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Optical Coherence Tomography and Coherence Domain Optical Methods in Biomedicine XVII

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Introduction

These proceedings are from the Optical Coherence Tomography and Coherence Domain Optical Methods in Biomedicine XVII, held February 4-6, 2013 at the SPIE Photonics West Symposia in San Francisco, California. This year's conference featured 129 oral and poster presentations from leading national and international research groups.

The conference was organized into several sessions including: OCT Technology I, II, and III; Light Sources and High speed OCT Technology; Ophthalmic Applications I and II; Endoscopic and Intravascular OCT; Functional, Doppler and PS OCT I and II; OCM, Full Field and Microscopy Techniques; Small Animal and Developmental Biology; Clinical Applications; and a poster session. A predominant fraction of the papers focused on optical coherence tomography – basic research, instrumentation and applications.

This year, there were presented significant advances in the development of new OCT technologies (eight sessions: OCT Technology I, II, and III; Light Sources and High speed OCT Technology; Endoscopic and Intravascular OCT; Functional, Doppler and PS OCT I and II; OCM, Full Field and Microscopy Techniques with 48 oral and 35 poster presentations) with discussion of OCT novel and upgraded technologies for angle-resolved ophthalmic MHz OCT at joint aperture detection, off-axis full-field swept-source OCT (SS OCT) imaging using holographic refocusing, chromatic visualization of reflectivity variance, computational and sensorless corrections in adaptive OCT, single-shot interpixel shifting for OCT by oblique incidence spectroscopy, polarization sensitive *en face* OCT using multichannel acousto-optic deflectors, real time 3D structural and Doppler OCT imaging on graphics processing units (GPU) and GPU accelerated OCT processing at megahertz axial scan rate, double-clad-fiber needle probe for combined OCT and fluorescence imaging, motion compensated hand-held common-path FD OCT probe for image-guided intervention and freehand OCT with real-time lateral motion tracking, ultrahigh speed MEMS tunable 1065nm and 1310nm VCSEL technology with ultralong imaging range providing Doppler OCT, 4D OCT at 25 Hz video rate with improved lateral resolution, SS-OCT system based on reflective Fabry-Perot tunable laser with enhanced depth range up to 13.8 mm, ultrahigh resolution OCT using high power fiber laser supercontinuum at 1.7 μm wavelength region, high-speed Doppler optical frequency-domain imaging (OFDI) using frequency multiplexed dual beam illumination, 3D velocity vector measurement by 3-beam spectral-domain Doppler OCT, high and ultrahigh speed endoscopic OCT systems using miniature motorized endoscopic probes, multimodal 2D and 3D full-field OCT imaging and elasticity mapping with a needle-like probe and elastic restoring-force-free magnetomotive OCT, 3D self-interference fluorescence microscopy without depth scanning, photothermal lock-in optical coherence microscopy (OCM), dual-wavelength photothermal OCT, and gold nanoparticle-based photothermal OCT combined with two-photon microscopy.

These hardware and software achievements in many cases were tested for biomedical applications to demonstrate their new facilities, such as revealing viscoelasticity of soft tissue tumors using phase sensitive OCT and a focused air puff system, label-free imaging of the dynamics of cell-to-cell string like structure bridging in the free-space, measurement of angle-resolved scattering property of ovarian tissue, first in human experience with tethered capsule OFDI endomicroscopy, OFDI guiding biopsy in pulmonary nodules, optimum stent detection in intravascular OCT, 3-D intravascular spectroscopic OCT automated detection of lipid, polarization sensitive intracoronary imaging, label-free optical imaging of blood and lymphatic vessels within tissue beds *in vivo*, high quality optical microangiography of ocular microcirculation and measurement of total retinal blood flow in mouse eye, diabetes imaging with pancreatic vasculature and blood flow analysis using joint spectral and time domain OCM, *in vivo* imaging of gold nanorod contrast agents using photothermal OCT, three-dimensional intracellular optical coherence phase imaging, and visible spectrum OCM for live subcellular imaging.

Sixteen oral presentations in the two sessions on Ophthalmic Applications reported on structural and functional imaging of the human retina with ultrahigh speed SS OCT using a VCSEL light source, multi-functional OCT for polarization and Doppler measurements in posterior eye, split-spectrum amplitude-decorrelation angiography, wide field-of-view retinal capillary mosaic imaging by ultrahigh speed dual-beam Doppler OCT angiography, phase-resolved OCT angiography of the retina and choroid with using interval-optimized backstitched B-scans, image acquisition and processing methods for artifact-reduced imaging and differentiation of retinal capillary beds using speckle variance OCT, *en face* adaptive optics OCT with 3D-motion correction, rotational Dove prism scanning dual angle Doppler OCT, intraoperative SD OCT for vitreo-retinal surgery, high sensitive fundus autofluorescence imaging combined with speckle-free OCT, retinal tracking PS OCT, and detection of retinal degeneration using angle-resolved low coherence interferometry.

The session on Small Animal and Developmental Biology contained six oral papers and was devoted to ultrahigh-speed ultrahigh-resolution adaptive optics OCT system for *in vivo* small animal retinal imaging, phase-sensitive OCT characterization of pulse-induced trabecular meshwork displacement in *ex vivo* eyes, dynamic OCT measurement of the biomechanical properties of mouse cornea *in vivo*, simultaneous multi-chromophore *in vivo* pump-probe OCT imaging in Xenopus laevis, OCT detection of neural activity in American cockroach nervous system, and OCT imaging of early effects of ethanol exposure on the embryonic heart.

A special session on Clinical Applications contained eight oral presentations with discussion of improved imaging of breast cancer using OCT elastography, application of OCT in brain cancer for *ex vivo* detection glioma invasion from non-neoplastic white matter in humans, OCT and hyperspectral imaging of vascular recovery in a model of peripheral arterial disease, characterization of middle ear effusions using phase variance and

decorrelation OCT imaging, sensing and 3D- imaging of cochlea and surrounding temporal bone using high-speed SS OCT, measuring elastic contrast in human tissues using OCT needle probes, ultrahigh resolution OCT of mucociliary activity on *in vitro* human airway epithelium, and characterization of ovarian tissue using PS OCT.

The poster session contained 46 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*: *Fundamentals and Applications to Biosensors, Drug Discovery, Microscopy and Biomedical Imaging* 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.

Not all presented papers are published in this volume, however the Conference Program and this Introduction reflect the full range of topics discussed during this very successful meeting.

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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