OPTICA Short Course:

Polarization Optical Imaging for Biomedical Applications

Prof. Anna N. Yaroslavsky

Department of Physics, University of Massachusetts, Lowell, USA

This lecture gives an introduction and overview of the techniques and biomedical applications of the polarization optical imaging. Electromagnetic radiation of the optical range is nonionizing and can be safely used for monitoring and characterization of the live tissues. Polarization optical imaging modalities are powerful techniques that yield information on the structure, as well as biochemical and biophysical properties that can be used for detection and delineation of pathology. Major focus will be on the development of the quantitative optical methods for the detection of human pathology. Even though the use of light in medicine has a long history, histopathology remains the mainstay for diagnosing diseases. Histopathology is subjective, costly, labor intensive and cannot be used *in vivo.* Nondestructive quantitative optical imaging offers unique advantage of evaluating the details of tissue morphology and biochemistry safely and rapidly, and may aid in the diagnosis and selective targeting of pathology. In particular, optical methods that can be used for rapid noninvasive interrogation of live tissues as well as for the high-resolution detection of pathological changes at the cellular level. Applications for detecting various cancers will be covered. Other potential benefits and future avenues of developments of the optical polarization methods will be discussed.

Learning objectives

This course will provide the participants with:

→ basic information about polarization reflectance and fluorescence optical imaging;

→ knowledge of applications of polarization-enhanced optical imaging in various fields of biomedical research and medicine, including skin.

→ understand the potential of the polarization optical imaging in the context of various diagnostic and treatment guidance methods.

Intended audience

Master and PhD students, postdocs, scientists from various disciplines, e.g. physicists, chemists, engineers, biologists, biomedical scientists, and clinicians.

Course level

Intermediate

Short Course duration

Half a day

Instructor

Anna N. Yaroslavsky is Associate Professor of Physics and Director of Advanced Biophotonics Laboratory (ABL) at the University of Massachusetts, USA. Her expertise is in biomedical optics and medical imaging. Her research is focused on the development of optical and multimodal technologies for medical applications. She graduated *summa cum laude* from Saratov State University, Russia, in 1990 with Masters Degree in Physics. Between 1990 and 1999, she conducted research at Twente University in Enschede (The Netherlands), Heinrich-Heine University in Dusseldorf (Germany), and Louisiana State University Medical Center in Shreveport, LA (USA). During that time, she pioneered development of individualized, image-based methods of laser dosimetry and planning for brain tumor treatment, formulated concept and implemented full inverse Monte Carlo technique for reconstruction of tissue optical properties, and investigated light scattering by complex biological structures. In 1999, she earned PhD degree in Biophysics from Saratov State University. In 2000, she joined Wellman Center for Photomedicine at Harvard Medical School, where she progressed from Instructor to Assistant Professor. Her research at Wellman Center

concentrated on the development of combined polarization, fluorescence and elastic scattering methods for diagnostics of cancers. Since 2010, Anna is with the Departmet of Physics of the University of Massachusetts at Lowell. The major focus of the research effort in her laboratory is on the development and integration of experimental and theoretical multi-modal technologies and methods for functional and structural characterization of biological tissues and cells, as well as pathology detection and treatment. She published more than 60 manuscripts in top-tier international journals and authored several internatinal patents. She participated as principal investigator in 11 externally funded projects. She served as a reviewer on various NIH panels and has been elected senior member of SPIE.