Type of presentation: Invited

IT-3-IN-2856 Smart NanoBioImaging: multimodal correlative nanoscopy.

Diaspro A.[1, 2, 3]

[1]Department of Nanophysics, Istituto Italiano di Tecnologia, Genoa, Italy, [2]Department of Physics, University of Genoa, Genoa, Italy, [3]Nikon Imaging Center, NIC@IIT, Genoa, Italy

Email of the presenting author: alberto.diaspro@iit.it

Nanoscopy and super resolution localization microscopy changed the paradigm in optical microscopy and increased the portfolio of applications along with new developments. Among biological applications, the demand for imaging cell aggregates (i.e., tumor spheroids) or tissues/organs and small organisms (i.e. zebrafish) and for performing multimodal investigations is challenging. Light scattering, polarization properties and other than light-based mechanisms of contrast can represent an important issue for further advances. Within such a framework, mixed technologies for investigating biological systems (and not only) at the nanoscale will be outlined. Specifically, the possibility of utilizing a Mueller matrix approach for scattering and polarization dependent data - also exploiting optically active biological structures, with particular interest in chiral objects - could lead to improve informative content of the formed images. For example, fluorescence and SHG data can be enriched by Mueller matrix signature and polarization considerations. As it was early demonstrated the possibility of getting ultrastructural information about chromatin-DNA organization by means of circular intensity differential light scattering makes the Mueller matrix integrated approach an effective good candidate projected to label free high-resolution imaging. To this end , a Mueller Matrix polarimetry integrated architecture will be outlined, based on photoelastic modulation. A Classical electrodynamics model can be the starting point to decipher high resolution information due to light scattering.
Moreover, although optical methods are a comparatively safe way to probe a biological system without substantial perturbation, scanning/surface probe microscopy had a relevant impact on biological imaging after the advent of atomic force microscopy (AFM). Force mapping and curves can be analyzed in order to obtain, for example, local elasticity information (Young's modulus evaluation pixel by pixel) or performing molecular nanomanipulation, with a high specificity that generally lacks in atomic force microscopy. A hybrid modality, coupling super resolution methods based on individual molecule localization (IML, PALM, STORM) and on optical nanoscopy (STED, RESOLFT) with AFM will be critically discussed.
Multimodal and multidimensional correlative super-microscopy launches a new trend in microscopy. The focus is on asserting that the key elemental differences in the superresolution hyrbid approaches can be perceived as a modern overture for addressing old and new biological biological questions.

Acknowledgement: The auhor is indebted with members of the NanoBioImaging and NanoBIoPhotonics - LAMBS IIT research team. This work partially funded by the Italian Programmi di Ricerca di Rilevante Interesse Nazionale PRIN 2010JFYFY2-002 grant.