

Optical Coherence Tomography and Coherence Domain Optical Methods in Biomedicine XVII

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

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Contents

xi	<i>Conference Committee</i>
xiii	<i>Introduction</i>

OCT TECHNOLOGY 1

- 8571 03 **Dual-wavelength photothermal optical coherence tomography for blood oxygen saturation measurement** [8571-2]
B. Yin, The Univ. of Texas at Austin (United States); R. V. Kuranov, Univ. of Texas Health Science Ctr. at San Antonio (United States); A. B. McElroy, T. E. Milner, The Univ. of Texas at Austin (United States)
- 8571 04 **Off-axis full-field swept-source optical coherence tomography using holographic refocusing** [8571-3]
D. Hillmann, Thorlabs GmbH (Germany); G. Franke, Univ. of Lübeck (Germany) and Medical Laser Ctr. Lübeck (Germany); L. Hinkel, T. Bonin, Univ. of Lübeck (Germany); P. Koch, Thorlabs GmbH (Germany); G. Hüttmann, Univ. of Lübeck (Germany) and Medical Laser Ctr. Lübeck (Germany)
- 8571 05 **Chromatic visualization of reflectivity variance within hybridized directional OCT images** [8571-4]
V. S. Makhijani, A. Roorda, J. K. Bayabo, K. K. Tong, C. A. Rivera-Carpio, Univ. of California, Berkeley (United States); B. J. Lujan, Univ. of California, Berkeley (United States) and West Coast Retina Medical Group (United States)

LIGHTSOURCES AND HIGH SPEED OCT TECHNOLOGY

- 8571 0B **Ultrahigh resolution optical coherence tomography using high power fiber laser supercontinuum at 1.7 μm wavelength region** [8571-10]
S. Ishida, H. Kawagoe, M. Aramaki, Nagoya Univ. (Japan); Y. Sakakibara, National Institute of Advanced Industrial Science and Technology (Japan) and JST CREST (Japan); E. Omoda, National Institute of Advanced Industrial Science and Technology (Japan); H. Kataura, National Institute of Advanced Industrial Science and Technology (Japan) and JST CREST (Japan); N. Nishizawa, Nagoya Univ. (Japan)
- 8571 0C **Enhancement of the depth range up to 13.8 mm with filtered external k-sampling-clock in an SS-OCT system using a reflective Fabry-Perot tunable laser** [8571-11]
H. Yamada, Y. Niimura, F. Hiwatashi, Systems Engineering, Inc. (Japan); D.-H. Choi, K. Ohbayashi, Kitasato Univ. (Japan)

ENDOSCOPIC AND INTRAVASCULAR OCT

- 8571 ON **Ultrahigh speed endoscopic optical coherence tomography using micro-motor imaging catheter and VCSEL technology** [8571-22]
T.-H. Tsai, Y. K. Tao, Massachusetts Institute of Technology (United States); B. M. Potsaid, Massachusetts Institute of Technology (United States) and Thorlabs, Inc. (United States); V. Jayaraman, Praviium Research, Inc. (United States); M. F. Kraus, Massachusetts Institute of Technology (United States) and Univ. Erlangen-Nuremberg (Germany); P. J. S. Heim, Thorlabs Quantum Electronics, Inc. (United States); J. Hornegger, Univ. Erlangen-Nuremberg (Germany); H. Mashimo, Veterans Affairs Healthcare System Boston (United States) and Harvard Medical School (United States); A. E. Cable, Thorlabs, Inc. (United States); J. G. Fujimoto, Massachusetts Institute of Technology (United States)
- 8571 OP **High speed miniature motorized endoscopic probe for 3D optical frequency domain imaging** [8571-24]
J. Li, F. Feroldi, J. Mo, F. Helderma, M. de Groot, J. F. de Boer, Vrije Univ. Amsterdam (Netherlands)

OCT TECHNOLOGY II

- 8571 OV **Single-shot interpixel shifting for optical coherence tomography by oblique incidence spectroscopy** [8571-29]
H. Y. Lee, A. K. Ellerbee, Stanford Univ. (United States)
- 8571 OW **Improvement of lateral resolution of optical coherence tomography images based on capon estimation of weighted multi-scatterer contributions** [8571-30]
E. Bousi, C. Pitris, Univ. of Cyprus (Cyprus)
- 8571 OX **Polarization sensitive en face optical coherence tomography using multichannel acousto-optic deflectors** [8571-89]
M. Zuraszkas, J. Rogers, A. G. Podoleanu, Univ. of Kent (United Kingdom)
- 8571 OY **Real time 3D structural and Doppler OCT imaging on graphics processing units** [8571-32]
M. Sylwestrzak, D. Szlag, M. Szkulmowski, I. Gorczyńska, D. Bukowska, M. Wojtkowski, P. Targowski, Nicolaus Copernicus Univ. (Poland)
- 8571 OZ **GPU accelerated OCT processing at megahertz axial scan rate and high resolution video rate volumetric rendering** [8571-33]
Y. Jian, K. Wong, M. V. Sarunic, Simon Fraser Univ. (Canada)

OPHTHALMIC APPLICATIONS II

- 8571 17 **Rotational Dove prism scanning dual angle Doppler OCT** [8571-41]
C. Blatter, S. Coquoz, B. Grajciar, A. S. G. Singh, R. M. Werkmeister, L. Schmetterer, R. A. Leitgeb, Medical Univ. of Vienna (Austria)
- 8571 19 **High sensitive fundus autofluorescence imaging combined with speckle-free optical coherence tomography** [8571-43]
P. Stremplewski, K. Komar, M. Szkulmowski, M. Motoczyńska, M. Wojtkowski, Nicolaus Copernicus Univ. (Poland)

OCM, FULL FIELD AND MICROSCOPY TECHNIQUES

- 8571 1G **Label-free imaging of the dynamics of cell-to-cell string-like structure bridging in the free-space by low-coherent quantitative phase microscopy** [8571-50]
T. Yamauchi, H. Iwai, Y. Yamashita, Hamamatsu Photonics K.K. (Japan)

OCT TECHNOLOGY III

- 8571 1N **Motion-compensated hand-held common-path Fourier-domain optical coherence tomography probe for image-guided intervention** [8571-57]
Y. Huang, C. Song, X. Liu, J. U. Kang, Johns Hopkins Univ. (United States)
- 8571 1O **Towards microscopic resolution in holoscopy** [8571-59]
G. L. Franke, Univ. zu Lübeck (Germany) and Medical Laser Ctr. Lübeck (Germany);
D. Hillmann, C. Lührs, P. Koch, J. Wollenzin, Thorlabs GmbH (Germany); G. Hüttmann, Univ. zu Lübeck (Germany)
- 8571 1P **Freehand OCT with real-time lateral motion tracking** [8571-60]
X. Liu, Y. Huang, Johns Hopkins Univ. (United States); P. Gehlbach, Johns Hopkins School of Medicine (United States); J. U. Kang, Johns Hopkins Univ. (United States)
- 8571 1Q **Measurement of angle-resolved scattering property of ovarian tissue by use of OCT** [8571-61]
Y. Yang, T. Wang, Univ. of Connecticut (United States); M. Brewer, Univ. of Connecticut (United States) and Univ. of Connecticut Health Ctr. (United States); Q. Zhu, Univ. of Connecticut (United States)

SMALL ANIMAL AND DEVELOPMENTAL BIOLOGY

- 8571 1R **Ultrahigh-speed ultrahigh-resolution adaptive optics: optical coherence tomography system for in-vivo small animal retinal imaging** [8571-62]
Y. Jian, J. Xu, Simon Fraser Univ. (Canada); R. J. Zawadzki, UC Davis Medical Ctr. (United States); M. V. Sarunic, Simon Fraser Univ. (Canada)
- 8571 1S **Phase-sensitive optical coherence tomography characterization of pulse-induced trabecular meshwork displacement in ex vivo non-human primate eyes** [8571-63]
P. Li, R. Reif, Z. Zhi, L. An, E. Martin, T. T. Shen, M. Johnstone, R. K. Wang, Univ. of Washington (United States)
- 8571 1T **Dynamic OCE measurement of the biomechanical properties of gelatin phantom and mouse cornea in vivo** [8571-64]
J. Li, S. Wang, R. K. Manapuram, F. M. Menodiado, M. Singh, Univ. of Houston (United States); S. Aglyamov, S. Emelianov, The Univ. of Texas at Austin (United States); M. Twa, Univ. of Houston (United States); K. V. Larin, Univ. of Houston (United States) and Baylor College of Medicine (United States)
- 8571 1V **OCT detection of neural activity in American cockroach nervous system** [8571-66]
I. Gorczyńska, J. Wyszowska, D. Bukowska, D. Ruminski, K. Karnowski, M. Stankiewicz, M. Wojtkowski, Nicolaus Copernicus Univ. (Poland)

CLINICAL APPLICATIONS

- 8571 1Z **Optical coherence tomography and hyperspectral imaging of vascular recovery in a model of peripheral arterial disease** [8571-70]
K. M. Poole, W. W. Sit, J. M. Tucker-Schwartz, C. L. Duvall, M. C. Skala, Vanderbilt Univ. (United States)
- 8571 21 **Sensing and three-dimensional imaging of cochlea and surrounding temporal bone using swept source high-speed optical coherence tomography** [8571-72]
M. Zhao, W. W. Chien, R. Taylor, I. Iordachita, Y. Huang, J. Niparko, J. U. Kang, Johns Hopkins Univ. (United States)
- 8571 22 **Measuring elastic contrast in tissue using OCT needle probes** [8571-73]
K. M. Kennedy, B. F. Kennedy, R. A. McLaughlin, The Univ. of Western Australia (Australia); C. Ford, Curtin Univ. (Australia); M. B. Bush, D. D. Sampson, The Univ. of Western Australia (Australia)
- 8571 24 **Characterization of ovarian tissue using polarization-sensitive optical coherence tomography** [8571-75]
T. Wang, Y. Yang, Univ. of Connecticut (United States); X. Wang, M. Sanders, Univ. of Connecticut Health Ctr. (United States); M. Brewer, Univ. of Connecticut (United States) and Univ. of Connecticut Health Ctr. (United States); Q. Zhu, Univ. of Connecticut (United States)

FUNCTIONAL AND DOPPLER OCT II

- 8571 2B **Combining a focused air-puff system with phase-sensitive optical coherence tomography for the detection of soft-tissue tumors based on elasticity measurement** [8571-82]
S. Wang, J. Li, S. Vantipalli, R. K. Manapuram, Univ. of Houston (United States); D. R. Ingram, The Univ. of Texas M.D. Anderson Cancer Ctr. (United States); M. D. Twa, Univ. of Houston (United States); A. J. Lazar, D. C. Lev, R. E. Pollock, The Univ. of Texas M.D. Anderson Cancer Ctr. (United States); K. V. Larin, Univ. of Houston (United States) and Baylor College of Medicine (United States)
- 8571 2C **In vivo imaging of gold nanorod contrast agents using photothermal optical coherence tomography** [8571-83]
J. M. Tucker-Schwartz, T. A. Meyer, C. A. Patil, C. L. Duvall, M. C. Skala, Vanderbilt Univ. (United States)

POSTER SESSION

- 8571 2D **Direct electronic linearization for camera based spectral domain optical coherence tomography** [8571-31]
A. Payne, A. G. Podoleanu, Univ. of Kent (United Kingdom)
- 8571 2F **Quantitative transverse flow assessment using OCT speckle decorrelation analysis** [8571-85]
X. Liu, Y. Huang, Johns Hopkins Univ. (United States); J. C. Ramella-Roman, The Catholic Univ. of America (United States); J. U. Kang, Johns Hopkins Univ. (United States)

- 8571 2H **Doppler frequency estimators under additive and multiplicative noise** [8571-87]
A. C. Chan, E. Y. Lam, The Univ. of Hong Kong (Hong Kong, China); V. J. Srinivasan, Univ. of California, Davis (United States) and Harvard Medical School (United States)
- 8571 2I **High-speed, high-sensitivity spectral-domain correlation mapping optical coherence tomography based modified scanning protocol** [8571-88]
H. M. Subhash, National Biophotonics and Imaging Platform, National Univ. of Ireland (Ireland); M. Leahy, National Biophotonics and Imaging Platform, National Univ. of Ireland (Ireland) and Royal College of Surgeons (Ireland)
- 8571 2J **Improved optical axis determination accuracy for fiber-based polarization-sensitive optical coherence tomography** [8571-90]
Z. Lu, S. J. Matcher, The Univ. of Sheffield (United Kingdom)
- 8571 2K **Investigation of polarization-sensitive optical coherence tomography towards the study of microstructure of articular cartilage** [8571-92]
D. Kasaragod, Z. Lu, The Univ. of Sheffield (United Kingdom); C. Le Maitre, Sheffield Hallam Univ. (United Kingdom); J. M. Wilkinson, S. Matcher, The Univ. of Sheffield (United Kingdom)
- 8571 2M **Ultrahigh-resolution optical coherence tomography imaging of protein crystals using gel inclusion technique** [8571-94]
N. Nishizawa, S. Ishida, Nagoya Univ. (Japan); M. Hirose, S. Sugiyama, T. Inoue, Y. Mori, K. Itoh, H. Matsumura, Osaka Univ. (Japan)
- 8571 2N **Simultaneous measurement of the sweating dynamics of a few tens of eccrine sweat glands by optical coherence tomography** [8571-95]
M. Ohmi, Y. Wada, Graduate School of Medicine, Osaka Univ. (Japan)
- 8571 2P **Temperature dependence of the fluorescence spectrum of ZnCdS nanoparticles** [8571-97]
E. K. Volkova, V. I. Kochubey, J. G. Konyukhova, A. A. Skaptsov, V. V. Galushka, S. V. German, N.G. Chernyshevsky Saratov State Univ. (Russian Federation)
- 8571 2Q **Imaging of electro-kinetic responses of tissues with optical coherence tomography** [8571-98]
V. Demidov, V. Toronov, Y. Xu, B. Vuong, C. Sun, V. X. D. Yang, Ryerson Univ. (Canada); A. Vitkin, Univ. of Toronto (Canada)
- 8571 2V **Fast wavelength sweep in dispersion-tuned fiber laser using a chirped FBG and a reflective SOA for OCT applications** [8571-104]
Y. Takubo, S. Yamashita, Univ. of Tokyo (Japan)
- 8571 2W **Combined tunable filters based swept laser source for optical coherence tomography** [8571-105]
M. Chen, Univ. of Shanghai for Science and Technology (China); Z. Ding, Zhejiang Univ. (China); C. Wang, Univ. of Shanghai for Science and Technology (China); Y. Huang, R. Chen, Fujian Normal Univ. (China); C. Song, Univ. of Shanghai for Science and Technology (China)
- 8571 2X **High-speed miniaturized swept sources based on resonant MEMS mirrors and diffraction gratings** [8571-106]
S. Gloor, A. H. Bachmann, M. Epitoux, T. von Niederhäusern, P. Vorreau, N. Matuschek, K. Hsu, M. Duell, C. Vélez, Exalos AG (Switzerland)

- 8571 2Y **FPGA-based non-uniform fast Fourier transform (NUFFT) algorithm for real-time OCT signal processing** [8571-108]
A. Bossen, S. Remund, D. Ernst, C. Meier, Berner Fachhochschule Technik und Informatik (Switzerland); T. von Niederhäusern, M. Duelk, Exalos AG (Switzerland); K. Vemishetty, National Instruments Corp. (United States)
- 8571 2Z **FPGA-based real-time swept-source OCT systems for B-scan live-streaming or volumetric imaging** [8571-109]
V. Bandi, J. Goette, M. Jacomet, Berner Fachhochschule Technik und Informatik (Switzerland); T. von Niederhäusern, A. H. Bachmann, M. Duelk, Exalos AG (Switzerland)
- 8571 34 **Interferometric synthetic aperture microscopy implementation on a floating point multi-core digital signal processor** [8571-115]
A. Ahmad, Univ. of Illinois at Urbana-Champaign (United States); M. Ali, Texas Instruments Inc. (United States); F. South, G. L. Monroy, S. G. Adie, N. Shemonski, P. S. Carney, S. A. Boppart, Univ. of Illinois at Urbana-Champaign (United States)
- 8571 36 **Combining Gabor and Talbot bands techniques to enhance the sensitivity with depth in Fourier domain optical coherence tomography** [8571-117]
A. Bradu, M. J. Marques, P. Bouchal, A. G. Podoleanu, Univ. of Kent (United Kingdom)
- 8571 3A **Ultrahigh resolution endoscopic spectral domain optical coherence tomography with a tiny rotary probe driven by a hollow ultrasonic motor** [8571-121]
N. Zhang, Tsinghua Univ. (China) and Massachusetts Institute of Technology (United States); T. Chen, T. Huo, C. Wang, J. Zheng, T. Zhou, P. Xue, Tsinghua Univ. (China)
- 8571 3C **Application of full range swept source optical coherence tomography for imaging of the anterior eye segment in patients with type I Boston Keratoprosthesis** [8571-123]
R. Poddar, D. Cortes, R. J. Zawadzki, M. J. Mannis, J. S. Werner, UC Davis Medical Ctr. (United States)
- 8571 3D **OCT corneal topography within ¼ diopter in the presence of saccadic eye movements** [8571-124]
S. I. Sayegh, The Eye Center (United States)
- 8571 3G **Reflective type objective based spectral-domain phase-sensitive optical coherence tomography for high-sensitive structural and functional imaging of cochlear microstructures through intact bone of an excised guinea pig cochlea** [8571-127]
H. M. Subhash, Oregon Health & Science Univ. (United States); R. K. Wang, Univ. of Washington (United States); F. Chen, A. L. Nuttall, Oregon Health & Science Univ. (United States)
- 8571 3H **History compounding: a novel speckle reduction technique for OCT guided cochleostomy** [8571-128]
Y. Zhang, Karlsruhe Institute of Technology (Germany); T. Pfeiffer, W. Wieser, Ludwig-Maximilians-Univ. München (Germany); M. Weller, Duesseldorf Univ. Hospital (Germany); R. Huber, Ludwig-Maximilians-Univ. München (Germany); T. Klenzner, Duesseldorf Univ. Hospital (Germany); J. Raczkowski, H. Wörn, Karlsruhe Institute of Technology (Germany)
- 8571 3K **Design of a swept-source, anatomical OCT system for pediatric bronchoscopy** [8571-132]
K. C. Wijesundara, The Univ. of North Carolina at Chapel Hill (United States); N. V. Iftimia, Physical Sciences Inc. (United States); A. L. Oldenburg, The Univ. of North Carolina at Chapel Hill (United States)

- 8571 3L **Fingerprint fake detection by optical coherence tomography** [8571-133]
S. Meissner, Dresden Univ. of Technology (Germany); R. Breithaupt, Federal German Office
of Information Security (Germany); E. Koch, Dresden Univ. of Technology (Germany)

Author Index

Conference Committee

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Session Chairs

- 1 OCT Technology I
James G. Fujimoto, Massachusetts Institute of Technology
(United States)
- 2 Lightsources and High Speed OCT Technology
Joseph A. Izatt, Duke University (United States)
- 3 Ophthalmic Applications I
Wolfgang Drexler, Medizinische Universität Wien (Austria)
- 4 Endoscopic and Intravascular OCT
Xingde Li, Johns Hopkins University (United States)
- 5 OCT Technology II
Robert A. Huber, Ludwig-Maximilians-Universität München (Germany)
- 6 Functional, Doppler and PS OCT I
Peter E. Andersen, Technical University of Denmark (Denmark)
- 7 Ophthalmic Applications II
Yoshiaki Yasuno, University of Tsukuba (Japan)
- 8 OCM, Full Field and Microscopy Techniques
Johannes de Boer, Vrije University Amsterdam (Netherlands)
- 9 OCT Technology III
Adrian Gh. Podoleanu, University of Kent (United Kingdom)
- 10 Small Animal and Developmental Biology
Kostadinka Bizheva, University of Waterloo (Canada)
- 11 Clinical Applications
Ruikang K. Wang, University of Washington (United States)
- 12 Functional and Doppler OCT II
Valery V. Tuchin, N.G. Chernyshevsky Saratov State University
(Russian Federation) and University of Oulu (Finland)

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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