as humans learn continuously from unlabeled data (or without supervision). The requirement of providing a large amount of well-annotated data is not just difficult due to cost, time constraints, and domain expertise, but it is an unscalable path towards having intelligent computational devices that can continuously sense, learn and adapt. Similarly, another key challenge associated with a well-functioning predictive system for ambient (or pervasive) sensing is to safeguard it against catastrophic failures (e.g., due to sensor malfunctions, heterogeneous signals, interpersonal variations, and more) in a real-world environment. Despite the growing body of literature to address the topic of learning robust and generalizable representations in a label-efficient manner, several challenges have yet to be overcome to achieve effective generalization.
To address aforementioned problems, in the thesis titled, Learning Sensory Representations with Minimal Supervision [3], we introduce novel techniques that lie on the intersection of deep learning, ambient sensing, and ubiquitous computing to address issues pertaining to learning from unlabeled data and making models robust to various input artifacts. Our focus is on representation learning with deep neural networks to realize the vision of self-learning for embedded intelligence in everyday devices, such as smartphones, wearables, earables, and more. Our proposed methods are primarily based on



> Figure 1: *Illustration of our Sense and Learn representation learning framework [4]. A deep neural network is pre-trained with self-supervision using input modalities from large unlabeled sensory data, such as inertial measurements (or electroencephalogram, heart rate, and channel state information). The learned network can then be utilized as a feature extractor or initialization for rapidly solving downstream tasks of interest with few labeled data.*

the theme of self-supervised learning *(see Figure 1 for an overview of Sense and Learn framework [4])* to extract generic representations from multi-modal sensory inputs, such as electroence-phalogram, audio, accelerometer and more. We present learning approaches that do not require semantic labels from humans but extract supervisory signals from the input itself, i.e., in a self-supervised manner. Our strategies enable deep neural networks to learn broadly useful representations that perform well on a spectrum of downstream tasks, are robust to noise and other artifacts and generalize also when transferred to other domains. The developed techniques can also harness massive unlabeled data to reduce the requirement of semantic labeling, effectively use multi-modal signals, exploit continuously growing decentralized (on-device) data in a federated setting, and leverage multi-task learning to utilize shared structure among tasks.
Our contributions provide several general insights about learning deep models for sensing tasks and corresponding shortcomings of existing approaches for the future work. Among them, adversarial examples [5] pose a major challenge for deep models. The safe execution of a model to generate correct predictions is crucial for any system equipped with a predictive model and that relies on it to make a decision. Likewise, avoiding learning via shortcuts [6] in deep neural networks is another key area that can improve our understanding of failure modes to develop better self-supervised algorithms, architectural priors and boost the transferability of models trained in a controlled environment to a real-world setting.

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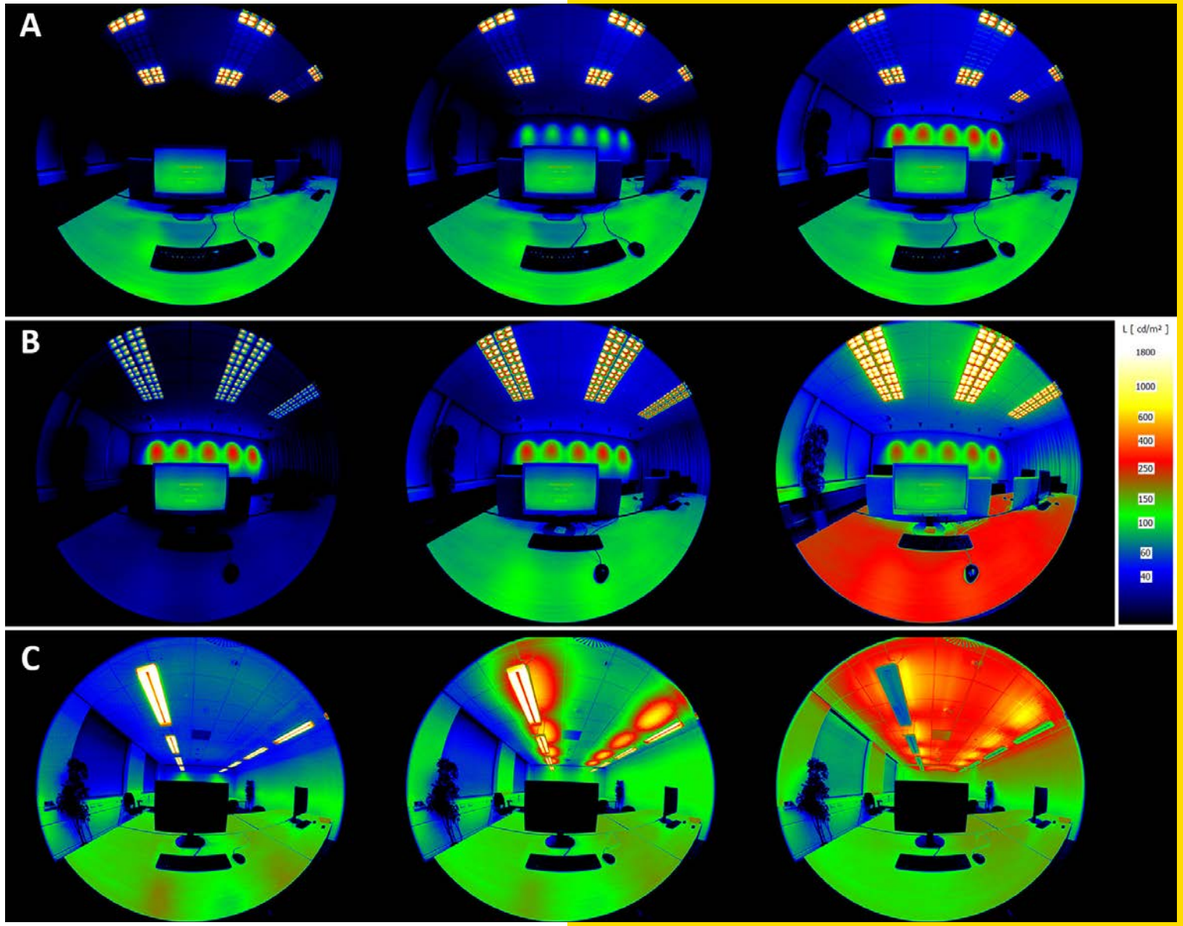

ADRIE DE VRIES | | ILI PHD HUMAN TECHNOLOGY INTERACTION (IE&IS)

Lighting up the 'great place to work'

How the illumination of different room surfaces affects office workers in open plan offices

Although we usually do not realize this, lighting is an essential part of our daily lives. Afterall, without light, no vision. Next to enabling us to see safely and comfortably move from place A to B, lighting also has a large impact on how we perceive and appreciate spaces. We all know the effect of bars or cafés who turn on the 'cleaning light' to signal the customers that the party is over, turning a space from a cozy bar, to a boring, unappealing space. Moreover, lighting has an impact on the synchronization of our biological clock. This is not something we notice directly but considering that we spend > 90% of our time indoor, 'shielding' ourselves from daylight, the office lighting can play a key role to provide an artificial (partial) alternative. But how does office lighting affect these different aspects?

To investigate this, we used three separate experiments to analyze how office workers perceived and experienced different lighting effects on the wall, the desk and the ceiling respectively. We also tried to relate this to task performance of knowledge workers. Although these types of investigations are typically done in highly controlled and often unrealistic environments, we chose environments that closely mimicked realistic, multi-user offices to ensure that the findings would also be representative and applicable to real world cases.

First, the effect of lighting the wall was studied and was found to have a clear effect on how people experienced the space. Increasing the light level on the wall rendered not only a brighter but also a more attractive environment. Moreover, although we did not find any effects on task performance, people did feel more alert in the spaces

>>

with more light on the walls and they stayed more alert there as well.
In contrast, varying the amount of light on the desk (with a constant amount of light on the wall) mainly impacted how well people could read from paper, and how bright people perceived the space, but did not impact alertness, task performance, or the attractiveness of the office space.

For the ceiling illumination, we found an increase in attractiveness and brightness when more light was directed to the ceiling. Additionally, the spaces were judged more attractive when spreading the light more evenly over the ceiling. Another important finding was that not all participants were equally sensitive and appreciative to changes in brightness. Although people having different opinions of what they like is not new, the fact that we could clearly separate them in a sensitive, appreciative group and an indifferent, mildly negative group, was a new and useful finding for future research.

Finally, we investigated if we could predict the brightness perceptions of individuals with accurate measurements of the lighting. We found that measurements of specific parts of the field of view provided a reasonable prediction of how bright people would assess the space and that both the average and the contrast in the field of view mattered.

To conclude, illuminating the walls, ceilings and desks can all result in brighter spaces, however, in our case, only lighting the walls and ceiling resulted in more attractive spaces. Additionally, lighting for example the walls can also support occupants in maintaining their alertness instead of becoming more sleepy. This shows that lighting does more than simply provide sufficient light to read, but also impacts how we experience spaces, and how we 'feel'. Importantly though, although it was possible to draw several overall conclusions, we are dealing with a highly diverse workforce, which can and will have different requirements for their *'great place to work'*.

ILI New employees

WILLEM JANSEN
PhD Computational Illumination Optics Group (M&CS)

I received my BSc degree in computer science at Avans University of Applied Sciences in the Netherlands. During this period, I studied software design and development, I did two internships at software development companies where I learned to use my skills in practice. I received my MSc degree in computer science at Utrecht University in the Netherlands. My master's was focused on algorithm design. During my thesis I investigated if there is a correlation between properties of polygons and time bounds of visibility algorithms.

In September 2021 I joined the com-putational illumination optics group at Eindhoven University of Technology. The aim of my project is to extend previous work on phase space ray tracing to 3d. Ray tracing is used in optical design, but it is a slow procedure. The ray tracing procedure can be sped up using information from the phase space of the light rays. This has already been shown in 2d and I will work on extending the existing research to 3d.

SANJANA VERMA
PhD Computational Illumination Optics Group (M&CS)

I received my Bachelor's degree in Mathematics from University of Delhi, India. Enthralled by the cross-cutting applications of mathematics, I wanted to delve deeper into the field and pursued my Master's degree in Mathematics from Indian Institute of Technology Bhubaneswar. During my master's, I have worked on finding numerical solutions to an optimal control problem using linear multistep methods. I also undertook a project involving a comparative study of finite volume and spectral methods with emphasis on numerical solution of Kortweg-De Vries (KdV) equation, which is used to model water waves. My academic experiences evoked a natural enthusiasm in Applied Mathematics and I wanted to engage in research that galvanizes my previous knowledge and my vehement desire to bridge the gap between theory and practice.
As of September, 2021, I am a doctoral candidate in Computational Illumination Optics group at TU/e. My PhD project is in collaboration with ASML and aims to develop methodologies for the design of optical systems that minimize aberrations.

NEMANJA CABRILO
PDEng ICT program, Signal Processing Systems group (EE)

I have obtained both my Bachelor's and Master's degree in Electrical and Computer Engineering at the University of Novi Sad in Serbia. At that time, I was following two tracks, in industrial and biomedical measurement systems. This experience helped me profiling my competencies into becoming a Systems Engineer at an early phase of my career, shortly after I graduated. My fascination with human physiology has motivated me to focus on biomedical applications, merging my enthusiasm for healthcare, fitness and nutrition with my field of expertise. Determined to continue growing in this direction, I started my PDEng journey as of 2021. Here I am involved in a multidisciplinary project, OptiLight, in close collaboration with Signify, which addresses the development of a Human-Centric Lighting control system based on monitoring the bio-logical clock and comfort of individual users. Our goal is to model and predict the state of internal biological clock. At present, we are perfor-ming a field study to investigate the use of wearables for non-invasive personalized circadian state estimation.

ILI Top Publications

Romijn, L. B., ten Thije Boonkkamp, J. H. M., Anthonissen, M. J. H., & IJzerman, W. L. (2021). Generating-function approach for double freeform lens design. *Journal of the Optical Society of America A, Optics, Image Science and Vision, 38(3), 356-368.*

Romijn, L. B., ten Thije Boonkkamp, J. H. M., Anthonissen, M. J. H., & IJzerman, W. L. (2021). An iterative least-squares method for generated Jacobian equations in freeform optical design. *SIAM Journal on Scientific Computing 43 (2), pp. B298 – B322*

Van Roosmalen, A. H., Anthonissen, M. J. H., Ijzerman, W. L., & Ten Thije Boonkkamp, J. H. M. (2021). Design of a freeform two-reflector system to collimate and shape a point source distribution. *Optics Express, 29(16), pp. 25605-25625*

Van Gestel, R. A. M., Anthonissen, M. J. H., ten Thije Boonkkamp, J. H. M., & IJzerman, W. L. (2021). An Energy Conservative hp-method for Liouville's Equation of Geometrical Optics. *Journal of Scientific Computing, 89, [27]*

Anthonissen, M.J.H., Romijn, L.B., ten Thije Boonkkamp, J.H.M. and Ijzerman, W.L. (2021). A unified mathematical framework for a class of fundamental freeform optical systems *Optics Express 29 (20), pp. 31650 – 31664*

Jägerbrand, A. K., Gasparovsky, D., Bouroussis, C.A., Schlangen, L.J.M, Lau, S., Donners, M. (in press) Correspondence: Obtrusive light, light pollution and sky glow: Areas for research, development and standardization, Lighting Research and Technology

Papatsimpa, C., Schlangen, L. J. M., Smolders, K. C. H. J., Linnartz, J. P. M. G., de Kort, Y. A. W. (2021). The interindividual variability of sleep timing and circadian phase in humans is influenced by daytime and evening light conditions. *Scientific Reports 11(1): 13709. https://doi.org/10.1038/s41598-021-92863-z*

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van Galen, W.P.L., (May 2021). Lining up for innovation: Exploring alignment dynamics of innovation across boundaries. *PhD Thesis IE&IS, Innovation Technology Entrepreneurship & Marketing*

Cerpentier, J., Meuret, Y. Fundamental spectral boundaries of circadian tunability (August 2021). *IEEE Photonics Journal, Vol. 13, No. 4, 8500105*

Van Duijnhoven, J., Aarts, M. P. J., van den Heuvel, E. R., & Kort, H. S. M. (2021). Exploring the relationship between light and subjective alertness using personal lighting conditions. *In Conference proceedings of CISBAT 2021, 8-10 September 2021, Lausanne, Switzerland.*

Van Duijnhoven, J., Aarts, M.P.J., & Kort, H.S.M. (2021). Personal lighting conditions of office workers: An exploratory field study. *Lighting Research & Technology, 53(4), 285–310. 2nd prize at Postdoc Best Paper Awards, June 10, 2021.*

Aarts, M.P.J., Morsink, K., Hartmeyer, S.L, Kort, H.S.M. (2021). Exploring light exposure of hospital nurses working rapidly rotating shifts in relation to sleepiness and sleep. *In Conference proceedings of CISBAT 2021, 8-10 September 2021, Lausanne, Switzerland.*

Gkaintatzi-Masouti, M., van Duijnhoven, J., Aarts, M. (2021). Evaluation of spectral lighting simulation tools for non-image-forming effects of light. *In Conference proceedings of CISBAT 2021, 8-10 September 2021, Lausanne, Switzerland.*

Pierson, C., Soto Magán, V.E., Aarts, Mariëlle, Andersen, M. (2021). Daylight exposure and alertness indoors: on the role of spectral simulation. *In Conference proceedings of CISBAT 2021, 8-10 September 2021, Lausanne, Switzerland.*

Pierson, C., Gkaintatzi-Masouti, M., Aarts, M.P.J., Andersen, M. (2021). Validation of spectral simulation tools for the prediction of indoor daylight exposure. *In Conference proceedings of CIE 2021, 27-29 September 2021, Kuala Lumpur, Malaysia*

Pierson, C., Aarts, M.P.J., Andersen, M. (2021). Validation of spectral simulation tools for the prediction of indoor daylight exposure. *In Conference proceedings proceedings of Building Simulations 2021, 1-3 September 2021, Bruges, Belgium*

ILI PDEng theses

Sustainable business model for facilitating public value creation of living lab innovation ecosystems. Pegah Kheiri (Department of IE&IS, Innovation Technology Entrepreneurship & Marketing), 25 May 2021. Advisors: Isabelle Reymen, Elke den Ouden and Myriam Cloodt

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Developing an Industry Technology Roadmap for planning the implementation of smart urban lighting in small and medium-sized cities. Swagata Chakraborty (Department of IE&IS, Innovation Technology Entrepreneurship & Marketing), 28 June 2021. Advisors: Ed Nijssen and Rianne Valkenburg

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Design of User Experience Evaluation (UXE) Toolbox for Smart Urban Lighting Solutions. Sila Akman (Department of Built Environment, Building Lighting in the Interreg Smart Spaces project, 28 September 2021. Advisors: Rianne Valkenburg and Juliëtte van Duijnhoven

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The Design and Implementation of a Context-Aware Lighting System. Relevance: Hossein Mahdian (Department of Mathematics and Computer Science, Software Technology Program) designs and prototypes a lighting system based on Philips Hue where AI researchers can deploy, change and operate different machine learning code and data in a trivial way. These system and infrastructure will be used by PhD student Ali Mahmoudi in the IntelLight project, 8 October 2021. Supervisor: Tanir Özçelebi

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ILI SHORT

Lecture: Light up your workplace at home and/or at the office!

On November 22, (Juliëtte van Duijnhoven will give this lecture during TU/e Vitality Week in Eindhoven. We need light to see and perceive the environment around us. However, light can do more. Light can also initiate so called non-image-forming effects such as regulating our core body temperature, sleep-wake rhythms, alertness and mood. When and how strong these effects will appear depends on the light exposure we receive at eye-level. This light exposure is composed of daylight and electric light components. Since we spend about 90% of our time indoors nowadays, it is crucial to consider the lighting conditions at indoor locations for our health, wellbeing, and performance. In this presentation, practical tips for lighting up your own workplace at home or at the office will be provided! Learn what you can do yourself to keep your environment and yourself as healthy as possible! This lecture can be attended online and on campus.

Thijs Kruisselbrink, former Ph.D. candidate at the Building Lighting-group was nominated for best Ph.D. thesis (TU/e Academic Awards) title thesis "Practical and continuous luminance distribution measurements for lighting quality" You can watch his nominee video (https://www.youtube.com/watch?v=ST1MUqJhZ0k)

Mariëlle Aarts gave an interview in the September, 2021 issue of LED Magazine: *'Intensivering onderzoek klinische lichttoepassingen hoognodig'.* You can read the interview here: *https://ledmagazine.nl/u/magazine/lm3-september2021.pdf*

ILIAD event 2021

November 9 // Auditorium, Blauwe Zaal // TU/e

PROGRAM

09:00 **Registration**
09:30 **Opening and welcome** *by ILI Scientific Director professor Ingrid Heynderickx*
09:45 **Overview of outcomes and impact of R&D and (technological) innovation ILI research programs**
- *Sound Lighting - by professor Yvonne de Kort*
- *Bright Environments - by dr. Tanir Ozcelebi*
- *Light by Design - by professor Wilbert Ijzerman/dr. Jan ten Thije Boonkkamp*

11:15 **Coffee break**
11:30 **Lectures: Effects of light on plants**
- *professor Leo Marcelis (Wageningen University & Research)*
- *dr. Esther de Beer (Signify)*

12:30 **Lunch with poster presentations ILI PHDs and PDEngs and GLOW Student teams**
13.30 **Lectures: Effects of light on animals**
- *dr. Marc De Samber (Signify)*
- *dr. Aaron Stephan (ONCE Animal Lighting, a Signify brand), Director of Biological R&D*

14.30 **Lectures: Effects of light on people**
- *professor dr. Roelof Hut (Rijksuniversiteit Groningen)*
- *drs. Ellen van Lieshout (GGzE)*

15.30 **Short break**
15.45 **Interactive sessions**
17.00 **Closure and drinks**

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