Medical Imaging 2016

Ultrasonic Imaging and Tomography

Neb Duric Brecht Heyde Editors

28–29 February 2016 San Diego, California, United States

Sponsored by SPIF

Cosponsored by

Modus Medical Devices Inc. (Canada) • Bruker (United States) • Poco Graphite (United States) • imXPAD (France)

Cooperating Organizations

AAPM—American Association of Physicists in Medicine (United States) • APS—American Physiological Society (United States) • IFCARS—International Foundation for Computer Assisted Radiology and Surgery (Germany) • Medical Image Perception Society (United States) • Radiological Society of North America (United States) • Society for Imaging Informatics in Medicine (United States) • World Molecular Imaging Society • The DICOM Standards Committee

Published by SPIE

Volume 9790

Proceedings of SPIE, 1605-7422, V. 9790

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

Medical Imaging 2016: Ultrasonic Imaging and Tomography, edited by Neb Duric, Brecht Heyde, Proc. of SPIE Vol. 9790, 979001 ⋅ © 2016 SPIE ⋅ CCC code: 1605-7422/16/\$18 ⋅ doi: 10.1117/12.2240428

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 these proceedings:

Author(s), "Title of Paper," in Medical Imaging 2016: Ultrasonic Imaging and Tomography, edited by Neb Duric, Brecht Heyde, Proceedings of SPIE Vol. 9790 (SPIE, Bellingham, WA, 2016) Six-digit Article CID Number.

ISSN: 1605-7422

ISSN: 2410-9045 (electronic) ISBN: 9781510600256

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.



SPIEDigitalLibrary.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 six-digit CID article numbering system structured as follows:

- 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.

Contents

vii	Authors
xi	Conference Committee
xiii	2016 Medical Imaging Award Recipients
SESSION 1	MOTION AND DEFORMATION IMAGING
9790 02	Portugion incresion with non-contrast alternatural (0700-1)
	Perfusion imaging with non-contrast ultrasound [9790-1]
9790 03	Blood flow velocity in the popliteal vein using transverse oscillation ultrasound [9790-2]
9790 04	High frame rate synthetic aperture vector flow imaging for transthoracic echocardiography [9790-3]
9790 05	3D vector flow using a row-column addressed CMUT array [9790-4]
9790 06	Fast myocardial strain estimation from 3D ultrasound through elastic image registration with analytic regularization [9790-5]
SESSION 2	ULTRASOUND TOMOGRAPHY AND RECONSTRUCTION
9790 07	Breast tumour visualization using 3D quantitative ultrasound methods [9790-6]
9790 08	Spatial smoothing coherence factor for ultrasound computed tomography [9790-7]
9790 09	Analysis of patient movement during 3D USCT data acquisition [9790-8]
9790 0A	3D ultrasound computer tomography: update from a clinical study [9790-9]
9790 OB	Ultrasound breast imaging using frequency domain reverse time migration [9790-10]
9790 OC	Frequency-domain ultrasound waveform tomography breast attenuation imaging [9790-11]
SESSION 3	ULTRASOUND IMAGE ANALYSIS AND TISSUE CHARACTERIZATION
9790 OD	Automatic left-atrial segmentation from cardiac 3D ultrasound: a dual-chamber model-based approach [9790-12]
9790 OE	Automatic short axis orientation of the left ventricle in 3D ultrasound recordings [9790-13]
9790 OF	Robust spatio-temporal registration of 4D cardiac ultrasound sequences [9790-14]

9790 OG	A new approach to ultrasonic elasticity imaging [9790-15]
9790 OH	Experimental characterization, comparison and image quality assessment of two ultrasound contrast agents: Optison and Definity [9790-16]
SESSION 4	ULTRASOUND IMAGE GUIDANCE: JOINT SESSION WITH CONFERENCES 9786 AND 9790
9790 01	Development of 3D ultrasound needle guidance for high-dose-rate interstitial brachytherapy of gynaecological cancers [9790-17]
9790 OJ	Preliminary investigation of an ultrasound method for estimating pressure changes in deep-positioned vessels [9790-18]
9790 OK	Novel automatic detection of pleura and B-lines (comet-tail artifacts) on in-vivo lung ultrasound scans [9790-19]
SESSION 5	NOVEL IMAGING STRATEGIES AND SIGNAL PROCESSING
9790 OL	Sub-mSV breast XACT scanner: concept and design [9790-20]
9790 OM	An evolutionary Bayesian search scheme for ultrasound modulated optical tomography [9790-21]
9790 ON	Monte Carlo investigation of the dosimetric effect of the Autoscan ultrasound probe for guidance in radiotherapy [9790-22]
9790 00	Ultrasound perfusion signal processing for tumor detection [9790-23]
9790 OP	Frequency-shift low-pass filtering and least mean square adaptive filtering for ultrasound imaging [9790-24]
SESSION 6	KEYNOTE AND NEW APPLICATIONS OF ULTRASOUND IN MEDICINE AND BIOLOGY
9790 OQ	Enhanced ultrasound for advanced diagnostics, ultrasound tomography for volume limb imaging and prosthetic fitting (Keynote Paper) [9790-25]
9790 OR	3D optical imagery for motion compensation in a limb ultrasound system [9790-26]
9790 OS	Quantitative head ultrasound measurements to determine thresholds for preterm neonates requiring interventional therapies following intraventricular hemorrhage [9790-27]
9790 OT	Development and evaluation of a novel VEGFR2-targeted nanoscale ultrasound contrast agents [9790-28]
SESSION 7	TRANSDUCERS AND BEAMFORMING
9790 OU	A pseudo non-linear method for fast simulations of ultrasonic reverberation [9790-29]

9790 OV	A beamforming method for plane wave Doppler imaging of high flow velocities [9790-30]
9790 OW	Detection of and compensation for blocked elements using large coherent apertures: ex vivo studies [9790-31]
9790 OX	Real-time 3D image reconstruction of a 24×24 row-column addressing array: from raw data to image [9790-32]
9790 OY	Volumetric synthetic aperture imaging with a piezoelectric 2D row-column probe [9790-33]
9790 OZ	Optimization of synthetic aperture image quality [9790-34]
9790 10	Analog gradient beamformer for a wireless ultrasound scanner [9790-35]
	POSTER SESSION
9790 11	Automated 3D ultrasound image segmentation for assistant diagnosis of breast cancer [9790-36]
9790 12	Development of estimation system of knee extension strength using image features in ultrasound images of rectus femoris [9790-37]
9790 13	Precise reconstruction of fast moving cardiac valve in high frame rate synthetic transmit aperture ultrasound imaging [9790-38]
9790 14	Effect of echo artifacts on characterization of pulsatile tissues in neonatal cranial ultrasonic movies [9790-39]
9790 15	Determining cardiac fiber orientation using FSL and registered ultrasound/DTI volumes [9790-40]
9790 16	Ultrasound transmission attenuation tomography using energy-scaled amplitude ratios [9790-41]
9790 17	Image reconstruction for robot assisted ultrasound tomography [9790-42]
9790 18	Phase aberration correction by multi-stencils fast marching method using sound speed image in ultrasound computed tomography [9790-43]
9790 19	Using ultrasound tomography to identify the distributions of density throughout the breast [9790-44]
9790 1A	Automated kidney morphology measurements from ultrasound images using texture and edge analysis [9790-45]
9790 1B	Automated kidney detection for 3D ultrasound using scan line searching [9790-46]
9790 1C	US-Cut: interactive algorithm for rapid detection and segmentation of liver tumors in ultrasound acquisitions [9790-47]
9790 1D	Delimitation of the lung region with distributed ultrasound transducers [9790-48]

9790 1E	Rotation elastogram: a novel method to visualize local rigid body rotation under quasi-static compression [9790-49]
9790 1F	Dynamic programming on a tree for ultrasound elastography [9790-50]
9790 1G	Image-based temporal alignment of echocardiographic sequences [9790-51]
9790 1H	Comparison of ultrasound B-mode, strain imaging, acoustic radiation force impulse displacement and shear wave velocity imaging using real time clinical breast images [9790-53]
9790 11	Differential diagnosis of thyroid nodules with virtual touch tissue imaging of ARFI elastography [9790-54]
9790 10	Frequency-space prediction filtering for acoustic clutter and random noise attenuation in ultrasound imaging [9790-60]
9790 1P	Towards predictive diagnosis and management of rotator cuff disease: using curvelet transform for edge detection and segmentation of tissue [9790-61]
9790 1Q	Classification of motor intent in transradial amputees using sonomyography and spatio-temporal image analysis [9790-62]
9790 1R	Single element ultrasonic imaging of limb geometry: an in-vivo study with comparison to MRI [9790-63]
9790 1T	Observations of liver cancer cells in scanning probe acoustic microscope: a preliminary study [9790-65]
9790 1U	A preliminary evaluation work on a 3D ultrasound imaging system for 2D array transducer [9790-66]
9790 1V	A new post-phase rotation based dynamic receive beamforming architecture for smartphone-based wireless ultrasound imaging [9790-67]
9790 1W	High-resolution synthetic aperture ultrasound imaging with minimum variance beamforming and spiking deconvolution [9790-68]
9790 1X	In vivo visualization of robotically implemented synthetic tracked aperture ultrasound (STRATUS) imaging system using curvilinear array [9790-69]
9790 1Y	Large-pitch steerable synthetic transmit aperture imaging (LPSSTA) [9790-70]
9790 1Z	Higher-frame-rate ultrasound imaging with reduced cross-talk by combining a synthetic aperture and spatial coded excitation [9790-71]

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.

Aalamifar, Fereshteh, 17, 1X Abbey, Craig K., 00 Aklaghi, Nima, 1Q Alessandrini, Martino, 06 Almeida, Nuno, 0D Annanai, Pavan, 1A Anthony, Brian W., OQ, OR, 1R

Azuma, Takashi, 18 Bækgaard, Niels, 03 Bagge, Jan Peter, 05, 10 Baker, Clayton A., 1Q Bamber, Jeffrey, 0N Bechsaard, Thor, 03, 04 Beers, Christopher, 05, 0Y Bersvendsen, Jørn, OF, 1G Boctor, Emad M., 17, 1X Boily, Mathieu, 1F Boone, Michael, OC Bottenus, Nick, OW Bouzari, Hamed, 0Y

Byram, Brett C., 02, 0U C., Sowmiya, 1E

Brandt, Andreas Hjelm, 03

Cardona Cárdenas, Diego Armando, 1D

Carson, Paul L., 11 Chakraborty, Bidisha, 06 Chee, Adrian J. Y., 0J Chen, Jian, 0L Chen, Ting, 16 Chen, Xiaohui, 1T

Christiansen, Thomas Lehrmann, 05, 0Y

Claus, Piet, 0E

Chen, Xiaojun, 1C

Czarnota, Gregory J., 07 Dahl, Jeremy, 0W Danudibroto, Adriyana, OF, 1G

Day, Steven W., 0H de Ribaupierre, Sandrine, OS D'hooge, Jan, 06, 0D, 0E, 1G Di Ianni, Tommaso, 10

Ding, Mingyue, 08, 0P, 0T, 0X, 11, 1T, 1U

Dokter, Mark, 1C Dormer, James, 15 D'Souza, D., 01 Du, Sidan, 11

Dumont, Douglas M., 02 Duric, Neb, 0B, 0C, 19 Edvardsen, Thor, 0E Egger, Jan, 1C

Engholm, Mathias, 05, 0Y

Engvall, Jan, 0E

Estépar, Raúl San José, OF Ewertsen, Caroline, 0K Fana, Xiaovue, 1T Fatemi, Mostafa, 0G Fei, Baowei, 15 Feigin, Micha, OR Fenster, Aaron, 01, 0\$ Fincke, Jonathan R., 1R Foley, Mark J., 0N Fujita, Hiroshi, 12 Fukuoka, Daisuke, 12 Fukuzawa, Masayuki, 14 Furuie, Sérgio Shiguemi, 1D Gangeh, Mehrdad J., 07 Gemmeke, H., 09, 0A Gérard, Olivier, 0D, 1G Ghaboussi, Jamshid, 0G

Gierach, Gretchen L., 19 Gilroy, Stephen, ON Gu, Peng, 11 Guo, Hua, 1T Hadizad, Farnoosh, 07 Hajdok, G., 01

Hann, Alexander, 1C Hansen, Kristoffer Lindskov, 03, 0K

Hara, Takeshi, 12

Hariharan, Harishwaran, 1Q

Harris, Emma, 0N He, Xiaoling, 0T Heeren, Laurens, 0E

Hemmsen, Martin Christian, OK, OZ, 10

Henrich, J., 0A Herr, Hugh M., 0R Heyde, Brecht, 06, 0E Ho, Chung Kit, 0J Hoeria, Cameron, 0G Hofmann, Michael, 1C Holbek, Simon, 03, 05 Hopp, T., 09, 0A

Huang, Lianjie, 16, 10, 1W Hughes, Amy C., 0H Ikeda, Teiichiro, 13, 1Z Imoto, Haruka, 18 Insana, Michael F., 0G, 0O Ishihara, Chizue, 13, 1Z Jakovljevic, Marko, 0W Jensen, Henrik, 10

Jensen, Jonas, 0Z Jensen, Jørgen Arendt, 03, 04, 05, 0J, 0K, 0Y, 0Z, Jiang, Rong, 15 Kaiser, C., 0A Kang, Jeeun, 1V Kim, Min, 1V Kim, MinWoo, 00 Kishimoto, Jessica, OS Kitsunezuka, Yoshiki, 14 Knaudt, J., 0A Kolios, Michael C., 1Y Kosecka, Jana, 1Q Kothawala, Ali Arshad, 1E Kretzek, E., 09, 0A Kumar, Shalki, OW Kuo, Lilv, OW Kwartowitz, David M., 1P Lacefield, James C., 0V Lanning, Justin, 1A Lee, David S. C., 0S Lee, Gunho, 1V Lee, Won-Mean, 11 Lei, Anders, 05, 0Y Leung, E., 01 Li, Chunfang, 0T Li, Chunyu, 0P, 0X, 1U Li, Cuiping, 0C Li, Tao, 11 Li, Xu, 0X, 1U Li, Ying, 1Y Li, Yiyong, 11 Lin, Hongxiang, 18

Lou, Cuijuan, 08 Machireddy, Ramasubba Reddy, 1H

Manickam, Kavitha, 1H Mansour, Omar, 0V Martineau, Paul A., 1F Martyn, Michael, 0N Masuzawa, Hiroshi, 13, 1Z Matsumoro, Voichiro, 18

Linte, Cristian A., 0H

Littrup, Peter, 19

Liu, Hong, OL

Liu, Simon, 07 Lönn, Lars, 03

Mi, Yongwei, 11 Mirea, Oana, 1G Mireault, Al, 0R

Moesner, Lars Nordahl, 05 Møller Sørensen, Hasse, 0K Montgomery, Katelyn, 0C Moshavegh, Ramin, 0K, 0Z Murakami, Hiroki, 12 Muramatsu, Chisako, 12 Nadolny, Anne, 1B

Nielsen, Michael Bachmann, 03, 04, 0K

Nikolov, Svetoslav Ivanov, OY

Noll, Matthias, 1B O'Shea, Tuathan, 0N Olesen, Jacob Bjerring, 0J Orderud, Fredrik, 0D Pai Raikar, Vipul, 1P

Papachristidis, Alexandros, 0E

Park, Minsuk, 1V Pedrosa, João, 0E Poepping, Tamie L., 0V Pratt, R. G., 0B Qin, Xulei, 15

Qu, Xiaolei, 18 Raghavan, Bagyam, 1H Raheem, Abdul, 07 Rahmim, Arman, 17 Ranger, Bryan J., 0R Rangwala, Huzefa, 1Q Raskar, Ramesh, 0R Rayishankar, Hariharan, 1A

Ren, Liqiang, OL Rivaz, Hassan, 1F Rodgers, J., Ol Romano, Walter, OS Roubidoux, Marilyn A., 11 Roy, Debasish, OM Roy, Olivier, OB, OC Ruiter, N. V., O9, OA Sak, Mark, 19 Sakuma, Ichiro, 18 Salehi, Fateme, OS Samant, Pratik, OL Samset, Eigil, OD, OF, 1G

Sandhu, Gursharan Yash Singh, OC

Sarvari, Sebastian I., 0D Schmalstieg, Dieter, 1C Schwarz, Karl Q., 0H Shams, Roozbeh, 1F Shen, Ming, 15 Sherman, Mark E., 19 Shin, Junseob, 16, 10, 1W Shu, Jasmine, 0U Sikdar, Siddhartha, 1Q Song, Junjie, 0X, 1U Song, Tai-Kyong, 1V

Strandberg, Charlotte, 03 Stuart, Matthias Bo, 04, 05, 0Y, 0Z Suzuki, Mayumi, 13

Tabata, Yuki, 14
Tadayyon, Hadi, 07
Takagi, Shu, 18
Takahashi, Kazuki, 14
Takano, Shinta, 13
Tamano, Satoshi, 18
Tang, Shanshan, 0L
Terabayashi, Nobuo, 12

Tessier, D., OI Thittai, Arun K., 1E Thomsen, Erik Vilain, 05, 0Y Tierney, Jaime E., 02 Toews, Matthew, 0F Traberg, Marie Sand, 0J Trahey, Gregg, 0W Tukalo, A., 0A

Umemura, Shin-Ichiro, 18

Urheim, Stig, OF

Vardi, Nitsan, 10

Vasu, Ram Mohan, 0M

Venugopal, Mamatha, 0M

Villagómez-Hoyos, Carlos Armando, 04, 0J, 0Z

Voglreiter, Philip, 1C

Wagner, Mary B., 15

Wang, Shanshan, OP

Wang, Silun, 15

Wang, Xueding, 11

Wang, Yuxin, 11

Washburn, Michael, 1A

Watanabe, Tsuneo, 12

Wells, William M., III, OF

Wesarg, Stefan, 1B

West, Erik, 0C

Xi, Qing, 1T

Xiang, Liangzhong, OL

Xu, Mengling, 08

Xu, Yuan, 1Y

Yang, Jiali, 0X, 1U

Yiu, Billy Y. S., OJ

Yu, Alfred C. H., 0J

Yu, Houqiang, 0T

Yuan, Jie, 11

Yuchi, Ming, 08, 0P, 0X, 1U

Zamorano, Jose, 0E

Zapf, M., 09, 0A

Zhang, Haichong K., 17, 1X

Zhang, Ji, 11

Zhang, Ning, 1T

Zhang, Xiang, OR, 1R

Zhang, Xiaodong, 15

Zhong, Xiaoli, 0X, 1U

Zhou, Pei, 11

Zhou, Qibing, 0T

Zoller, Wolfram G., 1C

Zuberi, M. A. H., 0B

ix

Proc. of SPIE Vol. 9790 979001-10

Conference Committee

Symposium Chairs

Steven C. Horii, The University of Pennsylvania Health System (United States)

Berkman Sahiner, U.S. Food and Drug Administration (United States)

Conference Chairs

Neb Duric, Delphinus Medical Technologies, Inc. (United States) and Karmanos Cancer Institute (United States)

Brecht Heyde, KU Leuven (Belgium) and Duke University (United States)

Conference Program Committee

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

Jeffrey C. Bamber, The Royal Marsden NHS Foundation Trust (United Kingdom)

Johan G. Bosch, Erasmus Universiteit Rotterdam (Netherlands)

Jan D'hooge, KU Leuven (Belgium)

Marvin M. Doyley, University of Rochester (United States)

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

Mostafa Fatemi, Mayo Clinic College of Medicine (United States)

Aaron Fenster, Western University (Canada)

Jérémie Fromageau, The Institute of Cancer Research (United Kinadom)

James F. Greenleaf, Mayo Clinic (United States)

Emma J. Harris, The Institute of Cancer Research (United Kingdom)

Martin Christian Hemmsen, Technical University of Denmark (Denmark)

Michael Jaeger, Universität Bern (Switzerland)

Jørgen Arendt Jensen, Technical University of Denmark (Denmark)

David H. Kim, Analogic Corporation (United States)

Roman G. Maev, University of Windsor (Canada)

Stephen A. McAleavey, University of Rochester (United States)

Mohammad Mehrmohammadi, Wayne State University (United States)

Serge Mensah, Aix-Marseille Université (France)

Svetoslav I. Nikolov, BK Ultrasound (Denmark)

Olivier Roy, Karmanos Cancer Institute (United States)

Nicole V. Ruiter, Karlsruher Institut für Technologie (Germany)

Kai E. Thomenius, Massachusetts Institute of Technology (United States)

William F. Walker, University of Virginia (United States)

Session Chairs

- Motion and Deformation ImagingBrett C. Byram, Vanderbilt University (United States)
- 2 Ultrasound Tomography and Reconstruction Olivier Roy, Delphinus Medical Technologies, Inc. (United States) and Karmanos Cancer Institute (United States) Torsten Hopp, Karlsruher Institut für Technologie (Germany)
- 3 Ultrasound Image Analysis and Tissue Characterization Brecht Heyde, KU Leuven (Belgium) and Duke University (United States)
- 4 Ultrasound Image Guidance: Joint Session with Conferences 9786 and 9790

Parvin Mousavi, Queen's University (Canada)
Brecht Heyde, KU Leuven (Belgium) and Duke University
(United States)

- 5 Novel Imaging Strategies and Signal Processing Mohammad Mehrmohammadi, Wayne State University (United States)
- 6 Keynote and New Applications of Ultrasound in Medicine and Biology

Brian W. Anthony, Massachusetts Institute of Technology (United States)

Neb Duric, Delphinus Medical Technologies, Inc. (United States) and Karmanos Cancer Institute (United States)

7 Transducers and Beamforming Jørgen Arendt Jensen, Technical University of Denmark (Denmark) Marko Jakovljevic, Duke University School of Medicine (United States) and Stanford University (United States)

χij

2016 Medical Imaging Award Recipients

Robert F. Wagner Best Student Paper Award

Robert F. Wagner was an active scientist in the SPIE Medical Imaging meeting, starting with the first meeting in 1972 and continuing throughout his career. He ensured that the BRH, and subsequently the CDRH, was a sponsor for the early and subsequent Medical Imaging meetings, helping to launch and ensure the historical success of the meeting. The Robert F. Wagner All-Conference Best Student Paper Award (established 2014) is acknowledgment of his many important contributions to the Medical Imaging meeting and his many important advances to the field of medical imaging.



This award is cosponsored by:



The Medical Image Perception Society



2016 Recipients:

First Place: MIND Demons for MR-to-CT deformable image registration in image-guided spine surgery (9786-16)

S. Reaungamornrat, T. De Silva, A. Uneri, Johns Hopkins Univ. (United States), J.-P. Wolinsky, Johns Hopkins Hospital (United States), A. J. Khanna, Johns Hopkins Health Care & Surgery Ctr. (United States), G. Kleinszig, S. Vogt, Siemens Healthcare (Germany), J. L. Prince, J. H. Siewerdsen, Johns Hopkins Univ. (United States)

Second Place: Design, fabrication, and implementation of voxel-based 3D printed textured phantoms for task-based image quality assessment in CT (9783-76)

Justin Solomon, Duke Univ. School of Medicine (United States), Alexandre Ba, Institut Univ. de Radiophysique Appliquée (Switzerland), Andrew Diao, Duke Univ. (United States), Joseph Lo, Elianna Bier, Duke Univ. School of Medicine (United States), François Bochud, Institut Univ. de Radiophysique Appliquée (Switzerland), Michael Gehm, Duke Univ. (United States), Ehsan Samei, Duke Univ. School of Medicine (United States)

Conference 9790 Awards

Cum Laude Poster Award

First Place: **Endocavity ultrasound, fiber-guided photoacoustic**, **and quasi-static elasticity imaging** (9790-59)

Yan Yan, Sirisha Kondle, Vishal N. Srivastava, Bhargava Saripalli, Jinjun Xia, Edgar A. Hernandez, Mohammad Mehrmohammadi, Wayne State Univ. (United States)

Proc. of SPIE Vol. 9790 979001-14