Kongsberg Vision Meeting 2023: Abstracts

Kongsberg Vision Meeting was held at the University of South-Eastern Norway in Kongsberg, for the 15th time, on October 23–25, 2023. The meeting was organised as a three-day meeting with a lighting design day followed by two clinical optometry and vision research days. Rigmor C. Baraas, Helle K. Falkenberg, Ellen Svarverud, Lene A. Hagen, Gro Horgen Vikesdal, Lotte-Guri B. Steen, Hilde R. Pedersen, Helga I. Wåseth and Are Røysamb organised the three-day meeting. The theme this year was *"New Developments and their impact on the practice of Optometry and Lighting"*. Keynote speakers for the lighting design day was Alp Durmus, Pennsylvania State University (USA) and Luciana Martinez, Light Follows Behaviour (UK). Keynote speakers for the optometry and visual science days were Linda Lundstrøm, KTH Royal Institute of Technology (Sweden), Geunyoung Yoon, University of Houston College of Optometry (USA) and Abinaya Priya Venkataraman, Karolinska Institutet (Sweden). The abstracts from the other invited and contributed talks on the different days are presented in the order they were given.

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Recent developments and future of lighting research

Alp Durmus

Lighting Lab, Architectural Engineering, Pennsylvania State University, University Park, USA

alp@psu.edu

Abstract

Lighting technology and research have undergone remarkable advancements in recent years, revolutionising the way surroundings are illuminated. These advancements have contributed to a deeper understanding and enhanced utilisation of lighting design for humans and the environment. The keynote presentation will delve into the recent developments and future directions of lighting research, exploring the dynamic landscape of this rapidly evolving field.

The first part of the keynote will focus on the advancements in lighting technology. Solid-state lighting (SSL) has emerged as a game-changer, offering energy-efficient and long-lasting lighting solutions. The latest breakthroughs in SSL, especially alternatives to LEDs (e.g., carbon-based quantum dots, laser diodes), will be discussed. Additionally, the role of VR and AR, freeform optics, and additive manufacturing in lighting design and research will be explored.

The second part of the keynote will focus on the diverse applications of lighting research. The topics will be discussed under two parts: measurement of light and user response (wearable sensors, circadian metrics, drone measurements, light fields, lighting application efficacy), and utilisation of techniques (projection mapping, adaptive, autonomous lighting systems, digital lighting design, predictive maintenance).

Finally, drawing from past experiences, future directions in lighting research will be outlined, highlighting the importance of resource management, applied research, circular economy, and systems thinking. The keynote aims to inspire researchers, practitioners, and industry professionals to continue pushing the boundaries of lighting technology and its applications, paving the way for a brighter and more sustainable future.

Nature centric lighting and LED

Kristin Bredal

Zenisk, Oslo, Norge

kristin@zenisk.no

Abstract

The extent of the adverse effects on human health from prolonged exposure to LED lighting, or artificial lighting in general, is a realm we are still uncovering. While we have identified many concerning effects already, there are also unmistakable indications of other significant consequences. It is crucial to recognise that we share this planet with countless other species, and if we disrupt the biodiversity around us, we ultimately jeopardise our own well-being too.

The era of human-centric lighting is behind us; our perspective has broadened. It is no longer only about catering to human needs but has evolved to consider the well-being of the entire planet. Through our profession, we are committed to making a positive impact. Our approach now includes lighting that is bird-friendly (or more precisely, avian-friendly), marine-friendly, and, of course, considerate of human needs without being solely centred on them. It is a comprehensive approach that enables society to function during hours of darkness while making every effort to minimise the impact on other life forms.

The field of lighting design is evolving, driven by a growing understanding of how artificial light impacts biodiversity. With light pollution increasing by 10% annually, largely due to the widespread adoption of LED lighting, and mounting evidence of the harm caused by artificial light to numerous species, there is an urgent need for conscious planning of all outdoor lighting installations.

As lighting designers, it is our responsibility to mitigate the adverse effects of artificial light. This means avoiding and controlling light where it creates harm. Achieving this goal requires more in-depth research into the effects of artificial light on different species.

Incorporating darkness into specific areas should also become an integral part of our profession. It is a continual challenge to educate our clients about the importance of leaving certain spaces unlit. Evidence-based research is essential for understanding the most effective ways to tailor solutions that balance the need for light with the preservation of natural ecosystems.

Fortunately, some clients are already on board. They understand the need to protect nature from artificial light and are willing to plan accordingly. The lighting strategy for Lilleakerbyen, an urban transformation project initiated by Mustad Property, tries to shield the river from light in order to restore and preserve the rich habitat of numerous species that live along the river.

Can an old industrial site be transformed into a dynamic, walkable town that boasts all the qualities of a thriving urban environment while simultaneously preserving the neighbouring natural ecosystem?

The presentation will show the methods used to develop a strategy for lighting and darkness in Lilleakerbyen in order to care for all the living species in the area.

Practical application of new developments in LED light sources and optics and rendering software

Stefan Maassen

Lighting Design/Electrical Engineering, Asplan Viak AS, Sandvika, Norway

stefan.maassen@asplanviak.no

Abstract

In this talk I will give varied examples regarding the use of different new technologies and developments in the field of lighting technology and software from my practice as senior lighting designer for Oslo Municipality, Henning Larsen Architects and Asplan Viak. My talk will include a case study of restoring the heritage lighting for the royal castle square in Oslo, and an impact assessment regarding light pollution and spill light for a nature conservation area in Bergen. I will also demonstrate new possibilities regarding the use of real time rendering software as a practical tool for lighting designers, and a showcase study in glare reduction by the application of recent developments in optical technologies for exterior LED lighting fixtures.

Acknowledgements

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Positive or negative health outcomes

Terje Christensen

National Centre for Optics, Vision and Eye Care, Department of Optometry, Radiography and Lighting Design; Faculty of Health and Social Sciences, University of South-Eastern Norway, Kongsberg, Norway

terje.christensen@usn.no

Abstract

New LED-technology has given us opportunities to create almost any spectrum of light, and in recent years researchers, clinicians and manufacturers have enthusiastically created new solutions for the application of light in medical treatments, diagnosis of pathology, and use of "healthy" lighting. We know that light has profound effects on health and well-being, notably on conditions linked with circadian rhythms. To be scientifically correct, claims of health effects must be supported by research. Since light is only one of many factors influencing our health, observational studies may be difficult to interpret. There are certain quality criteria that should be fulfilled, among them is the use of appropriate controls depending on study design. Furthermore, effects should be plausible, e.g., a mechanism may be identified with some degree of scientific certainty and a dose-response relationship should be demonstrated. Absorption of light in the eyes or skin is of importance, because no effect of light can take place without absorption of photons in chromophores, either pigments in the eyes or natural absorbers in the skin, like precursors of vitamin D.

General lighting may support well-being, but as soon as one applies light in diagnosis and treatment of disease there are many legal requirements that need to be fulfilled. Among the requirements are involvement of health professionals and restrictions on marketing of medical treatment, also in the frame of alternative medicine. Examples will be provided and discussed.

Adaptive Road Lighting

Frode Nilsen

Comlight AS, Skjeberg, Norge

frode.nilsen@comlight.no

Abstract

Comlight AS is a Norwegian company established in 2007, which has become world leader in adaptive dimming of road lights. The plug-in node Comlight Eagle Eye Zhaga was launched in 2020 and won 1st prize for "Best use of Zhaga-D4i" in 2021. Our detectors are being marketed in Europe, Australia, Asia, and South America.

Benefits of adaptive dimming:

- Reduced energy consumption
- Reduced light pollution
- Enhanced safety

Energy and sustainability are topics of high interest especially in the Western world. Cleaner energy sources and reduced consumption are targets to be met to reach climate goals. For European cities and highways, the electricity spent on road lighting is substantial. The exact numbers vary in the EU, but we have seen claims as high as 40% of the total consumption for some local municipalities.

The interest in light pollution varies around the world. In Norway there is research on the effect on insects and in Sweden the negative effects on bats are being studied. In North America DarkSky International has become an authority on combatting light pollution.

Well-lit roads save lives. In the search for reduction of energy the most frequently used alternatives are MidPointDimming (MPD), adaptive dimming, or turning the light off completely at night. MPD is a cost-effective solution since most luminaires sold today can have this software installed. Adaptive dimming gives full effect upon detection and dims down seconds later to save energy. From a safety perspective adaptive dimming is the best option.

Comlight Eagle Eye detectors are mounted on the pole or directly on the luminaire with a Zhaga socket. The Doppler radar provides one solution for all when detecting both slow pedestrians and fast cars. When detecting an object, the unit will make the luminaire increase the effect to a given maximum level, often 100% effect. It will also alert preset neighbouring units so they also give the maximum effect. When the object is detected by the next unit, radio signals will be sent again. This is how Comlight makes a 1-1 light wave in front of a moving object. The road ahead will always be safely lit.

When the object has passed, the detector will start its countdown and after a few seconds make the luminaire dim down, often to 20% effect. The result is a light wave also behind the object. This light wave adapts if the object's speed increases or decreases.

The Comlight Doppler radar differentiates between slow- and fast-moving objects. A fast car triggers more lamps lit up to maximum effect ahead of it, while a slow pedestrian triggers fewer lamps ahead. The effect is held for a longer period for the pedestrian and shorter period for the car.

For 2-way communication to and from the installation, one or more gateways with 4G mobile SIM card is used. With gateway it is easy to change parameters or harvest statistics and diagnostics.

The powerful effect of light

Anders Bru
Glamox AS, Oslo, Norway
anders.bru@glamox.com

Abstract
Research in chronobiology has shown us how important light/dark cycles are for our circadian rhythm. With the right light settings during the day, we will be able to improve the quality of sleep.

Research has also shown us that light can help improve our performance, although the research on light still will require more field studies to underline the effect. But researchers at University of Bergen have done a very interesting study with significant results on how light can improve the working condition for night shift workers.

We at Glamox have incorporated knowledge on the non-visual effects of light into our Human Centric Lighting concept since 2013. The research done within the field has defined four parameters we have to have control to enable design of a lighting solution that takes the non-visual effects of light into account.

In my presentation I will go through three interesting studies to which Glamox has contributed. I will present the design parameters for the successful design of a lighting system that takes the non-visual effects of light into account in the best possible way.

User Participation Processes and Sense of Place from a Sociological Perspective

Luciana Martinez
Light Follows Behaviour, London, UK
luciana@lightfollowsbehaviour.com

Abstract
Public spaces are vital components that influence the everyday experience of our towns and cities, yet they are also some of the more complex spaces to design to benefit their diverse range of users. To light a space in one way rather than another influences and shapes how it feels and is experienced by all the people who inhabit it. This raises key questions such as: "who are we designing for?" and "for what purpose?".

While the physical design of a space can be easily communicated to the general public in terms of design elements (seating, playgrounds, trees and planting), lighting is still very much unknown territory and very much imposed on the general public. It is also a complex topic to discuss with non-lighting professionals with key terms that need to be deciphered before beginning any conversation.

The lighting profession additionally has various guidelines and, at times conflicting, best practice approaches related to wellbeing, ecology, light pollution, energy efficiency, safety and security among others. And while following these guidelines can lead to technically and aesthetically successful lighting projects they also need to work on a social level. They need to support and improve people's quality of life and interactions and address any root concerns or issues. For this to happen, there needs to be a shift in the design approach of lighting that values and recognises the social aspects of lighting as equal to the aesthetic and the technical.

The fundamental starting point is to understand the place one is designing and the users of the space, the activities happening and not happening, the impact the seasons and time of day and night have and the bigger role of the space in the local context. This approach can then inform how user participation can be implemented to the fullest potential in a manner that meaningfully informs the design and the research focus, and most importantly brings communities into the design process for the long term.

Mechanisms of optical interventions for myopia control

Linda Lundström*, Petros Papadogiannis, Charlie Börjeson, Peter Unsbo
Biomedical & X-ray Physics, KTH (Royal Institute of Technology), Stockholm, Sweden
* Correspondence: linda@biox.kth.se

Abstract
The prevalence of myopia increases rapidly worldwide, and the World Health Organization estimates that half of the world's population will be myopic by the year 2050 if no treatment is developed soon. The eye health field is therefore working intensively to find strategies to prevent the progression of myopia. Today, several different myopia control interventions are in clinical use. However, the underlying treatment mechanisms of these interventions are still unknown, and the treatment effect is only partial. This presentation will review current optical myopia control interventions in the form of spectacles and contact lenses and compare their optical characteristics. These interventions are often designed to introduce myopic peripheral defocus. However, their effect varies between individuals and goes beyond defocus; other proposed mechanisms include accommodation, retinal contrast, and asymmetries in peripheral optical errors. To gain further understanding on how the treatment efficacy can be improved, it is therefore important to also assess the depth of focus and the retinal image quality with the optical interventions.

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Accommodation and phoria in myopia control

Trine Langaas
National Centre for Optics, Vision and Eye Care, Department of Optometry, Radiography and Lighting Design, Faculty of Health and Social Sciences, University of South-Eastern Norway, Kongsberg, Norway
trine.langaas@usn.no

Abstract
Myopia is on the increase worldwide and is reaching pandemic numbers in some parts of the world. The research into understanding the aetiological factors causing the observed increase of myopia, and to find treatment options towards stagnation of myopia is extensive.

In the Nordic countries the distribution of refractive errors is different than other parts of the world, with a modest proportion of youngsters developing myopia. An increase in myopia is, however, concerning particularly due to the increased risk of sight threatening pathology, and myopia control should be mandatory in a modern optometric practice. There is extensive evidence of the benefit of applying myopia control to slow the progression of myopia.

Various features of binocular vision (BV) may be related to the progression of myopia. Research has indicated that some factors may be predictive of myopia progression, some may have causative effects, and some may even influence outcome and predict the response to some treatment options.

In this presentation the rationale and importance of testing

binocular vision in patients that go through myopia control will be discussed.

Applying the NorDSam learning model to flexible education of Norwegian optometrists

Per O. Lundmark

National Centre for Optics, Vision and Eye Care, Department of Optometry, Radiography and Lighting Design; Faculty of Health and Social Sciences, University of South-Eastern Norway, Kongsberg, Norway

per.lundmark@usn.no

Abstract

NorDSam's learning model for flexible continuing education has been developed in collaboration with the optometry profession and optometry education in Norway, Sweden, and Denmark. The purpose of this model is to provide long-lasting learning outcomes for professionals and to equip them with lifelong learning skills, enabling evidence-based practice.

The model has been initially implemented in a continuing education course focused on effective and efficient patient referrals in optometric practice. The course has been successfully delivered twice, attracting a total of 20 optometrists with varying levels of experience and training. All courses have concluded with comprehensive course evaluations to gather feedback for improvement.

The learning model will be presented in comprehensive detail, accompanied by a summary of experiences gained from the completed courses. Additionally, a plan for further development and implementation of the model will be discussed.

Design of a cohort study on myopia development in schoolchildren in Stockholm

Charlie Börjeson[1,*], Anna-Caisa Söderberg[2], Linda Lundström[1]

[1] Applied Physics, KTH Royal Institute of Technology, Stockholm, Sweden

[2] Mittuniversitetet, Östersund, Sweden

* Correspondence: cborje@kth.se

Abstract

In recent years, near work and peripheral image quality have gained increased attention as contributing factors to myopia development. However, it is not yet understood what aspects of the peripheral image quality affect myopia progression, or what parts of the periphery are the most susceptible. Furthermore, as accommodation itself changes the peripheral image quality, near work tasks should be included when assessing peripheral image quality and its effect on myopia progression. This is the basis for a new study on myopia that has just been launched in Stockholm as a collaboration between KTH Royal Institute of Technology and Karolinska Institutet. The aim of the study is to identify optical biomarkers that affect myopia progression in children, with a unique focus on peripheral image quality during accommodation.

The study is a prospective cohort study on myopia that will follow schoolchildren longitudinally for up to eight years, with measurements every 6-12 months. Up to 80 children aged 6-9 years at baseline are to be included in the study. The children are recruited from schools and optometrists in the Stockholm area, and the first subjects were measured in September 2023. Measurements include:

- Eye examination and vision tests to ensure normal ocular health and normal monocular and binocular vision.
- Questionnaire to assess environmental factors, e.g., time spent outdoors, time spent on near work, and parental myopia.
- Simultaneous wavefront measurements in the foveal and peripheral field (±25°) of the right eye, using a custom built dual-angle wavefront sensor. The subject fixates binocularly on a Maltese cross target placed at either 0.22 D or 5 D accommodative demand. This allows measurement of:
  - Relative peripheral refraction at different levels of accommodation.
  - Foveal and peripheral image quality at different levels of accommodation.
  - Accommodative lead or lag.
- Cycloplegic autorefraction (cyclopentolate 1%)
- Axial length
- Corneal curvature
- Retinal OCT

An example of baseline results from the first subjects will be presented.

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The association between vision anomalies and academic attainment in children

Tina R. Johansen, Hilde R. Pedersen, Rigmor C. Baraas, Trine Langaas[*], The SNOW Study Investigators

National Centre for Optics, Vision and Eye Care, Department of Optometry, Radiography and Lighting Design; Faculty of Health and Social Sciences, University of South-Eastern Norway, Kongsberg, Norway

* Correspondence: trine.langaas@usn.no

Abstract

Vision is the most important sensory input for children to learn and to reach their academic potential. This relates to both sensorimotor and cognitive function (Hill et al., 2022; Utdanningsdirektoratet, 2018) known to impact on their academic attainment (Bjørset et al., 2022). The final systematic vision assessment carried out in Norwegian children is at 4–5 years of age (Mavi et al., 2022). Whether a child receives an eye examination closer to starting school or during the school years up to the age of 18 rests on the child's parents'/guardians' knowledge about the importance of good eyesight for proper learning. Socioeconomic status may play a role, whereupon informed carers are more likely to bring the child for an eye examination and to follow up advice given, ensuring prescribed correction is worn if needed. Up to four in ten school aged children have an untreated visual condition (Hagen et al., 2018; Kulp et al., 2022; Sandfeld et al., 2018), and in Scandinavian children and adolescents, hyperopia is the most prevalent vision anomaly (Demir et al., 2021; Hagen et al., 2020; Hopkins et al., 2020). Left uncorrected, it may impact on academic attainment (Falkenberg et al., 2019; Flodgren & Ding, 2018). To detect hyperopia (and to make sure myopes get the correct prescription), cycloplegic refraction is necessary (Niechwiej-Szwedo et al., 2017).

The SNOW study obtains measures of eyes and vision (including ocular biometry and cycloplegic autorefraction) every year for children attending 2nd, 5th and 10th grade (corresponds to age 7–8, 11–12 and 15–16 years), at four schools in Kongsberg municipality. To assess the children's sensorimotor and cognitive function, we use a computer-based tablet with a set of standardised visuomotor and cognitive tests, using a stylus or their finger as an input (Birch & Kelly, 2023). The results from the vision assessments are compared with sensorimotor and cognitive function. The next steps involve analysing the results from the

national compulsory tests ("Nasjonale prøver"; The Norwegian Directorate for Education and Training, Norway (Roch-Levecq et al., 2008)) in reading, maths, and English to investigate the relationship between uncorrected vision anomalies in primary and secondary school and academic attainment.

Our findings may further emphasise the importance of assessing children's vision during school years, to understand how it may impact on their learning trajectories and potential in the future.

References

Birch, E. E., & Kelly, K. R. (2023). Amblyopia and the whole child. *Progress in Retinal and Eye Research*, *93*. https://doi.org/10.1016/j.preteyeres.2023.101168

Bjørset, C. O., Pedersen, H. R., Synstelien, G. O., Gilson, S. J., Hagen, L. A., Langaas, T., Schiøtz Thorud, H.-M., Horgen Vikesdal, G., Baraas, R. C., & Svarverud, E. (2022). Non-cycloplegic refraction cannot replace cycloplegic refraction in primary school children. *Scandinavian Journal of Optometry and Visual Science*, *15*(2). https://doi.org/10.15626/sjovs.v15i2.3645

Demir, P., Baskaran, K., Theagarayan, B., Gierow, P., Sankaridurg, P., & Macedo, A. F. (2021). Refractive error, axial length, environmental and hereditary factors associated with myopia in Swedish children. *Clinical and Experimental Optometry*, *104*(5), 595–601. https://doi.org/10.1080/08164622.2021.1878833

Falkenberg, H. K., Langaas, T., & Svarverud, E. (2019). Vision status of children aged 7-15 years referred from school vision screening in Norway during 2003-2013: A retrospective study. *BMC Ophthalmology*, *19*(1), 180–180. https://doi.org/10.1186/s12886-019-1178-y

Flodgren, G. M., & Ding, Y. K. (2018). Vision screening in children under the age of 18: a systematic review. Report –2018. *Norwegian Institute of Public Health*.

Hagen, L. A., Gilson, S. J., & Baraas, R. C. (2020). Vision status and reading test results in Norwegian adolescents. *Scandinavian Journal of Optometry and Visual Science*, *13*(2), 2–7. https://doi.org/10.5384/sjovs.vol13i2p2-7

Hagen, L. A., Gjelle, J. V. B., Arnegard, S., Pedersen, H. R., Gilson, S. J., & Baraas, R. C. (2018). Prevalence and Possible Factors of Myopia in Norwegian Adolescents. *Scientific Reports*, *8*(1). https://doi.org/10.1038/s41598-018-31790-y

Hill, L. J., Shire, K. A., Allen, R. J., Crossley, K., Wood, M. L., Mason, D., & Waterman, A. H. (2022). Large-scale assessment of 7-11-year-olds' cognitive and sensorimotor function within the Born in Bradford longitudinal birth cohort study. *Wellcome Open Research*, *6*(53). https://doi.org/10.12688/wellcomeopenres.16429.2

Hopkins, S., Narayanasamy, S., Vincent, S. J., P., S. G., & Wood, J. M. (2020). Do reduced visual acuity and refractive error affect classroom performance? *Clinical and Experimental Optometry*, *103*(3), 278–289. https://doi.org/10.1111/cxo.12953

Kulp, M. T., Ciner, E., Ying, G.-S., Candy, T. R., Moore, B. D., & Orel-Bixler, D. (2022). Vision Screening, Vision Disorders, and Impacts of Hyperopia in Young Children: Outcomes of the Vision in Preschoolers (VIP) and Vision in Preschoolers — Hyperopia in Preschoolers (VIP-HIP) Studies. *The Asia-Pacific Journal of Ophthalmology*, *11*(1), 52–58. https://doi.org/10.1097/APO.0000000000000483

Mavi, S., Chan, V. F., Virgili, G., Biagini, I., Congdon, N., Piyasena, P., Yong, A. C., Ciner, E. B., Kulp, M. T., Candy, T. R., Collins, M., Bastawrous, A., Morjaria, P., Watts, E., Masiwa, L. E., Kumora, C., Moore, B., & Little, J.-A. (2022). The Impact of Hyperopia on Academic Performance Among Children: A Systematic Review. *The Asia-Pacific Journal of Ophthalmology*, *11*(1), 36–51. https://doi.org/10.1097/apo.0000000000000492

Niechwiej-Szwedo, E., Alramis, F., & Christian, L. W. (2017). Association between fine motor skills and binocular visual function in children with reading difficulties. *Human Movement Science*, *56*, 1–10. https://doi.org/10.1016/j.humov.2017.10.014

Roch-Levecq, A. C., Brody, B. L., Thomas, R. G., & Brown, S. I. (2008). Ametropia, preschoolers' cognitive abilities, and effects of spectacle correction. *Archives of Ophthalmology*, *126*(2), 252–258. https://doi.org/10.1001/archophthalmol.2007.36

Sandfeld, L., Weihrauch, H., Tubæk, G., & Mortzos, P. (2018). Ophthalmological data on 4.5- to 7-year-old Danish children. *Acta Ophthalmologica*, *96*(4), 379–383. https://doi.org/https://doi.org/10.1111/aos.13650

Utdanningsdirektoratet, . (2018). Rammeverk for nasjonale prøver [in Norwegian]. *Utdannings Direktoratet*. https://doi.org/https://www.udir.no/eksamen-og-prover/prover/rammeverk-for-nasjonale-prover2/

Extended reality in optometry education

Tatjana Pladere

University of Latvia, Riga, Latvia

tatjana.pladere@lu.lv

Abstract

Extended reality technology has emerged as a promising tool for education, enabling experience-based learning through digital simulations. At the University of Latvia, students enrolled in the master's programme in clinical optometry use this technology, specifically the Eyesi indirect ophthalmoscope simulator, to enhance their ophthalmoscopic skills. This training has resulted in positive learning outcomes and has been well-received by students, serving as a valuable addition to their traditional clinical practice. However, it has also presented certain challenges. Notably, some students have reported experiencing asthenopic symptoms following their training sessions. This has fuelled our scientific interest and motivated us to gain a deeper understanding of the underlying causes of these issues.

Currently, at the Department of Optometry and Vision Science, we are investigating how the human visual system reacts to various extended reality technologies. In this presentation, I will share the findings from the ongoing study, focusing on elucidating the effects of a 40-minute training session using the indirect ophthalmoscope simulator on visual functions and user comfort among master's students. Additionally, I will discuss these results in the context of the considerations required when integrating extended reality tools into optometric education.

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Wavefront-guided Individualized Vision Correction

Geunyoung Yoon

Advanced Physiological Optics Laboratory, College of Optometry, University of Houston, Houston, Texas, USA

gyoon2@uh.edu

Abstract

Ocular wavefront sensing has revolutionised our understanding of the optics of the eye and the limitations of human vision. This technology not only allows us to objectively measure optical defects in the eye (i.e., higher order aberrations), but also to correct the aberrations by using advanced vision correction methods including adaptive optics, customised ophthalmic lenses, and surgical procedures. Studies have demonstrated that correcting higher order aberrations significantly improves visual performance compared to conventional refractive error correction. The visual benefit is even more substantial in patients with pathologic corneal conditions such as keratoconus. My talk will focus on the principles and key factors of wavefront-guided vision correction, and recent advances in making the technology clinically applicable. I will also introduce custom, wavefront guided presbyopia correction, and discuss fundamental insights on how prolonged visual experience with the native optics alters neural processing.

Artificial Intelligence and Machine Learning Algorithms in Optometry

Abinaya Venkataraman

Karolinska Institute, Solna, Sweden

abinaya.venkataraman@ki.se

Abstract

Artificial intelligence (AI) is becoming increasingly available in many areas of eye care. AI is a broad term that covers any technology that simulates intelligent behaviour and critical thinking comparable to a human being. Machine learning (ML) is a subset of AI where the computer can learn from data with or without human intervention (deep learning) for optimisation. The wide-ranging use of multi-modal digital imaging, and objective markers make optometry best suited for AI integration. This talk will mainly focus on the automated subjective refraction techniques and predicting subjective refraction based on objective data. Developments in AI in other areas within optometry such as contact lens fitting, myopia development, and diagnosis of ocular diseases will also be reviewed. The strengths, challenges, validation, and limitations of AI in optometric practice will be discussed.

Limit values of optical radiation and application in phototherapy

Terje Christensen

National Centre for Optics, Vision and Eye Care; Department of Optometry, Radiography and Lighting Design; Faculty of Health and Social Sciences, University of South-Eastern Norway, Kongsberg, Norway

terje.christensen@usn.no

Abstract

The purpose of this presentation is to make users of optical techniques aware that too much optical radiation can cause damage. Therefore, limit values of exposure of skin and eyes are implemented according to international guidelines. All limit values are expressed in units determined by the relevant biological endpoint and represent a dose below which exposure cannot cause a harmful effect. It is exactly such biological damage that is intended in most forms of efficient phototherapy, but at doses and exposure conditions beyond the limit values. The use of photosensitising drugs may increase the light-induced effects in e.g., photodynamic therapy.

Legally, the use of optical radiation on patients is exempt from the limit values, because if you stay below the limit values, the dose will be too low in most forms of phototherapy. To be eligible for such an exception, the practitioners must meet certain requirements for medical competence. The use of light treatment for circadian rhythm disturbances may, on the other hand, occur with relatively low irradiance from light sources with a large area (for example, the blue sky) and at doses that will not violate the limit value for blue light retinal hazard. For radiation workers (yes, light is radiation, and light designers, optometrists and ophthalmologists may be regarded as radiation workers), bystanders and the general public the limit values apply.

In conclusion, everyone who works with radiation, and especially with advanced techniques on patients, should be aware of the limitations that apply. They must know about physical units, doses and spectra and be able to protect themselves, their colleagues, and their patients.