SYBO 2: Symposium Biomedical Optics 2

Time: Thursday 14:30–16:30 Location: e415

Invited Talk SYBO 2.1 Thu 14:30 e415

Smart and multimodal light sheet microscopy — •Jan Huisken — Max Planck Institute of Molecular Cell Biology and Genetics, Dresden, Germany

Light sheet microscopy has become the tool of choice for *in vivo* fluorescence imaging of fragile biological specimens. Low phototoxicity and high speed acquisition have offered unique applications ranging from fast volumetric imaging to extended timelapse experiments spanning the entire embryogenesis of fish and fly. The enormous amounts of data from these instruments (TB/hour) now require a new approach to imaging: we cannot blindly image large samples with uniformly high spatial and temporal resolution.

We propose smart microscopy as a solution, in which illumination and detection are adaptively adjusted to obtain meaningful information at any time without any *a priori* knowledge about the sample. Only the regions in the sample that change over time or exhibit interesting new information will be illuminated and detected. Alternative modalities such as optical projection tomography offer additional information about the location and state of the sample that are used to optimize light sheet acquisitions. This presentation will give an overview of the latest developments in light sheet microscopy that lead towards a smart and gentle microscope.

Invited Talk SYBO 2.2 Thu 15:00 e415

Laser Applications at the Cochlea: Imaging and Stimulation — •Alexander Heisterkamp[1,2], Nicole Kallweit[2,3], Peter Baumhoff[4], Alexander Krueger[2,3], Nadine Tinne[2,3], Heiko Meyer[2,3], Andrej Kral[2,4], Hannes Maier[2,4], and Tammo Ripken[2,3] — [1]Institute of Quantum Optics, Leibniz University Hannover, Hannover, Germany — [2]Cluster of Excellence Hearing for all, Hannover, Germany — [3]Laser Zentrum Hannover e.V., Hannover, Germany — [4]Institute of Audioneurotechnology, Hannover Medical School, Hannover, Germany

Using laser radiation, tissues and cells can be studied, characterized and manipulated with high resolution and low side effects. By optical tomography, single hair cells or their excitation can be visualized in model systems and even in vivo in an animal model. Using optoacoustics, sound generation within tissue can be induced. These processes can be employed for imaging or stimulation of the cochlea. In our investigations we studied the excitation of hair cells within the cochlea by laser irradiation and determined the underlying mechanisms. Further optical procedures allow the excitation of action potentials in neural cells as well and are currently studied with respect to applicability. For optical imaging, usually high resolution techniques such as confocal microscopy or histology are used to study the structure of the cochlea. However, optical penetration depth is limited by scattering within the osseous composition of the cochlea. Thus, we applied decalcification and optical clearing techniques to allow tomographic imaging of the cochlea ex vivo and generated 3D data of these structures.

Invited Talk SYBO 2.3 Thu 15:30 e415

Scuplted light landscapes for optical micro-manipulation — Christina Alpmann, Alvaro Barroso Pena, Eileen Otte, Kathrin Dieckmann, and •Cornelia Denz — Institute of Applied Physics, University of Muenster

The modulation of the spatial polarization, amplitude and phase distribution of light covers a broad range of applications, e.g. in laser machining, high-NA microscopy or optical micro-manipulation where these properties are used to shape the focal field in three dimensions.

In the last years, the holographic modulation of amplitude and phase have been widely employed in optical trapping techniques to create three-dimensional optical potential landscapes that allow manipulating several microscopic particles. In particular, we have shown that such tailored light fields are ideally suited for the organization and structuring of soft and biomatter entities, as e.g. zeolite L nanocontainers or bacterial molecular motors. Beside the modulation of amplitude and phase, polarization modulation enriches light shaping. While phase gradients can be used in order to exert orbital angular momentum, polarization structured light fields offer the possibility of spatially varying spin angular momentum affecting the trapped micro-particle.

In this contribution, we present our recent results in holographic generation of sophisticated tailored light fields which, in comparison to established holographic optical tweezers, provide remarkable higher trapping and control of complex particle orientation, and discuss the principles and applications of phase, amplitude and polarization modulated light for optical micro-manipulation.

Invited Talk SYBO 2.4 Thu 16:00 e415

Optogenetics: Lighting Up the Brain — •Gero Miesenboeck — Centre for Neural Circuits and Behaviour, University of Oxford, United Kingdom

An emerging set of methods enables an experimental dialogue with biological systems composed of many interacting cell types*in particular, with neural circuits in the brain. These methods are called *optogenetic* because they employ light-responsive proteins (*opto-*) encoded in DNA (*-genetic*). Optogenetic devices can be introduced into tissues or whole organisms by genetic manipulation and be expressed in anatomically or functionally defined groups of cells. In a decade and a half, optogenetic control has developed from a far-fetched idea to a widely used technique. My talk will illustrate how this happened, drawing on the earliest and latest results from my lab.