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Optical Coherence Tomography and Coherence Domain Optical Methods in Biomedicine XVI

**Joseph A. Izatt
James G. Fujimoto
Valery V. Tuchin**
Editors

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Introduction

These proceedings are from the Optical Coherence Tomography and Coherence Domain Optical Methods in Biomedicine XVI, held January 23-25, 2012 at the SPIE Photonics West Symposia in San Francisco, California. This year's conference featured 131 oral and poster presentations from leading national and international research groups.

The conference was organized into several sessions including: Imaging Vascular Structure and Flow: Ophthalmology; New Clinical and Pre-Clinical Applications; Ophthalmic New Technology; New Light Sources and Systems; Cardiovascular New Technology; Imaging Vascular Structure and Flow: New Technology; Catheter/Endoscopic and Cancer; OCT New Technology; OCT Novel Applications; Phase and Polarization Sensitive OCT; Novel Coherence Microscopy; Signal/Image Processing, and a poster session with 47 presentations. As usual, a predominant fraction of the papers focused on optical coherence tomography–basic research, instrumentation and applications.

This year, there were significant advances in clinical and biological applications (six sessions: Imaging Vascular Structure and Flow: Ophthalmology; New Clinical and Pre-Clinical Applications; Ophthalmic New Technology; Cardiovascular New Technology; Imaging Vascular Structure and Flow: New Technology; Catheter/Endoscopic and Cancer, with 40 oral and 15 poster presentations) with discussion of OCT technologies for non-invasive optical imaging of true capillary blood flow within microcirculatory tissue beds, high-resolution 3D vasculature imaging by adaptive optics OCT angiography, *in vivo* human retinal and choroidal vasculature visualization and measurement of choroidal blood flow, 3D measurement of blood flow based on intensity information analysis of OCT data, multiple blood flow imaging modes by ultrahigh speed dual-beam DOCT, angle-insensitive total axial flow measurement using transversal scanning DOCT, simultaneous *in vivo* structural and functional assessment of the microcirculation using correlation mapping OCT, real-time 3D dynamic imaging of airways reactivity, volumetric imaging of pulmonary pathology, assessment of collagen changes in ovarian tissue, imaging of American cockroach nervous system, ultrahigh speed and adaptive *in vivo* imaging of retina and retinal nerve fiber layer, measurement of embryonic cardiac dynamics, simultaneous high-resolution morphological and biochemical optical imaging of atherosclerosis and classification of atherosclerotic plaques, *in vivo* intracardiac imaging through percutaneous access, cardiovascular imaging using a fully integrated intravascular OCT-ultrasound system, 3D volumetric quantification of fibrous caps using intravascular OCT, simultaneous endoscopic OCT and fluorescence imaging using all-fiber optically based catheter system, preclinical study on breast cancer and cellular resolution imaging using a full-field OCT endoscopic probe, marking-guided biopsy in patients referred for screening or surveillance of Barrett's esophagus, early diagnosis of carcinoma *in situ* of the bladder, and etc.

Eight oral presentations in the session on New Light Sources and Systems reported advanced technologies and systems, such as MEMS tunable VCSEL light source for ultrahigh speed 100kHz - 1MHz axial scan rate and long range centimeter class OCT imaging, dispersion compensated megahertz FDML laser, coherence length extension of Fourier-domain mode locked lasers, polarization maintaining buffered Fourier domain mode-locked swept source, spacing-swept multi-wavelength source for deeper OCT imaging, broadband Fourier domain mode-locked 1060 nm-laser, dual-wavelength-swept active mode locking laser, a monolithic semiconductor laser with long coherence length for fast and inexpensive OCT systems was presented as well.

The session on OCT New Technology contained eight oral papers and was devoted to further development of OCT components and whole systems, such as multi-MHz FDML OCT allows for snapshot retinal imaging at 6.7 million axial-scans per second, ultrafast spectral domain system at an A-scan rate of 12.5 MHz at 1300 nm, dual-depth swept source OCT for simultaneous complex conjugate resolved eye anterior segment and retinal imaging and dispersion encoded full-range SSOCCT at 1060 nm, streak-mode Fourier domain OCT, depth-ambiguity free PSOCCT imaging using the Pancharatnam-Berry phase, multiple-depth en face OCT using active recirculation loops in the non-stationary state, and etc.

A special session on OCT Novel Applications contained six oral presentations with discussion of simultaneous dark-bright field swept SSOCCT for ultrasound detection, optimizing magnetomotive contrast of SPIO-labeled platelets for thrombosis imaging, *in vivo* measurement of differential motion within the organ of Corti under sound stimulation and vibrational response of the mouse ear using coherently interleaved OCT, spectral and time domain OCT as a tool for optimal imaging of biological samples, and conformal laser therapy.

This year's Phase and Polarization Sensitive OCT (PSOCCT) session with six oral presentations highlighted the following actual problems: polarimetry noise analysis and compensation, imaging of photothermal tissue expansion, design of ultrahigh speed swept source / Fourier domain PSOCCT system, the possibility of automated measurement of choroidal thickness and chorio-scleral interface, as well as absolute measurement of subnanometer scale vibration of cochlear partition of an excised guinea pig cochlea.

The Novel Coherence Microscopy session presented eight oral papers on optical coherence microscopy (OCM) for deep tissue imaging of the cerebral cortex with intrinsic contrast, structural and functional imaging of the pathology of Alzheimer's disease in a mouse model using extended-focus OCM, sub-cellular resolution imaging of coronary arteries and respiratory mucosa using μ OCT, interferometric synthetic aperture microscopy with virtual adaptive optics aberration correction, combined two-photon microscopy and OCT for *in vivo* tissue imaging, quantifying sub-diffractional tissue mass density correlation function by spectroscopic OCT, high resolution holography, and study of development and dynamics of 3D mammary epithelial-stromal co-cultures using OCT.

The last session on Signal/Image Processing also contained eight oral presentations and discussed the following problems: anterior segment and retinal 3D-OCT motion correction using orthogonal scan patterns, morphological image analysis for classification of gastrointestinal tissues using OCT, joint OCT spectral and time domain processing applied to elastography, digital refocusing in OCT, hybrid FPGA and GPU acceleration of OCT angiography computation, and graphics processing unit-based ultra-high-speed real-time and dispersion encoded full-range FDOCT.

The poster session contained 47 papers on the major above mentioned topics.

Two short courses for engineers, scientists, and clinicians SC312 - *Principles and Applications of Optical Coherence Tomography* by James Fujimoto and SC1054 - *Bio-Interferometry* by David Nolte accompanied the conference.

All submissions were fully peer reviewed. Authors were requested to submit a 3-page summary of their paper. The program committee evaluated the submissions for technical content and assigned a numerical score to each paper. The selection of the papers as oral presentations, posters, or non-acceptance was based upon the program committee score. We have had very positive feedback and a record number of submissions and attendees again this year.

The conference chairs would like to thank the members of the technical program committee for their help in organizing the conference. We sincerely appreciate the support of the SPIE and the conference staff. Finally, we would like to thank all of the conference attendees and manuscript authors for their contributions and participation which helped to make this meeting a success.

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