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Breaking the bounds of imaging in label-free nanoscopy, micro-endoscopy and ophthalmology

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Imaging systems as well as human vision system have limited capability for separation of spatial features (due to diffraction and sensor's geometry) and this information can also be extracted only from depth limited range. I will present novel photonic approaches to exceed the resolution and depth of focus limitations and show how those concepts can be adapted to microscopic configurations, to micro-endoscopy as well as embedded into ophthalmic device for correcting visual deficiencies.

In the case of microscopy I will present how the resolution limit can go below sub-wavelength bound towards nanoscopic imaging while using label-free configurations involving time multiplexing (time dependent light collection) based upon label-free non-static nano-particles either moving in uncontrolled Brownian motion or being manipulated with light.

In the case of micro-endoscopy, I will show how projection of high-resolution wavelength dependent or time dependent random codes can enhance the resolution of the collected light. Those concept of wavelength and time multiplexing super-resolved imaging will also be demonstrated for imaging through biological scattering medium such as biological tissues and liquids as blood.

The last part of the talk will be related to extending the depth of focus of imaging systems in all-optical manner while introducing "interference" effect based extended depth of focal imaging (rather than diffraction and refraction based). The proposed extended depth of focus approaches will be implemented in ophthalmic usage on top of conventional spectacles, contact lenses and intraocular lenses while aiming to simultaneously correct various visual refractive errors, such as myopia, hyperopia, presbyopia, regular/irregular astigmatism.

Biography

Prof. Zeev Zalevsky received his B.Sc and direct Ph.D degrees in electrical-engineering from Tel-Aviv University in 1993 and 1996 respectively. Zeev is currently a full Professor and the Dean of the faculty of engineering in Bar-Ilan University, Israel. His major fields of research are optical super resolution, biomedical optics, nano-photonics and fiber-optics. Zeev published more than 520 peer review papers, 330 proceeding papers, 9 books, 31 book chapters and 100 patents. Zeev gave 600 conference presentations (more than 200 invited/keynote/plenary talks). Zeev is a fellow of many large scientific societies as IEEE, OSA, SPIE, IET, IOP, EOS, NAI and more.