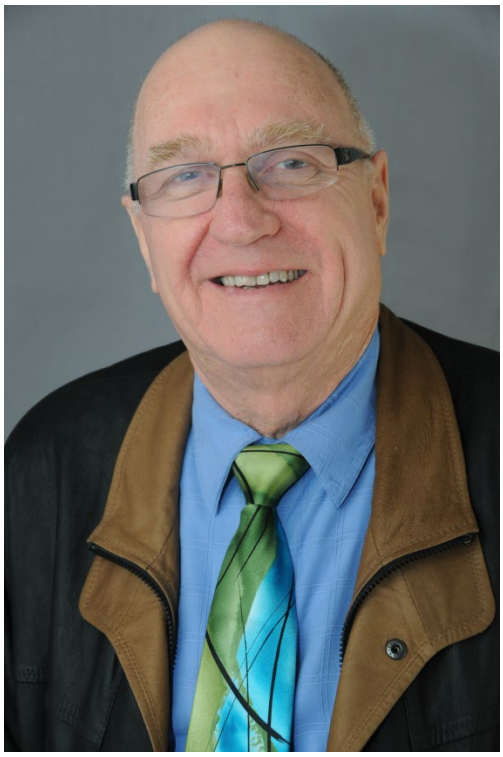
ESLRR 2019 KEYNOTE LECTURERS

Peripheral Prisms for Visual Field Expansion: A Translational Journey

Eli Peli

Prism corrections for visual field loss have been in use for many decades. The main limitations of the earlier prism designs for homonymous hemianopia are: a small (10º) field expansion only when looking to the blind side with central confusion, central diplopia, and pericentral apical (optical) scotoma. To eliminate the annoyance and disturbance of central confusion and diplopia, we use peripheral prism segments mounted above and below the line of sight on one lens on the side of the field loss. The clear area between the prism segments permits continuous single undisrupted central binocular vision. The peripheral prisms were initially implemented in a “horizontal” design using 40Δ (providing 20° field expansion) followed by the development of a 57Δ high power PMMA prism, providing 30° of field expansion measurable perimetrically. An “oblique” design enables expansion of blind side field of view through the windshield of a car while single binocular vision is maintained centrally. A series of studies including multi center community based clinical trials have confirmed that the prisms are helpful for obstacle avoidance when walking and continued to be worn for extended periods (>12 months). A randomized control trial in Belgium has shown that the prisms improve on road driving performance and driving simulator study has shown improved pedestrians detection. To address the needs of field expansion for monocular patients, a novel optical device the multiplexing prism (MxP) which overcomes the apical scotoma. The risk of collision between pedestrian in open environments was found to be highest from pedestrians at eccentricity of 45°. A novel refection-based prism-like device, multi periscopic prism (MPP), provides high angle of deflection (45°). The field of view covered is up to 60° wide, the eye scanning range is more than twice wider than that afforded by the lower power (30°), and the image quality is dramatically better than that available with current Fresnel prisms.



Eli Peli is Professor of Ophthalmology at Harvard Medical School and director of Vision Rehabilitation at Tufts Medical Center in Boston. Dr. Peli is a Fellow of the American Academy of Optometry, the Optical Society of America, the Society for Information Display, ARVO, and the International Society of Optical Engineering. Dr. Peli has consulted for 60 companies in the ophthalmic instrumentation and manufacturers of head mounted displays. He served as a consultant on many national committees, including the NIH, NASA, US Air Force, Department of Veterans Affairs, US Army Research Labs, and US Department of Transportation. Dr. Peli has published more than 220 peer reviewed scientific papers and has been awarded 12 US Patents. He edited a book entitled Visual Models for Target Detection and co-authored a book entitled Driving with Confidence: A Practical Guide to Driving with Low Vision. He was presented numerous National and International awards.

Melanopsin – why you should care
Robert Lucas

We have known for 20 years that retinal photoreception extends beyond rods and cones. Since then a lot has been learnt about the melanopsin-expressing, intrinsically photosensitive retinal ganglion cells (ipRGCs) responsible for this photoreception and their contribution to our sensory capacity. Despite being small in number (<1% of human ganglion cells) ipRGCs are extraordinarily influential. In addition to playing a critical role in synchronising biological clocks to the light:dark cycle, they drive light-dependent adjustments in behavioural and physiological state; control pupil size; support visual light adaptation; and contribute directly to perception of scene brightness and pattern discrimination. The discovery of ipRGCs can thus have implications for diagnosis and treatment of retinal dystrophy, and for the design of artificial light sources and visual displays. I will present an overview of the anatomy and physiology of this inner retinal photoreceptor system and of our own efforts to understand their numerous function(s) and apply these discoveries for practical benefit.

Having graduated with a BSc in Biological Sciences from the University of York, UK, Robert Lucas spent several years working in the pharmaceutical industry, supporting phase III and IV clinical trials. He then returned to academia to undertake a PhD in neuroendocrinology at the Institute of Zoology in London. During these post-graduate studies he developed an interest in circadian biology and pursued this as a post-doctoral researcher in the laboratory of Russell Foster in the Biology Department at Imperial College London. In Russell's laboratory he worked on the retinal mechanisms providing light information to the circadian clock, and continued that work as an independent researcher in the Medical School at Imperial College London. During this time he was able to contribute to the discovery of the melanopsin inner retinal photoreceptors that play such an important part in this process, and discovered that they are also the origin of the pupil light reflex. Since moving to the University of

Manchester in 2003, he has continued to study retinal control over circadian clocks and other aspects of physiology and behaviour. His interests have expanded to more conventional aspects of vision science as the various ways in which melanopsin photoreceptors support vision have been identified, and lessons from this inner retinal photoreceptor have been applied to develop new potential therapies for retinal degeneration. Rob studies these processes primarily in laboratory rodents, but recently also in human subjects, taking a keen interest in the real world application of these discoveries: he has active collaborations with partners from lighting, visual display and biopharma industries.

What happens to the brain when visual function is compromised by eye disease?

Antony Morland

Eye disease is becoming an increasing burden on society as populations age. Rightly there is a focus on treating and curing diseases of the eye, but the impact of eye disease on the brain also needs to be considered. In this presentation I will discuss work we have undertaken on individuals with low vision that is inherited or acquired later in life that examines the way in which visual information is represented in the brain. I will show that individuals born with no cone-mediated vision, who as a result have a small central scotoma, can exhibit a remapping the visual cortex. This plasticity may help individuals maximise the allocation of cortical resources to the vision that is spared. In contrast, scotomas that occur later in life because of macular degeneration do not appear to result in a remapping of visual cortex. There appears therefore to be a limit to brain plasticity later in life. I will also present work on individuals with congenital misrouting of the optic nerve at the optic chiasm, as a result of albinism for example. The visual cortex in these individuals shows a remarkable preservation of the canonical cortical mapping of thalamic inputs. This again shows a limit to large scale remapping, but opens up the idea that there must be extensive plasticity at a synaptic level to allow useful vision to be preserved across the visual field. Finally, I will show that not only does eye disease have effects on how visual information is functionally mapped in the brain, it also has an impact on cortical anatomy. The changes that occur are most frequently atrophic and this brings into focus the idea that the cortex may be vulnerable to long term deprivation that could potentially affect the way in which vision is ultimately restored through treatments.

Tony graduated from Imperial College London in Physics and stayed in the Physics Department to study for a doctorate on colour vision. Held post-doctoral positions at Imperial College and the Institute of Neurology, London. In 1997 he gained a Wellcome Trust Research Career Development Fellowship that allowed him to pursue neuroimaging research of the visual system under the supervision of Professor Brian Wandell at Stanford University. Following six years on the Psychology faculty at Royal Holloway University of London, he came to the University of York in 2006. His research interests are in imaging the visual areas of the human brain to reach a greater understanding of fundamental visual mechanisms in health and disease. His work has been funded by the Wellcome Trust, Medical Research Council, the BBSRC, Fight for Sight and the European Commission. He is currently the director of the York Neuroimaging Centre and is the lead for Neuroscience in the York Biomedical Research Institute.