PROCEEDINGS OF SPIE

SPIDigitalLibrary.org/conference-proceedings-of-spie

Front Matter: Volume 9693

, "Front Matter: Volume 9693," Proc. SPIE 9693, Ophthalmic Technologies XXVI, 969301 (20 April 2016); doi: 10.1117/12.2231321

SPIE.

Event: SPIE BiOS, 2016, San Francisco, California, United States

PROGRESS IN BIOMEDICAL OPTICS AND IMAGING

Vol. 17 No. 5

Ophthalmic Technologies XXVI

Fabrice Manns
Per G. Söderberg
Arthur Ho
Editors

13–14 February 2016
San Francisco, California, United States

Sponsored and Published by
SPIE

Volume 9693

Proceedings of SPIE, 1605-7422, V. 9693

SPIE is an international society advancing an interdisciplinary approach to the science and application of light.

Ophthalmic Technologies XXVI, edited by Fabrice Manns, Per G. Söderberg, Arthur Ho, Proc. of SPIE Vol. 9693, 969301 · © 2016 SPIE · CCC code: 1605-7422/16/\$18 · doi: 10.1117/12.2231321

Proc. of SPIE Vol. 9693 969301-1

The papers 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. Additional papers and presentation recordings may be available online in the SPIE Digital Library at SPIEDigitalLibrary.org.

The papers 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 *Ophthalmic Technologies XXVI*, edited by Fabrice Manns, Per G. Söderberg, Arthur Ho, Proceedings of SPIE Vol. 9693 (SPIE, Bellingham, WA, 2016) Six-digit Article CID Number.

ISSN: 1605-7422

ISSN: 2410-9045 (electronic)

ISBN: 9781628419276

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA

Telephone +1 360 676 3290 (Pacific Time) · Fax +1 360 647 1445

SPIE.org

Copyright © 2016, 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 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 1605-7422/16/\$18.00.

Printed in the United States of America.

Publication of record for individual papers is online in the SPIE Digital Library.

**SPIE. DIGITAL
LIBRARY**

SPIDigitalLibrary.org

Paper Numbering: Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print. Papers are published as they are submitted and meet publication criteria. A unique 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 as 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.

Contents

vii	<i>Authors</i>
ix	<i>Conference Committee</i>
xi	<i>Introduction</i>
xiii	<i>16th Pascal Rol Award for Excellence in Ophthalmic Technologies</i>
xv	<i>The Ophthalmic Technologies Foundation Award</i>

OCULAR ANGIOGRAPHY AND BLOOD FLOW

9693 02	Total retinal blood flow and reproducibility evaluation by three beam optical Doppler tomography [9693-1]
---------	--

OPHTHALMIC IMAGING: CLINICAL AND SURGICAL

9693 06	4D microscope-integrated OCT improves accuracy of ophthalmic surgical maneuvers (Translational Research Best Paper Award) [9693-5]
9693 0B	Comparison of the effectiveness of three retinal camera technologies for malarial retinopathy detection in Malawi [9693-10]

OPHTHALMIC IMAGING: SMALL ANIMAL MODELS

9693 0H	<i>In vivo</i> intrinsic optical signal imaging of mouse retinas [9693-16]
---------	---

OPHTHALMIC IMAGE PROCESSING AND ANALYSIS

9693 0M	Quantitative polarization and flow evaluation of choroid and sclera by multifunctional Jones matrix optical coherence tomography [9693-21]
9693 0N	Estimating a structural bottle neck for eye-brain transfer of visual information from 3D-volumes of the optic nerve head from a commercial OCT device [9693-22]
9693 0O	Analysis of the variation in OCT measurements of a structural bottle neck for eye-brain transfer of visual information from 3D-volumes of the optic nerve head, PIMD-Average $[0;2\pi]$ [9693-23]

OPHTHALMIC OCT AND SLO TECHNOLOGY

9693 0P	Eye motion corrected OCT imaging with Lissajous scan pattern [9693-24]
---------	---

9693 0Q **Multimodal ophthalmic imaging using swept source spectrally encoded scanning laser ophthalmoscopy and optical coherence tomography [9693-25]**

9693 0S ***In-vivo*, real-time cross-sectional images of retina using a GPU enhanced master slave optical coherence tomography system [9693-27]**

OCULAR BIOMETRY, MORPHOLOGY, AND MECHANICS

9693 0V **Influence of corneal hydration on optical coherence elastography [9693-29]**

9693 0X **Assessing the viscoelasticity of green light induced CXL in the rabbit cornea by noncontact OCE and FEM [9693-31]**

9693 0Y **Morphological characterization of keratoconus-affected human corneas by SHG imaging and correlation analysis [9693-32]**

VISION ASSESSMENT AND CORRECTION

9693 16 **Optical extended depth of focus lens design for children myopia control [9693-40]**

OPHTHALMIC LASER AND LIGHT THERAPY

9693 19 **Heat shock protein expression as guidance for the therapeutic window of retinal laser therapy [9693-43]**

9693 1A **Towards real time speckle controlled retinal photocoagulation [9693-44]**

ADAPTIVE OPTICS AND CELLULAR IMAGING

9693 1E **Imaging human retinal pigment epithelium cells using adaptive optics optical coherence tomography [9693-48]**

9693 1F **Computational adaptive optics of the human retina [9693-49]**

POSTER SESSION

9693 1K **Objective straylight assessment of the human eye with a novel device [9693-54]**

9693 1N **Measurement of intraocular distances in human eyes by using Fourier domain low-coherence interferometry [9693-57]**

9693 1O **Optical design of a novel instrument that uses the Hartmann-Shack sensor and Zernike polynomials to measure and simulate customized refraction correction surgery outcomes and patient satisfaction [9693-58]**

9693 1P **Assessing the elasticity change of cataract lens with OCE [9693-59]**

- 9693 1R **Effects of short term changes in the blood glucose level on the autofluorescence lifetime of the human retina in healthy volunteers** [9693-61]
- 9693 1T **A comparison study of Riboflavin/UV-A and Rose-Bengal/Green light cross-linking of the rabbit corneas using optical coherence elastography** [9693-63]
- 9693 1U **Quantitative assessment of rat corneal thickness and morphology during stem cell therapy by high-speed optical coherence tomography** [9693-64]
- 9693 1V **Mimicking cataract-induced visual dysfunction by means of protein denaturation in egg albumen** [9693-65]
- 9693 1X **Tilt and decentration tolerance of intraocular lenses: measurements with an improved mechanical model eye** [9693-67]
- 9693 1Y **Basic studies on laser-assisted phacoemulsification using diode-pumped Er:YAG laser** [9693-68]
- 9693 21 **Comparison of performance of some common Hartmann-Shack centroid estimation methods** [9693-71]

Authors

Numbers in the index correspond to the last two digits of the six-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first four digits reflect the volume number. Base 36 numbering is employed for the last two digits and indicates the order of articles within the volume. Numbers start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B...0Z, followed by 10-1Z, 20-2Z, etc.

Aglyamov, Salavat R., 0X
Bagnato, Vanderlei S., 1O
Barnes, Frederick, 0S
Barriga, E. Simon, 0B
Baumann, Bernhard, 02
Baumgarten, Daniel, 1K
Bayer, Natascha, 1X
Beckert, Erik, 1X
ben Yaish, Shai, 16
Bliedtner, Katharina, 1A
Boppert, Stephen A., 1F
Boudoux, Caroline, 0Q
Bradú, Adrian, 0S
Brinkmann, Ralf, 1A
Burman, R., 21
Carney, P. Scott, 1F
Carrasco-Zevallos, Oscar, 06
Carvalho, Luis A. V., 1O
Castro N., Jarbas C., 1O
Chen, Yiwei, 0P
Cicchi, R., 0Y
Cremasco, Antonio, 1O
Dalal, Roopa, 19
Drauschke, Andreas, 1X
Effe, Lisa, 1A
El-Haddad, Mohamed T., 0Q
Feng, Liang, 1N
Ferraro, P., 1V
Finizio, A., 1V
Godbout, Nicolas, 0Q
Haindl, Richard, 02
Han, Zhaolong, 0X, 1P, 1T
Harding, Simon P., 0B
Haueisen, Jens, 1K, 1R
Hausladen, Florian, 1Y
Hitzenberger, Christoph K., 02
Hong, Young-Joo, 0M, 0P
Huie, Philip, 19
Hutchings, N., 21
Ikuno, Y., 0M
Izatt, Joseph A., 06
Joshi, Vinayak S., 0B
Kaeding, André, 1K
Kapinchev, Konstantin, 0S
Kasragod, D., 0M
Kazemi, Tina, 1T
Keller, Brenton, 06
Klemm, Matthias, 1K, 1R
Kocaoglu, Omer P., 1E

Krause, Sylvio, 1X
Kuo, Anthony, 06
Lakshminarayanan, V., 21
Lal, Cerine, 1U
Larin, Kirill V., 0V, 0X, 1P, 1T
Lavinsky, Daniel, 19
Leahy, Martin, 1U
Lee, Daeyoung, 19
Lee, Seungjun, 19
Lerm, Elena, 1K
Lewallen, Susan, 0B
Li, En, 0P
Li, Jiasong, 0V, 0X, 1P, 1T
Li, Qinghua, 1N
Liu, Chih-hao, 0X, 1P, 1T
Liu, Yuan-Zhi, 1F
Liu, Zhuolin, 1E
Ma, Zhenhe, 1N
MacCormick, Ian J., 0B
Majeau, Lucas, 0Q
Makita, Shuichi, 0M, 0P
Malmberg, Filip, 0N, 0O
Malone, Joseph D., 0Q
Mandrachia, B., 1V
Marcato, Rafael, 1O
Matos, Luciana, 1O
McGrath, James, 1U
Menabuoni, L., 0Y
Mercatelli, R., 0Y
Miller, Donald T., 1E
Miura, Masahiro, 0M, 0P
Nagel, Edgar, 1R
Nemeth, Sheila C., 0B
Nicoletti, R., 0Y
Numajiri, Mirian, 1O
Oliveira, Otavio G., 1O
Ommani, A., 21
Palanker, Daniel, 19
Pavone, Frederick, 0Y
Pini, R., 0Y
Pircher, Michael, 02
Podoleanu, Adrian, 0S
Raghunathan, Raksha, 1P, 1T
Rani, Sweta, 1U
Rank, Elisabet, 1X
Ratto, F., 0Y
Reutterer, Bernd, 1X
Ritter, Thomas, 1U
Rollins, Andrew M., 0Q

Rossi, F., 0Y
 Sabino, Luis G., 1O
 Sandberg-Melin, Camilla, 0N, 0O
 Schikowski, Patrick, 1K
 Schramm, Stefan, 1K, 1R
 Schweitzer, Dietrich, 1R
 Seifert, Eric, 1A
 Shen, Liangbo, 06
 Shieh, Christine, 06
 Singh, Manmohan, 0V, 0X, 1P, 1T
 Söderberg, Per G., 0N, 0O
 Soliz, Peter, 0B
 South, Fredrick A., 1F
 Stock, Karl, 1Y
 Stockmann, Leoni, 1A
 Subhash, Hreesh, 1U
 Sugiyama, S., 0M
 Tan, Gavin, 19
 Tao, Yuankai K., 0Q
 Tatini, F., 0Y
 Taylor, Terrie E., 0B
 Thapa, D., 21
 Thatiparthi, C., 21
 Todorich, Bozho, 06
 Toth, Cynthia, 06
 Trasischker, Wolfgang, 02
 Traxler, Lukas, 1X
 Turner, Timothy L., 1E
 Twa, Michael D., 0V, 0X, 1T
 Tye, Logan A., 0Q
 Vantipalli, Srilatha, 0V, 0X, 1T
 Viehland, Christian, 06
 Wang, Benquan, 0H
 Wang, Bo, 1N
 Wang, Jenny, 19
 Wang, Yi, 1N
 Wartak, Andreas, 02
 Wu, Chen, 0X, 1P, 1T
 Wurm, Holger, 1Y
 Yao, Xincheng, 0H
 Yasuno, Yoshiaki, 0M, 0P
 Yasuoka, Fatima M. M., 1O
 Zalevsky, Zeev, 16
 Zhu, Lida, 1N

Conference Committee

Symposium Chairs

James G. Fujimoto, Massachusetts Institute of Technology
(United States)

R. Rox Anderson, Wellman Center for Photomedicine, Massachusetts
General Hospital (United States) and Harvard School of Medicine
(United States)

Program Track Chair

Brian Jet-Fei Wong, Beckman Laser Institute and Medical Clinic
(United States)

Conference Chairs

Fabrice Manns, University of Miami (United States)

Per G. Söderberg, Uppsala University (Sweden)

Arthur Ho, Brien Holden Vision Institute (Australia)

Conference Program Committee

Rafat R. Ansari, NASA Glenn Research Center (United States)

Michael Belkin, Tel Aviv University (Israel)

Kostadinka Bizheva, University of Waterloo (Canada)

David Borja, Alcon Laboratories, Inc. (United States)

Ralf Brinkmann, Universität zu Lübeck (Germany)

Wolfgang Drexler, Medizinische Universität Wien (Austria)

Daniel X. Hammer, U.S. Food and Drug Administration (United States)

Karen M. Joos, Vanderbilt University (United States)

Kirill V. Larin, University of Houston (United States)

Ezra Maguen, American Eye Institute (United States)

Donald T. Miller, Indiana University (United States)

Daniel V. Palanker, Stanford University (United States)

Jean-Marie Parel, Bascom Palmer Eye Institute (United States)

Roberto Pini, Istituto di Fisica Applicata Nello Carrara (Italy)

Luigi Rovati, Università degli Studi di Modena e Reggio Emilia (Italy)

Georg Schuele, OptiMedica Corporation (United States)

Jerry Sebag, VMRI Institute (United States)

Peter Soliz, VisionQuest Biomedical, LLC (United States)

Valery V. Tuchin, N.G. Chernyshevsky Saratov State University
(Russian Federation)

Session Chairs

- 1 Ocular Angiography and Blood Flow
Daniel X. Hammer, U.S. Food and Drug Administration (United States)
Rafat R. Ansari, NASA Glenn Research Center (United States)
- 2 Ophthalmic Imaging: Clinical and Surgical
Per G. Söderberg M.D., Uppsala University (Sweden)
Michael Belkin, Tel Aviv University (Israel)
- 3 Pascal Rol Lecture
Per G. Söderberg M.D., Uppsala University (Sweden)
- 4 Ophthalmic Imaging: Small Animal Models
Kirill V. Larin, University of Houston (United States)
Marco Ruggeri, University of Miami (United States)
- 5 Ophthalmic Image Processing and Analysis
Donald T. Miller, Indiana University (United States)
Peter Soliz, VisionQuest Biomedical LLC (United States)
- 6 Ophthalmic OCT and SLO Technology
Kostadinka Bizheva, University of Waterloo (Canada)
Wolfgang Drexler, Medizinische Universität Wien (Austria)
- 7 Ocular Biometry, Morphology, and Mechanics
David Borja, Alcon Laboratories, Inc. (United States)
Fabrice Manns, University of Miami (United States)
- 8 Vision Assessment and Correction
Arthur Ho, Brien Holden Vision Institute (Australia)
Ezra Maguen M.D., American Eye Institute (United States)
- 9 Ophthalmic Laser and Light Therapy
Georg Schuele, Abbott Medical Optics (United States)
Ralf Brinkmann, Medizinisches Laserzentrum Lübeck GmbH (Germany)
- 10 Adaptive Optics and Cellular Imaging
Daniel V. Palanker, Stanford University (United States)
Roberto Pini, Istituto di Fisica Applicata "Nello Carrara" (Italy)

Introduction

The papers contained in this volume were presented at the twenty-sixth conference on Ophthalmic Technologies, held from February 13 to 14, 2016, at the Moscone Center in San Francisco, California as a part of the SPIE Photonics West BIOS Meeting.

A total of 52 papers and 16 posters were presented by scientists, clinicians, and engineers from academia and industry representing 19 countries and 4 continents. Topics included new ophthalmic devices and approaches for the assessment of neurological function, characterization of corneal biomechanics using optical coherence elastography, retinal and choroidal blood and vasculature imaging, handheld retinal imaging technology for pediatric applications, laser therapy, ophthalmic image processing, and applications of adaptive optics for retinal imaging.

The conference hosted its tenth presentation on the topic of the unmet needs and impact of technology in a clinical area. Prof. Mingguang He, from the University of Melbourne, gave a lecture on the topic of technology needs in delivering community-based eye care services.

The sixteenth Pascal Rol Award was presented to Dr. Zhuolin Liu and her colleagues from Indiana University for their outstanding paper on "*Imaging human retinal pigment epithelium cells using adaptive optics optical coherence tomography*" (9693-48). Established in memory of Dr. Pascal O. Rol, former chair and co-founder of the Ophthalmic Technologies conference, the award is in recognition of the best manuscript and presentation. The 2016 finalists of the award, selected by the entire program committee among the 68 abstract submissions, were Oscar Carrasco-Zevallos (9693-5), Frederick South (9693-49), and Satoshi Sugiyama (9693-21).

We are very grateful to the Brien Holden Vision Institute in Sydney, Australia, for sponsoring the 2016 Pascal Rol award and keynote lecture through the Pascal Rol Foundation.

We thank the Program Committee members, session chairs, speakers and participants, as well as the SPIE staff for their support and dedication in making this conference a success.

We extend an invitation for the Ophthalmic Technologies XXVII conference, which is scheduled for Saturday January 28 and Sunday January 29, 2017 in San Francisco, CA.

Fabrice Manns
Per G. Söderberg
Arthur Ho

Sixteenth Pascal Rol Award for Excellence in Ophthalmic Technologies
Supported by the Brien Holden Vision Institute
through the Pascal Rol Foundation

Presented on Sunday February 14, 2016 to

Dr. Zhuolin Liu

for her excellent paper on

***"Imaging human retinal pigment epithelium cells using
adaptive optics optical coherence tomography"***

Wolfgang Drexler (left) and Arthur Ho (right) presents the 2016 Pascal Rol Award to Zhuolin Liu (center).

Past awardees

2015	Francesco de la Rocca	<i>Ultra-compact switchable SLO/OCT handheld probe design</i>
2014	Marco Ruggeri	<i>Biometry of the ciliary muscle during dynamic accommodation assessed with OCT</i>
2013	Yossi Mandel	<i>In-vivo performance of photovoltaic subretinal prosthesis</i>
2012	Clemens Alt	<i>In vivo quantification of microglia dynamics with an SLO in a mouse model of focal laser injury</i>
2011	James Loudin	<i>Photovoltaic Retinal Prosthesis</i>
2010	Daniel Hammer	<i>Multimodal adaptive optics for depth enhanced high-resolution ophthalmic imaging</i>
2009	Kazuhiro Kurokawa	<i>1μm wavelength adaptive optics scanning laser ophthalmoscope</i>
2008	Boris Povazay	<i>Minimum distance mapping using volumetric OCT: A novel indicator for early glaucoma diagnosis</i>
2007	Yoshiaki Yasuno	<i>Clinical examinations of anterior eye segments by three-dimensional swept-source optical coherence tomography</i>
2006	Enrique Fernandez	<i>Adaptive optics using a liquid crystal spatial light modulator for ultrahigh-resolution optical coherence tomography</i>
2005	Karsten König	<i>Cornea surgery with nanojoule femtosecond laser pulses</i>
2004	Daniel Palanker	<i>Attracting retinal cells to electrodes for high-resolution stimulation</i>
2003	Igor Ermakov	<i>Non-invasive optical techniques for the measurement of macular pigments</i>
2002	Georg Schuele	<i>Non-invasive temperature measurements during laser irradiation of the retina with optoacoustic techniques</i>
2001	Matthew Smith	<i>Minimizing the influence of fundus pigmentation on retinal vessel oximetry measurements</i>

The 2016 Pascal Rol Lecture on Ophthalmic Technologies
Saturday February 13, 2016

Professor Mingguang He
Centre for Eye Research Australia (CERA)
University of Melbourne, Australia

***Need for technologies for advancement in delivering
community-based eye care service***

The Pascal Rol Lecture on Ophthalmic Technologies" is presented by a leading researcher in ophthalmology with a strong interest and pioneering research contributions to the field of ophthalmic technologies. This invited lecture is intended to trigger further development of ophthalmic technologies by stimulating discussions between basic scientists, engineers, and clinicians.

*The 2016 lecture was supported by the Brien Holden Vision Institute
through the Pascal Rol Foundation (www.pascalrolfoundation.org)*

Brien Holden Vision Institute