

Photons Plus Ultrasound: Imaging and Sensing 2017

Alexander A. Oraevsky

Lihong V. Wang

Editors

29 January–1 February 2017

San Francisco, California, United States

Sponsored by

SPIE

Co-sponsored by

SENO Medical Instruments, Inc. (United States)

Published by

SPIE

Volume 10064

Proceedings of SPIE, 1605-7422, V. 10064

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

Photons Plus Ultrasound: Imaging and Sensing 2017, edited by Alexander A. Oraevsky, Lihong V. Wang, Proc. of SPIE Vol. 10064, 1006401 · © 2017 SPIE · CCC code: 1605-7422/17/\$18 · doi: 10.1117/12.2276293

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 *Photons Plus Ultrasound: Imaging and Sensing 2017*, edited by Alexander A. Oraevsky, Lihong V. Wang, Proceedings of SPIE Vol. 10064 (SPIE, Bellingham, WA, 2017) Seven-digit Article CID Number.

ISSN: 1605-7422

ISSN: 2410-9045 (electronic)

ISBN: 9781510605695

ISBN: 9781510605701 (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

- xi *Authors*
- xv *Conference Committee*
- xix *Introduction*

BRAIN IMAGING

- 10064 07 **Recording membrane potential changes through photoacoustic voltage sensitive dye** [10064-6]

CLINICAL APPLICATIONS

- 10064 08 **Photoacoustic analysis of thyroid cancer in vivo: a pilot study** [10064-7]
- 10064 09 **Photoacoustic evaluation of human inflammatory arthritis in human joints** [10064-8]
- 10064 0A **Optoacoustic mapping of cerebral blood oxygenation in humans** [10064-9]
- 10064 0B **Quantitative photoacoustic elastography of Young's modulus in humans** [10064-10]

THERAPY MONITORING AND GUIDANCE

- 10064 0D **In vivo photoacoustic mouse eye imaging of healing after chemical injury and automated eyeball surface estimation based on a random sample consensus algorithm** [10064-12]
- 10064 0G **Identification and removal of reflection artifacts in minimally invasive photoacoustic imaging for accurate visualization of brachytherapy seeds** [10064-15]
- 10064 0H **Non-contact monitoring during laser surgery by measuring the incision depth with air-coupled transducers** [10064-16]
- 10064 0J **Optimizing light delivery for a photoacoustic surgical system** [10064-18]

FUNCTIONAL IMAGING

- 10064 0M **Imaging small animal whole-body dynamics by single-impulse panoramic photoacoustic computed tomography** [10064-21]
- 10064 0N **Quantitative imaging of tumor vasculature using multispectral optoacoustic tomography (MSOT)** [10064-22]

- 10064 0P **Simultaneous measurements of total hemoglobin concentration and blood oxygenation with laser diode-based optoacoustic system** [10064-24]
- 10064 0Q **Cerebral blood oxygenation measurements in neonates with optoacoustic technique** [10064-25]

MULTIMODALITY IMAGING AND CONTRAST AGENTS

- 10064 0T **Real-time intravascular photoacoustic-ultrasound imaging of lipid-laden plaque at speed of video-rate level** [10064-28]
- 10064 0W **First steps towards dual-modality 3D photoacoustic and speed of sound imaging with optical ultrasound detection** [10064-31]

ENDOSCOPY AND INTRAVASCULAR IMAGING

- 10064 0Z **Imaging of post-embryonic stage model organisms at high resolution using multi-orientation optoacoustic mesoscopy** [10064-34]
- 10064 12 **Microstructured polymer optical fiber sensors for optoacoustic endoscopy** [10064-37]

QUANTITATIVE IMAGING

- 10064 15 **Three-dimensional photoacoustic imaging and inversion for accurate quantification of chromophore distributions** [10064-40]
- 10064 16 **Experimental validation of a Monte-Carlo-based inversion scheme for 3D quantitative photoacoustic tomography** [10064-41]
- 10064 17 **Ultrasound spectral analysis of photoacoustic signals from red blood cell populations at different optical wavelengths** [10064-42]
- 10064 19 **Exploiting statistical independence for quantitative photoacoustic tomography** [10064-44]
- 10064 1A **20 frames per second model-based reconstruction in cross-sectional optoacoustic tomography** [10064-45]

PRECLINICAL IMAGING

- 10064 1B **Non-negative constrained inversion approaches for unmixing chromophores in multispectral optoacoustic tomography** [10064-46]
- 10064 1C **Optoacoustic endoscopy with optical and acoustic resolution** [10064-47]
- 10064 1D **Non-invasive volumetric optoacoustic imaging of cardiac cycles in acute myocardial infarction model in real-time** [10064-49]

10064 1E **Real-time photoacoustic flow cytography and photothermolysis of single circulating melanoma cells in vivo** [10064-50]

10064 1F **Photoacoustic imaging with a multi-view Fabry-Pérot scanner** [10064-51]

NOVEL METHODS AND SYSTEMS

10064 1I **Improving visibility in limited-view scenarios with dynamic particle-enhanced optoacoustic tomography** [10064-53]

10064 1N **Development of a photoacoustic handheld probe using 2-axis MEMS scanner** [10064-58]

10064 1O **Multiple speckle illumination for optical-resolution photoacoustic imaging** [10064-59]

10064 1P **Linear-array-based photoacoustic tomography for label-free high-throughput detection and quantification of circulating melanoma tumor cell clusters** [10064-60]

10064 1Q **Dynamics of the photoacoustic response of single-element PZT transducers to pulse burst excitation** [10064-61]

ALL-OPTICAL AND LASER ULTRASOUND SYSTEMS

10064 1V **Photoacoustic imaging with planoconcave optical microresonator sensors: feasibility studies based on phantom imaging** [10064-66]

10064 1W **All-optical endoscopic probe for high resolution 3D photoacoustic tomography** [10064-67]

10064 1X **Polarization-dependent optical reflection ultrasonic detection** [10064-68]

10064 1Y **Sub-sampled Fabry-Perot photoacoustic scanner for fast 3D imaging** [10064-69]

10064 23 **Optoacoustic microscopy based on pi-FBG ultrasound sensors** [10064-74]

MICROSCOPY

10064 26 **Frequency domain optical resolution photoacoustic and fluorescence microscopy using a modulated laser diode** [10064-77]

10064 27 **Combined synthetic aperture focusing technique and three-dimensional deconvolution for resolution enhancement in photoacoustic microscopy** [10064-78]

MOLECULAR IMAGING

10064 2D **Copper sulfide nanodisk as photoacoustic contrast agent for ovarian tumor detection** [10064-86]

SIGNAL PROCESSING, IMAGE RECONSTRUCTION

- 10064 2H **Photoacoustic super-resolution microscopy using blind structured speckle illumination** [10064-90]
- 10064 2I **Compressed sensing in photoacoustic imaging and application for planar detection geometries** [10064-91]
- 10064 2K **Imaging multi-scale dynamics in vivo with spiral volumetric optoacoustic tomography** [10064-93]
- 10064 2L **Weighted synthetic aperture focusing for optoacoustic microscopy with scanning illumination and detection** [10064-94]
- 10064 2M **Acoustic resolution photoacoustic Doppler flowmetry using a transducer array: optimising processing for velocity contrast** [10064-95]
- 10064 2N **Fast sparse recovery and coherence factor weighting in optoacoustic tomography** [10064-96]

HOT LATEST RESULTS

- 10064 2P **Slit-enabled linear-array photoacoustic tomography with near isotropic spatial resolution in three dimensions** [10064-141]

POSTER SESSION

- 10064 2S **In vivo photoacoustic imaging of uterine cervical lesion and its image processing based on light propagation in biological medium** [10064-98]
- 10064 2U **Possibility of transrectal photoacoustic imaging-guided biopsy for detection of prostate cancer** [10064-100]
- 10064 2V **Accuracy of a novel photoacoustic-based approach to surgical guidance performed with and without a da Vinci robot** [10064-101]
- 10064 2X **Deep-tissue photoacoustic imaging at 1064 nm using a contrast agent based on phosphorus phthalocyanine formulation** [10064-103]
- 10064 2Z **Functional photoacoustic tomography for neonatal brain imaging: developments and challenges** [10064-105]
- 10064 31 **A suite of phantom-based test methods for assessing image quality of photoacoustic tomography systems** [10064-107]
- 10064 32 **A monomeric water-soluble NIR-absorbing porphyrin derivative as in vivo photoacoustic tomography contrast agent** [10064-108]

- 10064 33 **N-doped carbon nanodots for non-invasive photoacoustic imaging and photothermal therapy** [10064-109]
- 10064 34 **Dependence of photoacoustic signal generation characteristics on fluorescence quantum yields of small organic molecule based contrast agents** [10064-110]
- 10064 36 **Towards non-contact photo-acoustic endoscopy using speckle pattern analysis** [10064-112]
- 10064 38 **Study of data analysis methods in functional connectivity photoacoustic tomography (fcPAT)** [10064-114]
- 10064 39 **A cost-effective functional connectivity photoacoustic tomography (fcPAT) of the mouse brain** [10064-115]
- 10064 3A **Comparative study on similarity metrics for seed-based analysis of functional connectivity photoacoustic tomography images** [10064-116]
- 10064 3C **Three-dimensional optoacoustic mesoscopy of the tumor heterogeneity in vivo using high depth-to-resolution multispectral optoacoustic tomography** [10064-118]
- 10064 3D **Photo acoustic imaging: technology, systems and market trends** [10064-119]
- 10064 3E **Utilising the radiative transfer equation in quantitative photoacoustic tomography** [10064-120]
- 10064 3G **Three-dimensional photoacoustic tomography through coherent-weighted focal-line-based image reconstruction** [10064-122]
- 10064 3H **Improvement of resolution in full-view linear-array photoacoustic computed tomography using a novel adaptive weighting method** [10064-123]
- 10064 3I **Variational photoacoustic image reconstruction with spatially resolved projection data** [10064-124]
- 10064 3J **A machine learning approach to identifying point source locations in photoacoustic data** [10064-125]
- 10064 3K **Iterative photoacoustic image reconstruction for three-dimensional imaging by conventional linear-array detection with sparsity regularization** [10064-126]
- 10064 3L **Free space ultrasound guided fluorescence diffuse optical tomography** [10064-127]
- 10064 3M **Bayesian approach to image reconstruction in photoacoustic tomography** [10064-128]
- 10064 3N **Estimation and uncertainty quantification of optical properties directly from the photoacoustic time series** [10064-130]
- 10064 3O **Software-based approach toward vendor independent real-time photoacoustic imaging using ultrasound beamformed data** [10064-131]

- 10064 3P **SNR enhancement for catheter based intravascular photoacoustic/ultrasound imaging** [10064-132]
- 10064 3R **Compression-tracking photoacoustic perfusion and microvascular pressure measurements** [10064-134]
- 10064 3S **Effect of small and large animal skull bone on photoacoustic signal** [10064-135]
- 10064 3T **Photoacoustic investigation of a neonatal skull phantom** [10064-136]
- 10064 3U **Modeling skull's acoustic attenuation and dispersion on photoacoustic signal** [10064-137]
- 10064 3W **Modified delay-and-sum reconstruction algorithm to improve tangential resolution in photoacoustic tomography** [10064-139]
- 10064 3X **Compact photoacoustic tomography system** [10064-140]
- 10064 40 **Photoacoustic measurements of red blood cell oxygen saturation in blood bags in situ** [10064-144]
- 10064 41 **Multi-wavelength photoacoustic system based on high-power diode laser bars** [10064-145]
- 10064 43 **Frequency domain non-contact photoacoustic microscopy** [10064-147]
- 10064 45 **Multi-modality analysis of glucose aqueous solution using photoacoustic and dielectric spectroscopy for non-invasive glucose monitoring** [10064-149]
- 10064 47 **Photoacoustic remote sensing microscopy with lock-in amplification** [10064-151]
- 10064 48 **Needle tip visualization by bevel-point ultrasound generator and prototype photoacoustic imaging system** [10064-152]
- 10064 4A **Multi-wavelength photoacoustic imaging for monitoring lesion formation during high-intensity focused ultrasound therapy** [10064-154]
- 10064 4E **Low-cost high-power light emitting diodes for photoacoustic imaging** [10064-158]
- 10064 4F **Cost-effective optoacoustic system based on the combination of high-power diode lasers** [10064-159]
- 10064 4G **Optoacoustic system based on 808-nm high energy short pulse diode laser stacks** [10064-160]
- 10064 4I **Optoacoustic effect from a point source moving in a circular orbit** [10064-162]
- 10064 4M **Multispectral photoacoustic bioimaging using low power continuous wave lasers** [10064-166]
- 10064 4N **Early-stage tumor detection using photoacoustic microscopy: a pattern recognition approach** [10064-167]
- 10064 4P **Combined optical and acoustic resolution photoacoustic microscopy** [10064-170]

- 10064 4R **Low-cost laser scanning photoacoustic microscopy system with a pulsed laser diode excitation source** [10064-172]
- 10064 4S **Photonic nanojet engineering to achieve super-resolution in photoacoustic microscopy: a simulation study** [10064-173]
- 10064 4T **Hybrid ultrasound and dual-wavelength optoacoustic biomicroscopy for functional neuroimaging** [10064-174]
- 10064 4U **Rapid computation of photoacoustic fields from normal and pathological red blood cells using a Green's function method** [10064-175]
- 10064 4W **pMUT+ASIC integrated platform for wide range ultrasonic imaging** [10064-176]
- 10064 4X **Detection of ICG at low concentrations by photoacoustic imaging system using LED light source** [10064-177]
- 10064 53 **Spatial interference encoding patterns based super resolved photoacoustic microscopy** [10064-183]
- 10064 54 **Ultrasound modulation of bioluminescence generated inside a turbid medium** [10064-184]
- 10064 55 **Hybrid microscopy of human carotid atheroma by means of optical-resolution optoacoustic and non-linear optical microscopy** [10064-185]
- 10064 57 **Light activated microbubbles for imaging and microsurgery** [10064-187]
- 10064 5A **Evaluation of blood glucose concentration measurement using photoacoustic spectroscopy in near-infrared region** [10064-190]
- 10064 5B **Biological tissue component evaluation by measuring photoacoustic spectrum** [10064-191]
- 10064 5C **Optical-frequency-comb based ultrasound sensor** [10064-192]
- 10064 5D **Effect of spatial filtering of ultrasound transducers on photoacoustic measurements** [10064-193]
- 10064 5E **Micromachined silicon acoustic delay line with improved structural stability and acoustic directivity for real-time photoacoustic tomography** [10064-194]
- 10064 5F **Quantitative photoacoustic assessment of red blood cell aggregation under pulsatile blood flow: experimental and theoretical approaches** [10064-195]
- 10064 5G **Adipocyte property evaluation with photoacoustic spectrum analysis: a feasibility study on human tissues** [10064-196]
- 10064 5H **Comparison study on the feasibility of photoacoustic power spectrum analysis in osteoporosis detection** [10064-197]
- 10064 5J **Monte-Carlo-based inversion scheme for 3D quantitative photoacoustic tomography** [10064-199]

- 10064 5K **Fluence compensated photoacoustic measurements of blood oxygen saturation in vivo at two optimal wavelengths** [10064-200]
- 10064 5L **Photoacoustic signal enhancement: towards utilization of very low-cost laser diodes in photoacoustic imaging** [10064-201]
- 10064 5N **Optimising probe holder design for sentinel lymph node imaging using clinical photoacoustic system with Monte Carlo simulation** [10064-203]
- 10064 5O **Pulsed laser diode photoacoustic tomography (PLD-PAT) system for fast in vivo imaging of small animal brain** [10064-204]
- 10064 5R **A charge amplification approach for photoacoustic tomography (PAT) with parallel acoustic delay line (PADL) arrays** [10064-207]

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.

Abou, Diane S., 07
Acker, Jason P., 40
Adabi, Saba, 2Z
Adhikari, Arunabha, 4U
Agano, Toshitaka, 4X
Ahmad, Junaid, 54
Ahn, Joongho, 3P
An, Lu, 15, 19
Ansari, R., 1W
Arbeit, Jeffrey M., 4N
Arridge, Simon R., 15, 1Y, 3E, 3N
Asano, Tomohiko, 2U
Avanaki, Mohammad R. N., 2Z
Bagga, Karan, 40
Bai, Wenyu, 4I
Balabani, S., 2M
Beack, Songeun, 33
Beard, Paul C., 15, 1F, 1V, 1W, 1Y, 2M
Behnam, H., 3U
Bell, Kevan, 47
Berer, Thomas, 26, 2H, 2I
Betcke, Marta, 1Y
Boctor, Emad M., 07, 3O
Bohndiek, Sarah E., 0N
Bok, Tae-Hoon, 5F
Borri, Claudia, 57
Bossy, Emmanuel, 1O
Brenner, Carsten, 1Q
Brückner, Christian, 32
Brunker, J., 2M
Buechegger, Bianca, 26
Buchmann, Jens, 16, 5J
Bücking, T. M., 2M
Buehler, Andreas, 1C, 2N
Burgholzer, Peter, 2H, 2I
Burton, Neal C., 1B
Cai, De, 27
Cao, Meng, 5G
Cao, Yingchun, 0T
Carpintero, Guillermo, 4I
Carson, Jeffrey, 3H
Carson, Paul, 5G, 5H
Cavigli, Lucia, 57
Centi, Sonia, 57
Chang, Kiyuk, 3P
Chekkoury, Andrei, 3C
Chen, Sung-Liang, 27
Chen, Wanyi, 0M
Chen, Weibiao, 0T
Cheng, Ji-Xin, 0T
Cheng, Qian, 5G
Cherkashin, Maxim, 1Q
Chiang, Huihua Kenny, 3L
Chitnis, Parag V., 43
Cho, Seonghee, 3P
Cho, Young, 5E, 5R
Choi, Changhoon, 3P
Choi, Min, 3R
Cochard, Jacques, 3D
Cook, Timothy R., 2X
Cox, Ben T., 15, 19, 1F, 1Y, 3E, 3N
Dai, Xianjin, 4E
Déan-Ben, Xosé Luís, 0H, 1A, 1B, 1D, 1I, 2K
Dehghani, Hamid, 54
Desjardins, A. E., 1W
d'Humières, Benoît, 3D
Diebold, Gerald J., 4I
Ding, Lu, 1A, 1B, 1I
Diop, Mamadou, 3H
Döpke, Benjamin, 1Q
Douplik, Alexandre, 40
Dundar, Murat, 4A
Eakins, Gregory, 0T
Eddins, Blackberrie, 0J
Ellwood, Robert, 15, 19, 1F
Erfanzadeh, Mohsen, 32, 4R
Esenaliev, Rinat O., 0A, 0P, 0Q
Estrada, Héctor, 2L, 4T
Fadhel, Muhannad N., 17, 4U
Fang, Cheng, 5R
Fatima, Afreen, 39, 3S, 3T
Faucheux, Marc, 3D
Fehm, Thomas F., 2K
Feng, Ting, 5H
Fonseca, Martina, 15, 19
Fonseca, Rafael A., 0A, 0Q
Ford, Steven J., 2K
Furuya, Kenichi, 2S
Gallego, Daniel C., 12, 41, 4F, 4G
Gandhi, Neeraj, 2V
Garra, Brian S., 31
Gateau, Jerome, 0Z
Gawali, Sandeep Babu, 41, 4F, 4G
Gelovani, Juri, 2Z
Geng, Jumin, 2P, 2X
George, Deepu, 43
Gerhardt, Nils C., 1Q
Girish, Gandikota, 09

Gjedde, Albert, 07
 Glasl, Sarah, 3C
 Gong, Lei, 0B
 Gottschalk, Sven, 2K, 4T
 Guggenheim, James A., 1V
 Guo, Zhendong, 27
 Ha, Jeonghoon, 08
 Haas, Helena, 1D
 Hai, Pengfei, 0B, 1P
 Hajireza, Parsin, 47
 Haltmeier, Markus, 2H, 2I
 Hammernik, Kerstin, 3I
 Hanaoka, Takamitsu, 4X
 Hariri, Ali, 2Z, 39, 3S, 3T, 5L
 Hase, Eiji, 5C
 Hashimoto, Atsushi, 48
 Hayakawa, Toshiro, 48
 He, Hailong, 1C, 2N
 He, Weizhen, 5H
 He, Yun, 1E
 Hendriksen, Ellen, 0G
 Henkel, S. Nan, 0P
 Herrmann, Stephen, 0Q
 Hill, Philip J., 54
 Hirasawa, Takeshi, 2S, 34
 Hirota, Kazuhiro, 2S
 Hofmann, Martin R., 1Q
 Honarvar, Mohammad, 3K
 Horiguchi, Akio, 2U
 Hosseinzadeh, M., 5L
 Hsu, Su-Wen, 2D
 Hu, Song, 4N
 Huang, Chih-Hsien, 1E
 Huang, Howard, 3O
 Huang, Zhiyu, 1X
 Hubbell, Ryan, 2P
 Hui, Jie, 0T
 Huynh, Nam, 1Y
 Hysi, Eno, 5F
 Irisawa, Kaku, 2S, 2U, 48
 Ishihara, Miya, 2S, 2U, 34
 Iwatate, Ryu J., 34
 Jacak, Jaroslaw, 26
 Jayet, Baptiste, 54
 Jeon, Seungwan, 0D
 Jia, Congxian, 3I
 Jiang, Huabei, 4E
 Jo, Janggun, 09
 Jo, Kwanhoon, 08
 Jokerst, Jesse V., 2D
 Joseph, James, 0N
 Kaipio, Jari P., 3N
 Kalva, Sandeep Kumar, 3W, 3X, 5O
 Kamiya, Mako, 34
 Kang, DongYel, 5D
 Kang, Jeeun, 07
 Kang, Jin U., 07
 Kang, Yeonsu, 3P
 Kaplan, Bernhard A., 16, 5J
 Karlas, Angelos, 55
 Karmakar, Subhajit, 4U
 Kazanzides, Peter, 2V
 Khazaaleh, S., 4W
 Khodaei, Afsoon, 38, 3A
 Kim, Chulhong, 08, 0D, 1N, 33, 3P
 Kim, Jaewoo, 0D
 Kim, Jeesu, 08
 Kim, Jeong Hun, 0D
 Kim, Jin Young, 1N
 Kim, Jinmoo, 3P
 Kim, Min-Hee, 08
 Kim, Sungmin, 2V
 Kim, Taehoon, 3P
 Kim, Yongmin, 08, 3P
 Kim, Younsu, 3O
 Kimm, Melanie, 1D
 Kirillin, M. Yu., 5K
 Kitagawa, Kazuo, 4X
 Klämpfl, Florian, 36
 Klar, Thomas A., 26
 Kneipp, Moritz, 2L
 Koberstein-Schwarz, Benno, 3C
 Kole, Ayeeshik, 0T
 Kolios, Michael C., 17, 40, 4M, 4U, 53, 5F
 Kondo, Kengo, 5A, 5B
 Kosanke, Katja, 1D
 Kumar, Akhil, 5E
 Kuniyil Ajith Singh, Mithun, 0G
 Kushibiki, Toshihiro, 2S
 Kwon, Woosung, 33
 Lai, Sarah, 57
 Lamela, Horacio, 12, 41, 4F, 4G
 Langer, Andreas, 26
 Langer, Gregor, 26
 Laufer, Jan, 16, 5J
 Lawrence, Aamna, 4U
 Le, Hanh N. D., 07
 Lediju Bell, Muyinatu A., 0J, 2V, 3J
 Lee, Byung Joo, 0D
 Lee, Changho, 1N
 Lee, Changho, 33
 Lee, Donghyun, 33
 Lee, Seunghoon, 3P
 Leggio, Luca, 41, 4F, 4G
 Lei, Chen, 3O
 Leiss-Holzinger, E., 2H
 Lengenfelder, Benjamin, 36
 Li, Changhui, 1X
 Li, Jiao, 3C
 Li, Lei, 0M
 Li, Lei, 1E
 Li, Wenzhao, 1X
 Li, Yan, 3Y
 Li, Yang, 1P
 Li, Yao, 27
 Li, Zhongfei, 27
 Liang, Jinyang, 4N
 Lim, Dong-Jun, 08
 Lim, Geunbae, 1N
 Lin, Hasiao-Chun Amy, 1D

Lin, Li, 0M
 Lloyd, Harriet, 43
 Lo, Pei-An, 3L
 Loew, Leslie M., 07
 Lohöfer, Fabian, 1D
 Lopez-Schier, Hernan, 0Z
 Lovell, Jonathan F., 2P, 2X, 3G
 Luciano, Michael, 32
 Lucka, Felix, 15, 1F, 1Y
 Ma, Cheng, 0M
 Ma, Jun, 1P
 Malone, Emma, 15
 Manohar, Srirang, 0G
 Mappes, Timo, 0Z
 Marquardt, April, 09
 Maslov, Konstantin, 0M
 Masuoka, Takashi, 5C
 Mather, Melissa L., 54
 Mehari, Fanuel, 36
 Meier, Reinhard, 1D
 Meiri, Amihai, 53
 Micheletti, Filippo, 57
 Minamikawa, Takeo, 5C
 Minoshima, Kaoru, 5C
 Mohammadi, L., 3U
 Montero de Espinosa, Francisco, 0H
 Moothanchery, Mohesh, 4P, 4S, 5O
 Moradi, Hamid, 3K
 Morgan, Stephen P., 54
 Morisono, Koji, 4X
 Moser, Christophe, 1O
 Murakoshi, Dai, 48
 Murata, Yuya, 5B
 Murray, T. W., 2H
 Nakajima, Yoshiaki, 5C
 Nakamura, Masahito, 45
 Nakatsuka, Hitoshi, 4X
 Namita, Takeshi, 5A, 5B
 Nasiriavanaki, Mohammadreza R., 38, 39, 3A,
 3H, 3S, 3T, 3U, 5L
 Noei, Sh., 5L
 Ntziachristos, Vasilis, 0Z, 1B, 1C, 23, 2N, 3C, 55
 Nuster, Robert, 0W, 3I
 Ogura, Takashi, 5C
 Okawa, Shinpei, 2S, 34
 Omar, Murad, 0Z, 3C
 Omid, Parsa, 3H
 Oralkan, Ömer, 4A
 O'Rourke, Robert, 5G
 Ovsepian, Saak V., 1C
 Oyaga Landa, Francisco Javier, 0H
 Paltauf, Guenther, 0W
 Parameshwarappa, Vinay, 0G
 Park, Hyoeun, 3P
 Park, Kyungjin, 1N
 Park, Sungjo, 3P
 Pelisek, Jaroslav, 55
 Perekatova, V. V., 5K
 Periyasamy, Vijitha, 5N
 Petrov, Irene Y., 0A, 0P, 0Q
 Petrov, Yuriy, 0A, 0P, 0Q
 Pfefer, T. Joshua, 31
 Pini, Roberto, 57
 Pinto, Ruben N., 40
 Pock, Thomas, 3I
 Poisson, Florian, 1O
 Prakash, Jaya, 2N
 Pramanik, Manojit, 3W, 3X, 4P, 4S, 5N, 5O
 Prohaska, Steffen, 16, 5J
 Prough, Donald S., 0A, 0P, 0Q
 Psaltis, Demetri, 1O
 Pulkkinen, Aki, 3E, 3M, 3N
 Putro, Widodo D., 1Q
 Quiros-Gonzalez, Isabel, 0N
 Rahmim, Arman, 07
 Ratto, Fulvio, 57
 Razansky, Daniel, 0H, 1A, 1B, 1D, 1I, 2K, 2L, 4T
 Rebling, Johannes, 0Z, 4T
 Reiter, Austin, 3J
 Richardson, C. Joan, 0A, 0Q
 Robertson, Claudia S., 0A
 Rodríguez, Sergio, 41, 4F, 4G
 Rossi, Francesca, 57
 Saeed, N., 4W
 Saha, Ratan K., 4U
 Salcudean, Septimiu E., 3K
 Sánchez, Miguel, 41, 4F, 4G
 Sanders, Jean, 4A
 Saratoon, Teedah, 19
 Sathiyamoorthy, K., 4M
 Sato, Mitsuki, 5A
 Sato, Naoto, 4X
 Schmidt, Michael, 36
 Schmitt-Manderbach, Tobias, 0Z
 Schwarz, Mathias, 0Z
 Seeger, Markus, 55
 Seeton, Roger, 0P
 Sei, Kiguna, 2S
 Sela, Gali, 4T
 Seyama, Michiko, 45
 Shi, Junhui, 0M, 1E
 Shi, Wei, 47
 Shigeta, Yusuke, 4X
 Shiina, Tsuyoshi, 5A, 5B
 Shinchi, Masayuki, 2U
 Shinmoto, Hiroshi, 2U
 Shnaiderman, Rami, 23
 Silverman, Ronald H., 43
 Sivasubramanian, Kathyayini, 5N
 Sobol, Robert W., 1B
 Sohn, Rebecca E., 4N
 Soliman, Dominik, 23, 55
 Song, Hyun Beom, 0D
 Stasio, Nicolino, 1O
 Steenbergen, Wiendelt, 0G, 2M
 Strohm, Eric M., 4M, 53
 Sturek, Michael, 0T
 Subochev, P. V., 5K
 Sundari Krisnan, Mogana, 4S
 Tajima, Takuro, 45

Tanaka, Chizuyo, 4X
 Tanaka, Yujiro, 45
 Tang, Shuo, 3K
 Tang, Yuqi, 36
 Tao, Andrea R., 2D
 Tarvainen, Tanja, 3E, 3M, 3N
 Tavakoli, Emytis, 2Z
 Thorek, Daniel L. J., 07
 Tick, Jenni, 3M
 Tillak, J., 4W
 Tokuyama, Junji, 5B
 Tomaszewski, Michal R., 0N
 Tortoli, Paolo, 57
 Tsuda, Hitoshi, 2U
 Turchin, I. V., 5K
 Turner, Jake, 2L
 Upputuri, Paul Kumar, 4S, 5O
 Urano, Yasuteru, 34
 Ustun, Arif, 5R
 van den Berg, P. J., 2M
 Vetschera, Paul, 3C
 Viegas, J., 4W
 Vogt, William C., 31
 Volinski, Bridget, 3S, 3T
 Wada, Takatsugu, 2S, 2U
 Wang, Depeng, 2P, 2X, 3G
 Wang, Guohe, 1X
 Wang, Huaideng, 5G, 5H
 Wang, Junxin, 2D
 Wang, Liang, 4N
 Wang, Lidai, 0M, 1E
 Wang, Lihong V., 0B, 0M, 1E, 1P, 4N
 Wang, Pu, 0T
 Wang, Xueding, 09, 5G, 5H
 Wang, Yuehang, 2P, 2X, 3G
 Wear, Keith A., 31
 Wen, Kew Kok, 5N
 Wicker, Kai, 0Z
 Wildgruber, Moritz, 1D
 Wiśniowski, Bartosz, 41
 Wissmeyer, Georg, 1C, 23
 Wong, Dean F., 07
 Wu, Xun, 4A
 Wurzinger, Gerhild, 0W
 Xia, Jun, 2P, 2X, 3G
 Xu, Guan, 09, 5G, 5H
 Xu, Qiuyun, 3S, 3T
 Xu, Song, 5E
 Yamakawa, Makoto, 5A, 5B
 Yamamoto, Katsuya, 48
 Yamaoka, Yoshihisa, 5C
 Yan, Ping, 07
 Yang, Hao, 4E
 Yao, Junjie, 0M, 1E
 Yasui, Takeshi, 5C
 Yeh, Chenghung, 4N
 Yoo, J., 4W
 Yu, Guangli, 0T
 Yuan, Jie, 5G, 5H
 Zalevsky, Zeev, 36, 53
 Zemp, Roger, 3R, 47
 Zhang, Edward Z., 1F, 1V, 1W, 1Y
 Zhang, Haichong K., 07, 3O
 Zhang, Ruiying, 0M, 1E, 1P
 Zhang, Songhe, 3C
 Zhang, Yi, 0T
 Zhang, Yumiao, 2P, 2X
 Zhang, Yuzhen, 2X
 Zhou, Feifei, 32
 Zhou, Yang, 2X, 3G
 Zhou, Yong, 0B, 1P, 4N
 Zhu, Liren, 0M
 Zhu, Quing, 32, 4R
 Zhu, Xiaoyi, 1X
 Zhu, Yunhao, 5G, 5H
 Zou, Jun, 1E, 5E, 5R
 Zwack, Michael, 4T

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

Steven L. Jacques, Oregon Health & Science University
(United States)

Conference Chairs

Alexander A. Oraevsky, TomoWave Laboratories, Inc. (United States)

Lihong V. Wang, Washington University in St. Louis (United States)

Conference Program Committee

Mark A. Anastasio, Washington University in St. Louis (United States)

Paul C. Beard, University College London (United Kingdom)

A. Claude Boccara, Institut Langevin (France)

Peter Burgholzer, Research Center for Non Destructive Testing GmbH
(Austria)

Stanislav Y. Emelianov, The University of Texas at Austin (United States)

Rinat O. Esenaliev, The University of Texas Medical Branch
(United States)

Martin Frenz, Universität Bern (Switzerland)

Miya Ishihara, National Defense Medical College (Japan)

Chulhong Kim, Pohang University of Science and Technology
(Korea, Republic of)

Changhui Li, Peking University (China)

Pai-Chi Li, National Taiwan University (Taiwan)

Andreas Mandelis, University of Toronto (Canada)

Srirang Manohar, University Twente (Netherlands)

Vasilis Ntziachristos, Helmholtz Zentrum München GmbH (Germany)

Matthew O'Donnell, University of Washington (United States)

Günther Paltauf, Karl-Franzens- Universität Graz (Austria)

Wiendelt Steenbergen, University Twente (Netherlands)

William M. Whelan, University of Prince Edward Island (Canada)

Roger J. Zemp, University of Alberta (Canada)

Vladimir P. Zharov, University of Arkansas for Medical Sciences
(United States)
Qifa Zhou, The University of Southern California (United States)
Qing Zhu, Washington University in St. Louis (United States)

Session Chairs

- 1 Brain Imaging
Edmund M. Talley, National Institute of Health (United States)
- 2 Clinical Applications
Alexander A. Oraevsky, TomoWave Laboratories, Inc. (United States)
- 3 Therapy Monitoring and Guidance
Miya Ishihara, National Defense Medical College (Japan)
William M. Whelan, University of Prince Edward Island (Canada)
- 4 Functional Imaging
A. Claude Boccara, Institut Langevin (France)
Rinat O. Esenaliev, The University of Texas Medical Branch
(United States)
- 5 Multimodality Imaging and Contrast Agents
Qing Zhu, Washington University in St. Louis (United States)
Stanislav Emelianov, Georgia Institute of Technology (United States)
- 6 Endoscopy and Intravascular Imaging
Wiendelt Steenbergen, University Twente (Netherlands)
Qifa Zhou, The University of Southern California (United States)
- 7 Quantitative Imaging
Roger J. Zemp, University of Alberta (Canada)
- 8 Preclinical Imaging
Vasilis Ntziachristos, Helmholtz Zentrum München GmbH (Germany)
Vladimir P. Zharov, University of Arkansas for Medical Sciences
(United States)
- 10 Novel Methods and Systems
Rinat O. Esenaliev, The University of Texas Medical Branch
(United States)
Changhui Li, Peking University (China)
- 11 All-optical and Laser Ultrasound Systems
Alexander A. Oraevsky, TomoWave Laboratories, Inc. (United States)
Paul C. Beard, University College London (United Kingdom)

- 12 Microscopy
Chulhong Kim, Pohang University of Science and Technology
(Korea, Republic of)
Lihong V. Wang, Washington University in St. Louis (United States)
- 13 Molecular Imaging
Stanislav Y. Emelianov, The University of Texas at Austin (United States)
Matthew O'Donnell, University of Washington (United States)
- 14 Signal Processing, Image Reconstruction
Mark A. Anastasio, Washington University in St. Louis (United States)
Peter Burgholzer, Research Center for Non Destructive Testing GmbH
(Austria)
- 15 Hot Latest Results
Lihong V. Wang, Washington University in St. Louis (United States)
Alexander A. Oraevsky, TomoWave Laboratories, Inc. (United States)

Introduction

This volume of SPIE Proceedings summarizes research and development conducted by our community in the past year. The field of biomedical optoacoustic (photoacoustic) imaging continues to experience healthy growth. The conference remains the largest at Photonics West.

The conference started at 8:00 am Sunday, 29 January 2017 with a special session on brain imaging, chaired by Dr. Edmund M. Talley, National Institute of Health (United States). Despite the early hour, there was standing room only. The session started with three invited talks:

- Photoacoustic tomography: deep imaging beyond the optical diffusion limit. Lihong V. Wang, Washington Univ. in St. Louis (United States)
- Towards genetically encoded Indicators for photoacoustic detection of neuronal activity. Robert E. Campbell, Univ. of Alberta (Canada)
- Engineering of bacterial phytochromes for in vivo imaging. Vladislav Verkhusha, Daria M. Shcherbakova, Andrii A. Kaberniuk, Mikhail Baloban, Albert Einstein College of Medicine (United States)

Beginning last year, the Best Paper of the conference have been selected through a two-tiered process. In the first tier, the conference organizing committee composed of leading researchers from our community selected the following finalists:

Paper 10064-7: Photoacoustic analysis of thyroid cancer in vivo: a pilot study. Jeesu Kim, Pohang Univ. of Science and Technology (Korea, Republic of); MinHee Kim, Kwanhoon Jo, Jeonghoon Ha, The Catholic Univ. of Korea (Korea, Republic of); Yongmin Kim, Pohang Univ. of Science and Technology (Korea, Republic of); DongJun Lim, The Catholic Univ. of Korea (Korea, Republic of); Chulhong Kim, Pohang Univ. of Science and Technology (Korea, Republic of)

Paper 10064-21: Photoacoustic computed tomography of small-animal wholebody dynamics. Lei Li, Liren Zhu, Cheng Ma, Junjie Yao, Washington Univ. in St. Louis (United States); Jun Xia, Univ. at Buffalo (United States); Lidai Wang, City Univ. of Hong Kong (China); Konstantin I. Maslov, Ruiying Zhang, Yang Li, Wanyi Chen, Junhui Shi, Lihong V. Wang, Washington Univ. in St. Louis (United States)

Paper 10064-100: Possibility of transrectal photoacoustic imaging-guided biopsy for detection of prostate cancer. Miya Ishihara, Masayuki Shinchi, Akio Horiguchi, Hiroshi Shinmoto, Hitoshi Tsuda, National Defense Medical College (Japan); Kaku Irisawa, Takatsugu Wada, Medical Systems Research & Development Ctr., FUJIFILM Corp. (Japan); Tomohiko Asano, National Defense Medical College (Japan)

In the second tier, a committee of independent experts formed by Seno Medical Instruments, the sponsor of the award, will select the Best Paper from the

list of finalists by reviewing the corresponding SPIE Proceedings. The \$3,000 award will be announced by SPIE in next year's conference.

We would like to congratulate the finalists and thank all the contributors of this conference and the Organizing Committee for their hard work.

Alexander A. Oraevsky
Lihong V. Wang