

Coherence Domain Optical Methods and Optical Coherence Tomography in Biomedicine XI

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

**22–24 January 2007
San Jose, California, USA**

Sponsored and Published by
SPIE—The International Society for Optical Engineering

Volume 6429



The International Society
for Optical Engineering

Proceedings of SPIE—The International Society for Optical Engineering, 9780819465429, v. 6429

SPIE is an international technical society dedicated to advancing engineering and scientific applications of optical, photonic, imaging, electronic, and optoelectronic technologies.

The papers included in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. The papers published in these proceedings reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from this book:

Author(s), "Title of Paper," in *Coherence Domain Optical Methods and Optical Coherence Tomography in Biomedicine XI*, edited by James G. Fujimoto, Joseph A. Izatt, Valery V. Tuchin, Proceedings of SPIE Vol. 6429 (SPIE, Bellingham, WA, 2007) Article CID Number.

ISSN 1605-7422
ISBN 9780819465429

Published by
SPIE—The International Society for Optical Engineering
P.O. Box 10, Bellingham, Washington 98227-0010 USA
Telephone 1 360/676-3290 (Pacific Time) • Fax 1 360/647-1445
<http://www.spie.org>

Copyright © 2007, The Society of Photo-Optical Instrumentation Engineers

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE subject to payment of copying fees. The Transactional Reporting Service base fee for this volume is \$18.00 per article (or portion thereof), which should be paid directly to the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923. Payment may also be made electronically through CCC Online at <http://www.copyright.com>. Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher. The CCC fee code is 1605-7422/07/\$18.00.

Printed in the United States of America.

Contents

xi	Conference Committee
xiii	Introduction

RETINAL IMAGING I

- 642902 **Swept source at 1060 nm for Fourier domain optical coherence tomography** [6429-01]
J. Zhang, Q. Wang, B. Rao, Z. Chen, Beckman Laser Institute (USA) and Univ. of California, Irvine (USA); K. Hsu, Micron Optics, Inc. (USA)
- 642903 **Combined confocal/en face optical coherence tomography imaging of the human eye fundus in vivo in the 1050-nm spectral region** [6429-02]
R. G. Cucu, Univ. of Kent (United Kingdom); J. A. Rogers, M. W. Hathaway, J. Pedro, Ophthalmic Technologies Inc. (Canada); A. Gh. Podoleanu, Univ. of Kent (United Kingdom); R. B. Rosen, New York Eye and Ear Infirmary (USA)
- 642905 **Phase-insensitive optical coherence angiography of the choroid by 1-micrometer band swept-source optical coherence tomography** [6429-04]
Y. Yasuno, Univ. of Tsukuba (Japan); Y. Hong, Univ. of Tsukuba (Japan) and Korea Advanced Institute of Science and Technology (South Korea); S. Makita, Univ. of Tsukuba (Japan); M. Miura, University of Tsukuba (Japan) and Tokyo Medical Univ. (Japan); T. Yatagai, Univ. of Tsukuba (Japan)
- 642907 **Fourier domain mode-locked (FDML) lasers at 1050 nm and 202,000 sweeps per second for OCT retinal imaging** [6429-06]
R. A. Huber, Ludwig-Maximilians-Univ. München (Germany) and Massachusetts Institute of Technology (USA); D. C. Adler, V. J. Srinivasan, I. M. Gorczynska, J. G. Fujimoto, Massachusetts Institute of Technology (USA)
-

Pagination: Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print and on CD-ROM. Papers are published as they are submitted and meet publication criteria. A unique, consistent, permanent citation identifier (CID) number is assigned to each article at the time of the first publication. Utilization of CIDs allows articles to be fully citable as soon they are published online, and connects the same identifier to all online, print, and electronic versions of the publication.

SPIE uses a six-digit CID article numbering system in which:

- The first four digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc.

The CID number appears on each page of the manuscript. The complete citation is used on the first page, and an abbreviated version on subsequent pages.

RETINAL IMAGING II

- 642909 **Ultrahigh-resolution adaptive optics - optical coherence tomography: toward isotropic 3- μ m resolution for in vivo retinal imaging** [6429-08]
R. J. Zawadzki, Univ. of California, Davis (USA); Y. Zhang, Indiana Univ. (USA); S. M. Jones, Lawrence Livermore National Lab. (USA); R. D. Ferguson, Physical Sciences Inc. (USA); S. S. Choi, Univ. of California, Davis (USA); B. Cense, Indiana Univ. (USA); J. W. Evans, D. Chen, Lawrence Livermore National Lab. (USA); D. T. Miller, Indiana Univ. (USA); S. S. Olivier, Lawrence Livermore National Lab. (USA); J. S. Werner, Univ. of California, Davis (USA)
- 64290C **Optical coherence angiography for the human eye** [6429-11]
S. Makita, Univ. of Tsukuba (Japan); Y. Hong, Univ. of Tsukuba (Japan) and Korea Advanced Institute of Science and Technology (South Korea); M. Yamanari, T. Yatagai, Y. Yasuno, Univ. of Tsukuba (Japan)
- 64290D **Automatic retinal blood vessel parameters calculation in spectral domain optical coherence tomography** [6429-12]
H. Wehbe, M. Ruggeri, S. Jiao, G. Gregori, C. A. Puliafito, Univ. of Miami Miller School of Medicine (USA)

DOPPLER AND POLARIZATION-SENSITIVE OCT

- 64290K **Polarization memory effect in the polarization-sensitive optical coherence tomography system** [6429-19]
Y. Chen, Univ. of Connecticut (USA); L. Otis, Univ. of Maryland (USA); Q. Zhu, Univ. of Connecticut (USA)
- 64290L **New approach to cross-polarized optical coherence tomography based on orthogonal arbitrarily polarized modes** [6429-20]
G. V. Gelikonov, V. M. Gelikonov, Institute of Applied Physics (Russia)
- 64290M **One-camera spectral-domain polarization-sensitive optical coherence tomography** [6429-21]
B. Baumann, M. Pircher, E. Götzinger, C. K. Hitzenberger, Medical Univ. of Vienna (Austria)
- 64290P **Imaging vasculature independent of direction of flow using spectral domain optical coherence tomography** [6429-24]
J. Fingler, J. Williams, C. Yang, S. E. Fraser, California Institute of Technology (USA)
- 64290R **SDOCT Doppler velocimetry for investigating the morphological influences on blood flow in the developing chick embryo heart** [6429-26]
A. M. Davis, Duke Univ. (USA); F. G. Rothenberg, Duke Univ. Medical Ctr. (USA); T. H. Law, Duke Univ. (USA); L. A. Taber, Washington Univ. (USA); J. A. Izatt, Duke Univ. (USA)

RETINAL IMAGING III

- 64290S **Spectral domain optical coherence tomography for in-vivo three-dimensional retinal imaging of small animals** [6429-27]
M. Ruggeri, H. Wehbe, S. Jiao, G. Gregori, M. E. Jockovich, A. Hackam, Y. Duan, C. A. Puliafito, Univ. of Miami Miller School of Medicine (USA)

- 64290T **Imaging the human retina and cone mosaic in vivo with PS-OCT** [6429-28]
M. Pircher, B. Baumann, E. Götzinger, C. K. Hitzenberger, Medical Univ. of Vienna (Austria)
- 64290W **Complex-conjugate-resolved retinal SDOCT using integrating buckets** [6429-31]
Y. K. Tao, M. Zhao, J. A. Izatt, Duke Univ. (USA)

RETINAL AND OTHER OPHTHALMIC APPLICATIONS

- 64290Y **Cornea curvature measurement using single shot C-scan OCT** [6429-33]
L. Plesea, M. Gomez, A. Gh. Podoleanu, Univ. of Kent (United Kingdom)
- 642910 **Imaging subsurface photodisruption in human sclera with FD-OCT** [6429-35]
B. Rao, J. Su, Univ. of California, Irvine (USA) and Beckman Laser Institute (USA); D. Chai, G. Chaudhary, Univ. of California, Irvine (USA); Z. Chen, Univ. of California, Irvine (USA) and Beckman Laser Institute (USA); T. Juhasz, Univ. of California, Irvine (USA)
- 642911 **Endoscopic optical coherence tomography of the retina at 1310 nm using paired-angle-rotating scanning** [6429-36]
M. V. Sarunic, Simon Fraser Univ. (Canada); S. Han, J. Wu, Z. Yaqoob, California Institute of Technology (USA); M. Humayun, Univ. of Southern California (USA); C. Yang, California Institute of Technology (USA)
- 642912 **In-vivo human retinal imaging with pulsed illumination spectral-domain optical coherence tomography** [6429-37]
J.-W. You, Korea Advanced Institute of Science and Technology (South Korea); T. C. Chen, Massachusetts Eye and Ear Infirmary, Harvard Medical School (USA); M. Mujat, B. H. Park, J. F. de Boer, Wellman Ctr. for Photomedicine, Massachusetts General Hospital, Harvard Medical School (USA)
- 642913 **Three-dimensional tracker for spectral domain optical coherence tomography** [6429-38]
D. X. Hammer, N. V. Iftimia, C. E. Bigelow, T. E. Ustun, B. Bloom, R. D. Ferguson, Physical Sciences Inc. (USA); T. E. Milner, Univ. of Texas at Austin (USA)

NOVEL TECHNIQUES

- 642915 **Linear OCT system with increased measurement depth for biomedical applications** [6429-40]
G. Hüttmann, V. Hellemanns, Institute of Biomedical Optics, Univ. of Lübeck (Germany); P. Koch, Thorlabs-HL AG (Germany)
- 642918 **Depth-resolved monitoring of analytes diffusion in ocular tissues** [6429-43]
K. V. Larin, Univ. of Houston (USA) and Saratov State Univ. (Russia); M. G. Ghosn, Univ. of Houston (USA); V. V. Tuchin, Saratov State Univ. (Russia)

FOURIER DOMAIN OCT

- 64291A **Complex-conjugate-resolved imaging using two-harmonic FD-OCT** [6429-45]
A. B. Vakhtin, K. A. Peterson, D. J. Kane, Southwest Sciences, Inc. (USA)

- 64291C **Inherent media dispersion compensation by FD-OCT** [6429-47]
A. R. Tumlinson, The Univ. of Arizona (USA); B. Hofer, B. Považay, Cardiff Univ. (United Kingdom); A. Winkler, The Univ. of Arizona (USA); W. Drexler, Cardiff Univ. (United Kingdom); J. K. Barton, The Univ. of Arizona (USA)
- 64291E **High-speed Fourier-domain optical coherence tomography using a chirped supercontinuum pulse source** [6429-49]
S. Moon, D. Lee, D. Y. Kim, Gwangju Institute of Science and Technology (South Korea)
- 64291F **Fourier domain optical coherence tomography using optical frequency comb** [6429-50]
T. Bajraszewski, M. Wojtkowski, A. Szkulmowska, W. Fojt, M. Szkulmowski, A. Kowalczyk, Nicolaus Copernicus Univ. (Poland)

FOURIER DOMAIN SWEPT SOURCE OCT

- 64291G **Discretely swept optical-frequency domain imaging toward high-resolution, high-speed, high-sensitivity, and long-depth-range** [6429-51]
K. Ohbayashi, T. Amano, H. Hiro-oka, H. Furukawa, D. Choi, P. Jayavel, Kitasato Univ. (Japan); R. Yoshimura, K. Asaka, N. Fujiwara, H. Ishii, NTT Corp. (Japan); M. Suzuki, M. Nakanishi, K. Shimizu, Kitasato Univ. (Japan)
- 64291I **Enhancement of OFDR-OCT sensitivity using semiconductor optical amplifier** [6429-53]
K. Ohbayashi, P. Jayavel, T. Amano, Kitasato Univ. (Japan); K. Asaka, NTT Corp. (Japan)
- 64291J **Semiconductor optical amplifier based swept wavelength source at 1060 nm using a scanning Fabry-Perot filter and an YDFA-based booster amplifier** [6429-54]
F. D. Nielsen, L. Thrane, Risø National Lab. (Denmark); K. Hsu, Micron Optics, Inc. (USA); A. Bjarklev, Technical Univ. of Denmark (Denmark); P. E. Andersen, Risø National Lab. (Denmark)
- 64291L **Phase-sensitive optical coherence tomography using buffered Fourier domain mode-locked lasers at up to 370,000 scans per second** [6429-56]
D. C. Adler, Massachusetts Institute of Technology (USA); R. Huber, Ludwig Maximilians Univ. Muenchen (Germany); J. G. Fujimoto, Massachusetts Institute of Technology (USA)

FULL-FIELD IMAGING TECHNIQUES

- 64291N **Real-time ultrahigh-resolution imaging by dual-channel full-field optical coherence tomography** [6429-58]
M. Akiba, K. P. Chan, Yamagata Promotional Organization for Industrial Technology (Japan)
- 64291P **Optimization of line-field spectral domain optical coherence tomography for in vivo high-speed 3D retinal imaging** [6429-60]
Y. Nakamura, S. Makita, M. Yamanari, Y. Yasuno, M. Itoh, T. Yatagai, Univ. of Tsukuba (Japan)
- 64291Q **Measurement of topographic phase image of living cells by white-light phase-shifting microscope with active stabilization of optical path difference** [6429-61]
T. Yamauchi, H. Iwai, M. Miwa, Y. Yamashita, Hamamatsu Photonics K.K. (Japan)

- 64291R **High-numerical-aperture full-field optical coherence tomography with space-invariant resolution without scanning the focus** [6429-62]
D. L. Marks, T. S. Ralston, P. S. Carney, Univ. of Illinois at Urbana-Champaign (USA);
S. A. Boppart, Beckman Institute for Advanced Science and Technology (USA) and Univ. of Illinois at Urbana-Champaign (USA)

NOVEL CONTRAST MECHANISMS

- 64291S **Experimental investigation of circular light depolarization using polarization sensitive OCT** [6429-63]
I. Charalambous, R. Cucu, Univ. of Kent at Canterbury (United Kingdom); A. Dogariu, College of Optics & Photonics/Univ. of Central Florida (USA); A. Podoleanu, Univ. of Kent at Canterbury (United Kingdom)
- 64291T **Scatterer-size-based analysis of optical coherence tomography images** [6429-64]
C. Pitris, P. Ioannides, A. Kartakoulis, Univ. of Cyprus (Cyprus)
- 64291V **Functional imaging by dynamic speckle in digital holographic optical coherence imaging** [6429-66]
K. Jeong, J. J. Turek, D. D. Nolte, Purdue Univ. (USA)
- 64291X **Phase-resolved spectral-domain magnetomotive optical coherence tomography** [6429-68]
V. Crecea, A. L. Oldenburg, T. S. Ralston, S. A. Boppart, Univ. of Illinois at Urbana-Champaign (USA)
- 64291Y **Molecular imaging of hemoglobin using ground state recovery pump-probe optical coherence tomography** [6429-69]
B. E. Applegate, J. A. Izatt, Duke Univ. (USA)
- 64291Z **Backscattering albedo contrast in OCT using plasmon-resonant gold nanorods** [6429-70]
A. L. Oldenburg, Univ. of Illinois at Urbana-Champaign (USA); M. N. Hansen, A. Wei, Purdue Univ. (USA); S. A. Boppart, Univ. of Illinois at Urbana-Champaign (USA)

POSTER SESSION

- 642921 **High-resolution frequency domain second harmonic optical coherence tomography** [6429-72]
J. Su, I. V. Tomov, Y. Jiang, Z. Chen, Beckman Laser Institute (USA)
- 642922 **Ultrahigh-speed axial-lateral parallel time domain optical coherence tomography** [6429-73]
Y. Watanabe, K. Yamada, M. Sato, Yamagata Univ. (Japan)
- 642924 **Investigation of coherent amplification with a semiconductor optical amplifier employed in a swept source OCT system** [6429-75]
B. Rao, Beckman Laser Institute (USA) and Univ. of California, Irvine (USA); J. Zhang, Q. Wang, Beckman Laser Institute (USA); Z. Chen, Beckman Laser Institute (USA) and Univ. of California, Irvine (USA)

- 642925 **Optimum design of spectrometer in FD-OCT** [6429-76]
Z. Hu, A. M. Rollins, Case Western Reserve Univ. (USA)
- 642926 **Dispersion compensation in OFDI-OCT by using dispersion shifted fiber** [6429-77]
K. Asaka, NTT Corp. (Japan); K. Ohbayashi, Kitasato Univ. (Japan)
- 64292B **Wavelength tunable broadband source based on Ti:Sapphire femtosecond laser applicable to FD-OCT system** [6429-82]
T. J. Eom, H.-G. Choi, J. H. Sung, C.-S. Kee, D.-K. Ko, J. Lee, Gwangju Institute of Science and Technology (South Korea); E. S. Choi, Chosun Univ. (South Korea)
- 64292D **High-speed optical-frequency domain imaging by one frame imaging within one single frequency sweep** [6429-84]
H. Furukawa, T. Amano, D. Choi, H. Hiro-Oka, K. Ohbayashi, Kitasato Univ. (Japan)
- 64292E **A method of improving scanning speed and resolution of OFDR-OCT using multiple SSG-DBR lasers simultaneously** [6429-85]
D. Choi, H. Hiro-Oka, T. Amano, H. Furukawa, Kitasato Univ. (Japan); N. Fujiwara, H. Ishii, NTT Corp. (Japan); K. Ohbayashi, Kitasato Univ. (Japan)
- 64292F **Two-dimensional velocity estimation for Doppler optical coherence tomography** [6429-86]
D. Morofke, Ryerson Univ. (Canada) and Univ. of Oxford (United Kingdom); M. C. Kolios, Ryerson Univ. (Canada); V. X. D. Yang, Ryerson Univ. (Canada) and Sunnybrook Health Sciences Ctr. (Canada)
- 64292G **Optical delay line using rotating rhombic prisms** [6429-87]
G. Lamouche, M. Dufour, B. Gauthier, National Research Council (Canada); V. Bartulovic, Novacam Technologies Inc. (Canada); M. Hewko, J.-P. Monchalain, National Research Council (Canada)
- 64292H **10-channel fiber array fabrication technique for a parallel optical coherence tomography system** [6429-88]
L. J. Arauz, Y. Luo, J. E. Castillo, R. K. Kostuk, J. Barton, Univ. of Arizona (USA)
- 64292I **Visualization of PDD sensitizer's concentration using Fourier domain optical coherence tomography** [6429-89]
Y. Nakamichi, S. Saeki, T. Saito, T. Hiro, M. Matsuzaki, Yamaguchi Univ. (Japan)
- 64292K **Reduced coherence and calibration optimization for transillumination interferometry** [6429-91]
P. Vacas-Jacques, M. Strojnik, G. Paez, Ctr. de Investigaciones en Optica (Mexico)
- 64292M **Birefringence measurement of retinal nerve fiber layer using polarization-sensitive spectral domain optical coherence tomography with Jones-matrix-based analysis** [6429-93]
M. Yamanari, Univ. of Tsukuba (Japan); M. Miura, Univ. of Tsukuba (Japan) and Tokyo Medical Univ. (Japan); S. Makita, T. Yatagai, Y. Yasuno, Univ. of Tsukuba (Japan)
- 64292O **Regional polarization sensitivity of articular cartilage by using polarization sensitive optical coherence tomography** [6429-95]
T. Xie, S. Guo, Z. Chen, G. M. Peavy, Beckman Laser Institute (USA)

- 64292P **Determination of 3D optic axis orientation in cartilage by polarization-sensitive optical coherence tomography** [6429-96]
N. Ugryumova, S. J. Matcher, Univ. of Sheffield (United Kingdom)
- 64292R **Study on diagnosis of micro-biomechanical structure using optical coherence tomography** [6429-98]
S. Saeki, Y. Hashimoto, T. Saito, T. Hiro, M. Matsuzaki, Yamaguchi Univ. (Japan)
- 64292S **Dynamic OCT of mentally stress-induced sweating in sweat glands of the human finger tip** [6429-99]
M. Ohmi, Y. Ueda, M. Haruna, Osaka Univ. (Japan)
- 64292T **Motion-sensitive 3D optical coherence microscope operating at 1300 nm for the visualization of early frog development** [6429-100]
B. M. Hoeling, Pomona College (USA); S. S. Feldman, D. T. Strenge, A. Bernard, E. R. Hogan, D. C. Petersen, Harvey Mudd College (USA); S. E. Fraser, Y. Kee, J. M. Tyszka, Biological Imaging Ctr., California Institute of Technology (USA); R. C. Haskell, Harvey Mudd College (USA)
- 64292U **Full-field optical coherence tomography image restoration based on Hilbert transformation** [6429-101]
J. Na, W. J. Choi, Gwangju Institute of Science and Technology (South Korea); E. S. Choi, Chosun Univ. (South Korea); S. Y. Ryu, B. H. Lee, Gwangju Institute of Science and Technology (South Korea)
- 64292V **From medical to art diagnostics OCT: a novel tool for varnish ablation control** [6429-102]
M. Góra, Nicolaus Copernicus Univ. (Poland); A. Rycyk, J. Marczak, Military Univ. of Technology (Poland); P. Targowski, A. Kowalczyk, Nicolaus Copernicus Univ. (Poland)
- 64292W **Rapid two-dimensional transversal scanning fiber probe for optical coherence tomography** [6429-103]
G. Huang, Z. Ding, Zhejiang Univ. (China)
- 64292X **Spectral-domain optical coherence tomography for endoscopic imaging** [6429-104]
X. Chen, Q. Li, W. Li, Y. Wang, D. Yu, Tianjin Univ. (China)

Author Index

Conference Committee

Symposium Chairs

James G. Fujimoto, Massachusetts Institute of Technology (USA)
R. Rox Anderson, Wellman Center for Photomedicine (USA),
Massachusetts General Hospital (USA), and Harvard School of Medicine
(USA)

Program Track Chairs

Tuan-Vo Dinh, Duke University (USA)
Anita Mahadevan-Jansen, Vanderbilt University (USA)

Conference Chairs

James G. Fujimoto, Massachusetts Institute of Technology (USA)
Joseph A. Izatt, Duke University (USA)
Valery V. Tuchin, Saratov State University (Russia)

Program Committee

Peter E. Andersen, Risø National Laboratory (Denmark)
Stephen A. Boppart, University of Illinois at Urbana-Champaign (USA)
Zhongping Chen, Beckman Laser Institute (USA) and University of
California, Irvine (USA)
Johannes F. de Boer, Wellman Center for Photomedicine, Massachusetts
General Hospital, Harvard Medical School (USA)
Wolfgang Drexler, Medical University of Vienna (Austria) and Cardiff
University (United Kingdom)
Christoph K. Hitzenberger, Medical University of Vienna (Austria)
Adrian Gh. Podoleanu, University of Kent (United Kingdom)
Andrew M. Rollins, Case Western Reserve University (USA)
Natalia M. Shakhova, Institute of Applied Physics (Russia)
Guillermo J. Tearney, Massachusetts General Hospital (USA)
Lihong V. Wang, Texas A&M University (USA)
Ruikang K. Wang, Oregon Health and Science University (USA)

Session Chairs

Retinal Imaging I
James G. Fujimoto, Massachusetts Institute of Technology (USA)

Retinal Imaging II
Christoph K. Hitzenberger, Medical University of Vienna (Austria)

In Vivo Imaging Applications

Ruikang K. Wang, Oregon Health and Science University (USA)

Doppler and Polarization-Sensitive OCT

Peter E. Andersen, Risø National Laboratory (Denmark)

Retinal Imaging III

Johannes F. de Boer, Wellman Center for Photomedicine, Massachusetts General Hospital, Harvard Medical School (USA)

Retinal and Other Ophthalmic Applications

Wolfgang Drexler, Medical University of Vienna (Austria) and Cardiff University (United Kingdom)

Novel Techniques

Stephen A. Boppart, University of Illinois at Urbana-Champaign (USA)

Fourier Domain OCT

Andrew M. Rollins, Case Western Reserve University (USA)

Fourier Domain Swept Source OCT

Zhongping Chen, Beckman Laser Institute (USA) and University of California, Irvine (USA)

Full-Field Imaging Techniques

Adrian Gh. Podoleanu, University of Kent (United Kingdom)

Novel Contrast Mechanisms

Valery V. Tuchin, Saratov State University (Russia)

Poster Session

Joseph A. Izatt, Duke University (USA)

Nikiforos Kollias, Johnson & Johnson CPPW (USA)

Introduction

These proceedings are from the Coherence Domain Optical Methods and Optical Coherence Tomography in Biomedicine XI conference, held 22–24 January 2007 at the SPIE Photonics West Symposium in San Jose, California. This year's conference featured a scheduled 104 oral and poster presentations from leading national and international research groups.

The conference was organized into several sessions including: Retinal Imaging I, II, and III; In Vivo Imaging Applications; Retinal and Other Ophthalmic Applications; Doppler and Polarization-Sensitive OCT; Novel Techniques; Fourier Domain OCT; Fourier Domain Swept Source OCT; Full-Field Imaging Techniques; Novel Contrast Mechanisms; and a poster session with 34 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 retinal imaging (four sessions, 20 oral and three poster presentations) with discussion of new techniques in near infrared (1050–1060 nm spectral range), ultrahigh-resolution adaptive optics systems, spectral/Fourier domain OCT for imaging retinal morphology, measurements of hemodynamics in the human eye, and clinical applications of polarization-sensitive OCT.

In vivo 3D transcranial imaging of blood vessel network in mice using ultrafast spectral/Fourier domain OCT, imaging of the embryonic heart using gated OCT, investigations of skin cancer, summary of recent clinical endoscopic studies, results on the human larynx and esophagus imaging, were presented and discussed in six papers in the session on In Vivo Imaging Applications.

Eight oral presentations in the session on Doppler and Polarization-Sensitive OCT reported advanced technologies for quantification of 3D velocity vector, imaging vasculature independent of flow direction, 4D Doppler imaging of cardiac and vascular flow dynamics, and morphological influences on blood flow in the developing embryo heart. New approaches in polarization-sensitive OCT were also discussed in this session.

The session on Novel Techniques contained six oral papers, and was devoted to further development of Doppler systems, increasing of measurement depth of linear OCT system and depth of field of Fourier domain optical coherence microscopy. New image reconstruction algorithms as well as depth-resolved monitoring of analytes diffusion in ocular tissues and real-time monitoring of laser therapy using phase-sensitive OCT were also presented on this session.

Two sessions on Fourier Domain OCT had 12 oral papers and discussed full-range, high-axial resolution, high speed, and high-sensitive Fourier domain OCT systems. Systems described in six papers were based on swept sources including a phase-

sensitive system with a Fourier domain mode-locked laser at up to 380,000 scans per second.

Various full-field OCT modalities were discussed in five papers in the session on Full-Field Imaging Techniques, including line-field swept source OCT, dual-channel full-field OCT, line-scanning OCM, line-field spectral domain OCT, and high numerical aperture OCT. One paper presented measurements of topographic phase image of living cells by white-light phase-shifting microscope with active stabilization of optical path difference.

The closing session on Novel Contrast Mechanisms with eight papers was devoted to description of different approaches of OCT image contrasting based on speckle reduction, polarization and magnetomotive measurements, ground state recovery pump-probe technique, and backscattering albedo contrasting using gold nanorods. One paper described principles of functional imaging using dynamic speckles in digital holography.

The poster session contained 34 papers on the major above-mentioned topics. In order to enhance the visibility of poster presentations for the second time, since in 2006 a poster preview session was organized. During this session, 20 three-minute oral presentations of posters were discussed.

Short courses for engineers, scientists, and clinicians, "Principles and Applications of Optical Coherence Tomography," by James Fujimoto, and "Optical Clearing of Tissue and Blood," by Valery Tuchin, accompanied the conference.

All submissions were fully peer reviewed. Authors were requested to submit a three-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. Although this process was time consuming, we felt that it was important for the conference. Many participants felt that the technical quality and novelty of the papers had increased as the result of peer review. The peer review also provided a fairer assessment of the submitted papers. We have had very positive feedback and a record number of submissions 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 SPIE 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.

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