

Design and Quality for Biomedical Technologies X

**Ramesh Raghavachari
Rongguang Liang**
Editors

**28–29 January 2017
San Francisco, California, United States**

Sponsored and Published by
SPIE

Volume 10056

Proceedings of SPIE, 1605-7422, V. 10056

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

Design and Quality for Biomedical Technologies X, edited by Ramesh Raghavachari, Rongguang Liang, Proc. of SPIE Vol. 10056, 1005601 · © 2017 SPIE · CCC code: 1605-7422/17/\$18 · doi: 10.1117/12.2275833

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 SPIDigitalLibrary.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 these proceedings:

Author(s), "Title of Paper," in *Design and Quality for Biomedical Technologies X*, edited by Ramesh Raghavachari, Rongguang Liang, Proceedings of SPIE Vol. 10056 (SPIE, Bellingham, WA, 2017) Seven-digit Article CID Number.

ISSN: 1605-7422
ISSN: 2410-9045 (electronic)

ISBN: 9781510605534
ISBN: 9781510605541 (electronic)

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 © 2017, 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 1605-7422/17/\$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. A unique citation identifier (CID) number is assigned to each article at the time of 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 and print versions of the publication. SPIE uses a seven-digit CID article numbering system structured as follows:

- The first five 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.

Contents

- v *Authors*
vii *Conference Committee*

PHANTOMS I

- 10056 02 **Label-free hyperspectral dark-field microscopy for quantitative scatter imaging**
[10056-39]
- 10056 03 **Polydimethylsiloxane tissue-mimicking phantoms for quantitative optical medical imaging standards** [10056-40]
- 10056 04 **Broadband spectral measurements of diffuse optical properties by an integrating sphere instrument at the National Institute of Standards and Technology** [10056-41]

3D PRINTED PHANTOMS

- 10056 07 **3D printed optical phantoms and deep tissue imaging for in vivo applications including oral surgery** [10056-3]

PHANTOMS II

- 10056 0A **Design and fabrication of solid phantoms for NIR water fraction studies** [10056-6]
- 10056 0C **Development and validation of a biologically realistic tissue-mimicking material for photoacoustics and other bimodal optical-acoustic modalities** [10056-8]
- 10056 0D **Comparison of the temperature accuracy between smart phone based and high-end thermal cameras using a temperature gradient phantom** [10056-9]
- 10056 0G **Evaluation of a multi-layer diffuse reflectance spectroscopy system using optical phantoms** [10056-12]

QUALITY OF BIOMEDICAL TECHNOLOGIES

- 10056 0H **Standardized assessment of infrared thermographic fever screening system performance**
[10056-13]
- 10056 0I **Ray-traced Monte Carlo simulation tool for computer-aided design of tissue fluorescence sensing system** [10056-14]

- 10056 OJ **Near-infrared fluorescence image quality test methods for standardized performance evaluation** [10056-15]
- 10056 OK **Traceable working standards with SI units of radiance for characterizing the measurement performance of investigational clinical NIRF imaging devices** [10056-16]
- 10056 OL **Image quality assessment for teledermatology: from consumer devices to a dedicated medical device** [10056-17]

OCT SYSTEM DEVELOPMENT AND APPLICATIONS

- 10056 OO **A comparative study of noise in supercontinuum light sources for ultra-high resolution optical coherence tomography** [10056-20]
- 10056 OP **Analysis of polygonal mirror scanning heads: from industrial to high-end applications in swept sources for OCT** [10056-21]
- 10056 OQ **Integrated-optics based multi-beam imaging for speed improvement of OCT systems** [10056-22]

IMAGING SYSTEMS AND APPLICATIONS

- 10056 OT **Laser assisted robotic surgery in cornea transplantation** [10056-25]
- 10056 OU **Design and implementation of a dual-wavelength intrinsic fluorescence camera system** [10056-26]
- 10056 OV **On the origin of the visible light responsible for proton dose measurement using plastic optical fibers** [10056-27]
- 10056 OW **Reliable determination of tissue optical properties from spatially resolved reflectance** [10056-28]

POSTER SESSION

- 10056 OY **Development of an antimicrobial blended white LED system containing pulsed 405nm LEDs for decontamination applications** [10056-31]
- 10056 OZ **Multispectral fluorescence diffuse optical tomography** [10056-33]
- 10056 10 **3D splint prototype system for applications in muscular rehab by transcutaneous electrical nerve stimulation (TENS)** [10056-34]
- 10056 12 **Continuous control systems for non-contact ECG** [10056-36]
- 10056 13 **A capillary-mimicking optical tissue phantom for diffuse correlation spectroscopy** [10056-37]

Authors

Numbers in the index correspond to the last two digits of the seven-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first five 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.

Akca, B. Imran, 0Q
Allen, David W., 02, 03, 04
Amouroux, Marine, 0L
Bang, O., 0O
Barajas-González, O. G., 10
Bentz, Brian Z., 07
Blondel, Walter, 0L
Bondu, M., 0O
Briggman, Kimberly, 03
Cantow, Kathleen, 0W
Casamento, Jon, 0H
Chen, Yu, 0J
Cheney, Philip, 02
Chiang, Huihua Kenny, 0Z
Cho, Jaedu, 0Z
Christian, James F., 13
Costas, Alfonso, 07
Coumans, Frank A. W., 0Q
D. Engelholm, R., 0O
Darafsheh, Arash, 0V
Duma, Virgil-Florin, 0P
Durkin, Anthony J., 0A, 0G
Fernandez, Daniel E., 13
Feuchter, T., 0O
Finlay, Jarod C., 0V
Flemming, Bert, 0W
Franco, Walfre, 0U
Fredriksson, Ingemar, 0G
Gaind, Vaibhav, 07
Garcia, Jose M., 07
García-Garza, A. K., 10
García-Ramírez, M. A., 10
Garra, Brian S., 0C
Ghassemi, Pejman, 0H, 0J
Gillespie, Jonathan B., 0Y
Given, Martin J., 0Y
Gladytz, Thomas, 03, 0W
González-García, R. B., 10
Gonzalo, I. B., 0O
Grosenick, Dirk, 03, 04, 0W
Gulsen, Gultekin, 0Z
Gutierrez-Herrera, Enoch, 0U
Guzmán-González, J. V., 10
Guzman-Ramos, V., 10
Haudrechy, Alexandre, 0L
Hoppe, Alexander, 0W
Hwang, Jeeseong, 02, 03, 04
Jia, Congxian, 0C
Kanick, Stephen, 02
Kanniyappan, Udayakumar, 0J
Kassaei, Alireza, 0V
Kennedy, Gordon T., 0A
Kim, Hyun-Jin, 03
Klaessens, John H., 0D
Kodkin, Vladimir L., 12
Kolodziejcki, Noah J., 13
Le Cunff, Sébastien, 0L
Lee, Seung Yup, 0I
Leick, L., 0O
Lemaillet, Paul, 02, 03, 04
Lentsch, Griffin R., 0A
Leoni, Fabio, 0T
Litorja, Maritoni, 0K
Lo, Pei-An, 0Z
MacGregor, Scott J., 0Y
Maclean, Michelle, 0Y
Magnani, Bernardo, 0T
Magni, Giada, 0T
Maria, M., 0O
McAdams, Daniel, 13
McClatchy, David, 02, 03
Menabuoni, Luca, 0T
Micheletti, Filippo, 0T
Moselund, P. M., 0O
Musacchia, Joseph J., 0U
Mycek, Mary-Ann, 0I
Niendorf, Thoralf, 0W
Nouizi, Farouk, 0Z
O'Reilly, Jameson P., 13
Ortega-Martinez, Antonio, 0U
Pfefer, T. Joshua, 0C, 0H, 0J
Pini, Roberto, 0T
Podoleanu, A., 0O
Pogue, Brian, 02, 03
Pohlmann, Andreas, 0W
Ponticorvo, Adrien, 0A
Rasmussen, John C., 0K
Rossi, Francesca, 0T
Saager, Rolf B., 0A, 0G
Saldaña-Martínez, M. I., 10
Samarov, Daniel, 02
Seeliger, Erdmann, 0W
Sevick-Muraca, Eva M., 0K
Smirnov, Alexey S., 12
Stapels, Christopher J., 13
Strömberg, Tomas, 0G
Taleei, Reza, 0V
Trieu, Brandon, 0A

van der Veen, Albert, 0D
van Leeuwen, Ton G., 0Q
Verdaasdonk, Rudolf M., 0D
Vogt, William C., 0C
Wabnitz, Heidrun, 03, 04
Wang, Bohan, 0J
Wang, Quanzeng, 0H, 0J
Wang, Ying, 0U
Wear, Keith A., 0C
Webb, Kevin J., 07
Weiss, Nicolas M., 0Q
Wilson, Mark P., 0Y
Yakovleva, Galina V., 12
Yang, Charles, 0J
Yang, Lin, 03, 04
Zhu, Banghe, 0K

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 Medical School
(United States)

Program Track Chairs

Tuan Vo Dinh, Fitzpatrick Institute for Photonics, Duke University
(United States)

Anita Mahadevan-Jansen, Vanderbilt University (United States)

Conference Chairs

Ramesh Raghavachari, U.S. Food and Drug Administration
(United States)

Rongguang Liang, College of Optical Sciences, The University of
Arizona (United States)

Conference Co-chair

T. Joshua Pfefer, U.S. Food and Drug Administration (United States)

Conference Program Committee

David W. Allen, National Institute of Standards and Technology
(United States)

Anthony J. Durkin, Beckman Laser Institute and Medical Clinic
(United States)

Jeeseong Hwang, National Institute of Standards and Technology
(United States)

Stephen P. Morgan, The University of Nottingham (United Kingdom)

Robert J. Nordstrom, National Institutes of Health (United States)

Jannick P. Rolland, University of Rochester (United States)

Eric J. Seibel, University of Washington (United States)

Behrouz Shabestari, National Institutes of Health (United States)

Kenji Taira, Olympus Corporation (United States)

Tomasz S. Tkaczyk, Rice University (United States)

Gracie Vargas, The University of Texas Medical Branch (United States)

Rudolf M. Verdaasdonk, Vrije University Medical Center (Netherlands)

Session Chairs

- 1 Phantoms I
Anthony J. Durkin, Beckman Laser Institute and Medical Clinic
(United States)
- 2 3D Printed Phantoms
T. Joshua Pfefer, U.S. Food and Drug Administration (United States)
- 3 Phantoms II
Jeeseong Hwang, National Institute of Standards and Technology
(United States)
William C. Vogt, U.S. Food and Drug Administration (United States)
- 4 Quality of Biomedical Technologies
Ramesh Raghavachari, U.S. Food and Drug Administration
(United States)
- 5 OCT System Development and Applications
Maritoni Litorja, National Institute of Standards and Technology
(United States)
- 6 Keynote
Ramesh Raghavachari, U.S. Food and Drug Administration
(United States)
- 7 Imaging Systems and Applications
Jeeseong Hwang, National Institute of Standards and Technology
(United States)
- 8 Special Session: NIH Funding Opportunities and Proposal Preparation
Eric J. Seibel, University of Washington (United States)