Carl Zeiss Stiftung

HONORARY GUEST LECTURE

A lecture series offered by the Jena Alliance "Life in Focus"

ACP/ASP Guest Professor

PROF. IGOR MEGLINSKI

Aston University, UK

Igor Meglinski, MSc, PhD, is a Professor at the School of Engineering & Applied Science and at the School of Life & Health Sciences in Aston University, Birmingham (UK), and at the Faculty of Information Technology and Electrical Engineering of the University of Oulu (Finland). Professor Meglinski's research interests lie at the interface between physics, medicine and biological sciences, focusing on the development of new non-invasive imaging/diagnostic techniques and their application in medicine & biology, material sciences, pharmacy, food, environmental monitoring, and health care industries.

He is a Chartered Physicist (CPhys), Chartered Engineer (CEng), Fellow of the Institute of Physics, Fellow of SPIE, and Fellow of OPTICA. Prof. Meglinski is author and co-author of over 350 papers published in peer-reviewed scientific journals, proceedings of international conferences, and book chapters, and over 700 presentations at major international conferences, including about 300 invited lectures, keynote and plenary talks.

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SPIN AND ORBITAL ANGULAR MOMENTA IN BIOMEDICAL DIAGNOSIS AND TISSUE CHARACTERISATION (PROF. IGOR MEGLINSKI)

Wednesday, March 22, 1 pm
ACP Auditorium, Albert-Einstein-Straße 6, 07745 Jena
Zoom-Meeting-ID: 651 5294 5838, Kenncode: 374059

We explore the potential of using shaped light with angular momentum in diagnosis of cells and biological tissues. The angular momentum of light contains a spin contribution, conditioned by the polarization of the electromagnetic fields and an orbital contribution, related to their spatial structure. While the spin angular momentum has been extensively employed in diagnostic studies (see e.g. [1-3]), the orbital angular momentum (OAM) has been added to the practical toolkit very recently [4]. When the shaped light propagates in a homogeneous transparent medium, both spin and orbital angular momenta are conserved. In the medium with complex structure and anisotropic scattering the spin and orbital angular momenta are changed significantly that leads to spin-orbit interaction. Such a spin-orbit interaction leads to the mutual influence of the polarization and the trajectories of twisted photons propagating in the medium. Significant increase of the visibility contrast and penetration depth when imaging through the homogeneous scattering media with vector light beams was demonstrated [5]. Nevertheless, the potential of OAM for biomedical diagnosis and characterization of cells and tissues is far from being fully explored. In this report we present the results of our most recent studies of how the spin-orbit interaction leads to the mutual influence of that shaped light with OAM could be up to ~103 times more sensitive to the refractive indices changes within the dense medium and has a strong potential to revolutionize the current practices of tissue diagnosis, e.g. histological examination. The application of OAM in biomedical diagnosis offers fascinating opportunities for both new fundamental biological studies and practical clinical applications.

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DYNAMIC LIGHT SCATTERING FOR NON-INVASIVE DIAGNOSIS OF BLOOD AND BLOOD MICROCIRCULATION (PROF. IGOR MEGLINSKI)

Monday, March 27, 2 pm
ACP Auditorium, Albert-Einstein-Straße 6, 07745 Jena
Zoom-Meeting-ID: 651 5294 5838, Kenncode: 374059

The majority of biological tissues are the highly heterogeneous media composing mixture of static (e.g. skin, bones) and dynamic (e.g. blood, lymph) structural inclusions. The presence of static areas exhibit non-ergodic features providing systematic uncertainty in the quantitative interpretation of the measurements of Dynamic Light Scattering (DLS). In fact, a number of various DLS-based techniques are extensively used for monitoring, imaging and quantitative assessment of blood flows in biological tissues, whereas the issues associated with the non-ergodicity are typically ignored. Based on the simple phenomenological model we present a justification for the applicability of DLS-based imaging technique for monitoring of blood flows within brain tissues under the formally broken ergodicity conditions. Taking into account that DLS recording images are nonstationary and the statistical properties might variate over a time of measurements, the continuous wavelet transform (CWT) is applied to explore whether the cerebral hemodynamic patterns of possible spatial or temporal synchronization across the brain surface emerged. In addition, Non-negative Matrix Factorization (NMF) is used for segmentation of DLS-based images, consequent identification of interpretable relationships within the distinct demarcated microstructure patterns and their functional evaluation. In addition, we introduce a time-space Fourier Kappa-Omega filtering approach for stabilization of fast dynamic brain images in vivo [1]. Finally, the results of evaluation of impairments of cerebral blood flow and blood microcirculation brought by acute hypoxia provoked by a poor respiration arrest and cardiac cessation are presented [2].

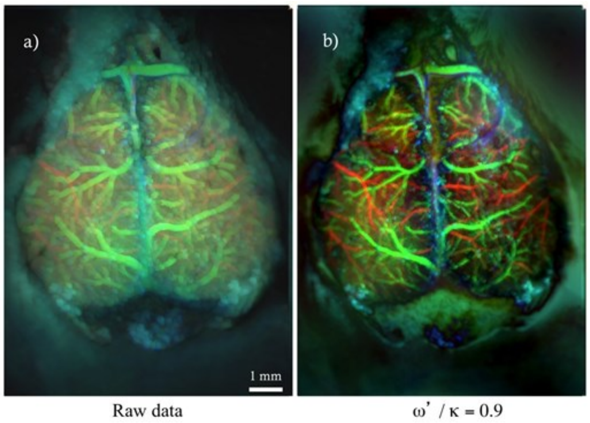

Fig.1. Brain images before (a) and after (b) the application of a time-space Fourier Kappa-Omega filtering approach [1].

References

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