Workshop June 3rd 2025, 11:00 - 13:30
Institute of Optics. Serrano, 121. Madrid

Novel imaging technologies for visual sciences

Live Imaging in Patients and Cells

Prof. Kate Grieve
Institut de la Vision Paris (France)

In Kate Grieve's team in Paris, we develop novel imaging technology to discover the health of cells in the patient's living retina or in the lab. The two main technologies we explore are adaptive optics ophthalmoscopy and optical coherence tomography. Imaging tools we developed in the clinic are used for diagnosis and follow up of cohorts of patients suffering from retinal disease. Advanced techniques such as phase contrast imaging and optoretinography for measurement of retinal function are the current focus of the group. We also develop full field optical coherence tomography to provide cellular resolution in the retina in a compact clinical device. In the lab, we have adapted dynamic full field optical coherence tomography to allow non-invasive label free imaging of cellular activity in retinal organoids and cell cultures. Our dynamic imaging microscope allows 3D live imaging over seconds to month long periods to track developmental or degenerative processes and thus help to decipher disease origins. We will give an overview of our imaging methods and results in this talk.

KATE GRIEVE *(>4000 citations, h-index 32, i10 index 58), research director and team leader at the Vision Institute, Paris; scientific director of the "Paris Eye Imaging" ocular imaging unit, at the Quinze Vingts National Ophthalmology Hospital, Paris; president and founder of startup SharpEye, and co-founder of startup Lutèce Dynamics, is an expert in optical imaging. Her research aims to develop non-invasive optical measurements of retinal cell structure and function in the living human eye, as well as in cell cultures in the lab. This development contributes to significantly improving the diagnosis and monitoring of ophthalmological pathologies, as well as to evaluating the results of innovative therapies. She was awarded the 2024 Irène Joliot Curie prize for Women in Research and Business from the French Academy of Sciences.*

Two-photon vision and its applications

Prof. Katarzyna Komar
International Center for Translational Eye Research (Poland)

Two-photon vision is a phenomenon of visual perception of pulsed infrared lasers caused by two-photon absorption of photons by visual pigments. The perceived color of projected stimuli is close to half of the laser wavelength. The intensity of two-photon stimulation depends quadratically on mean power of the laser, as the two-photon absorption is a nonlinear optical effect. Both, basic features of this phenomenon and its translational potential are explored in International Centre of Translational Eye Research (ICTER) in Warsaw. We study: two-photon visual sensitivity to different wavelengths, two-photon contrast sensitivity, and eye accommodation induced by two-photon vision. We also characterize the influence of various laser beam parameters and determine color coordinates for two-photon stimuli. We are working on the application of this effect in medical diagnostics (two-photon microperimetry) and for displaying augmented content in augmented reality glasses.

KATARZYNA KOMAR *graduated from Gdansk University of Technology (MSc in Technical Physics) and received a Ph.D. in Technical Sciences in 2007. Since 2011, she has worked in biomedical imaging of the human eye at Nicolaus Copernicus University in Torun. he is also working at the International Centre for Translational Eye Research in Warsaw, exploring two-photon vision, i.e., a phenomenon of perception of pulsed near-infrared lasers due to two-photon absorption in visual pigments. She focuses on developing optical systems and methods for psychophysical testing of this new way of perceiving light and integrating these methods into ophthalmic imaging systems.During both phases of her career, she has participated in and led nationally and internationally funded-research projects. Now, she is leading two projects devoted to a two-photon vision funded by the Foundation for Polish Science and by the National Science Centre, Poland.*