

# Introduction: Advances in Optical Coherence Tomography, Photoacoustic Imaging, and Microscopy

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**Abstract:** The editors introduce the *Biomedical Optics Express* feature issue, “Advances in Optical Coherence Tomography, Photoacoustic Imaging, and Microscopy,” which combines three technical areas from the 2010 Optical Society of America (OSA), Biomedical Optics (BIOMED) Topical Meeting held on 11–14 April in Miami, Florida, and includes contributions from conference attendees.

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This special issue is one of a series of feature issues in *Biomedical Optics Express*. This issue focuses on recent developments and applications of high-resolution imaging technologies, which cover three of the seven technical areas in the recent OSA Biomedical Optics (BIOMED) Topical Meeting, held on April 11–14, 2010, in Miami, Florida. These three areas are Optical Coherence Tomography (OCT) and Sensing, Photoacoustic Imaging and Spectroscopy, and Microscopy, which were chaired by Xingde Li from the Johns Hopkins University (USA), by Paul Beard from the University College London (UK), and by Irene Georgakoudi from Tufts University (USA) and Jerome Mertz from Boston University (USA), respectively. This special issue includes contributions from the conference attendees of the

above three technical programs. More detailed information about the BIOMED meeting can be found in a sister Special Issue of *Biomedical Optics Express* [1].

Optical Coherence Tomography and Sensing is a traditional session in the BIOMED topical meetings. This year we received 39 contributed submissions, which covered a broad and nicely blended spectrum of the field. Most of the submissions showcased new technology developments, including new record of OCT imaging speed, new light sources, imaging contrast mechanisms, algorithms for blood vessels imaging and hemoglobin sensing, new concepts of multimodal integration, novel miniature imaging devices and others. In addition to technology development, quite a few papers reported *in vivo* animal model and clinical OCT applications, including retina and cornea imaging, cancer detection, and cell viability assessment.

In addition to the contributed submissions, we had a plenary talk on the state-of-art OCT technology developments and applications in ophthalmology and cardiology, delivered by Dr. James Fujimoto from Massachusetts Institute of Technology. We also had two invited talks, with one presented by Dr. Robert Huber from Ludwig-Maximilians-University München on ultrahigh speed OCT imaging technologies that set the new imaging speed record, and the other one presented by Dr. Andrew Rollins from Case Western Reserve University on 3D and 4D OCT imaging of developing heart, which presented an extremely important area where OCT is making a growing impact.

This special issue has three papers in the area of OCT and sensing, including (i) a multimodal platform that integrates OCT with fluorescence life time microscopy for both morphological imaging and biochemical sensing [2], (ii) a clever method to combine confocal fundus imaging with ophthalmic OCT allowing for natural co-registration and motion tracking [3], and (iii) systematic investigation on the wavelength-dependence of OCT imaging depth, particularly for 1300 nm and 1600 nm [4].

The Photoacoustic Imaging and Spectroscopy session (the first such dedicated session at OSA BIOMED) generated significant interest with 35 abstract submissions. Topics encompassed new developments in photoacoustic instrumentation, multimodal techniques, nonlinear photoacoustic microscopy, and *in vivo* clinical and preclinical imaging applications, as well as quantitative photoacoustic image reconstruction methods. In addition to the submitted oral presentations and posters, Dr Alexander Oraevsky from TomoWave Laboratories, Inc. gave an invited talk outlining his latest work in small animal and clinical photoacoustic imaging. The three papers in this special feature include (i) a new type of ultrasound detector based on an axicon that provides an extended depth range of focus compared with conventional spherical focused transducers for use in photoacoustic microscopy [5], (ii) a means of achieving optically defined axial as well as lateral spatial resolution in photoacoustic microscopy by exploiting nonlinear transient absorption [6], and (iii) the use of an exogenous chromophore that exhibits a fluence-dependent absorption to provide a quantitative image of its concentration [7].

There were 45 Microscopy contributed submissions that were presented during the poster sessions and two oral presentation sessions that focused on Advances in Nonlinear Microscopy and Novel Approaches in Microscopy. Two invited talks were delivered in these sessions by Guillaume Labroille from Ecole Polytechnique, France, on the use of pulse shaping for two-photon microscopy applications and by Alexander Egner from the Max Planck Institute for Biophysical Chemistry, Germany, on fluorescence nanoscopy. The three studies reported in detail in this special feature describe (i) the development of high-speed focal modulation microscopy using acousto-optical modulators [8], (ii) the marriage of microfluidics and optics in a microfluidic photoporation system to enable automated, high-throughput optical injection of cells [9], and (iii) the interplay of chromatic aberrations and scattering in two-photon fluorescence spectroscopic measurements performed with a GRIN-lens-based imaging set-up [10].

The papers published in this special issue represent an excellent combination of different topics covered at the BIOMED conference. The editors (and the conference organization members) would like to take this opportunity to thank the attendees for their contribution to the conference and the authors for their contribution to this special issue.