

Medical Imaging 2017

**Imaging Informatics for
Healthcare, Research, and
Applications**

**Tessa S. Cook
Jianguo Zhang**
Editors

**15–16 February 2017
Orlando, Florida, United States**

Sponsored by
SPIE

Co-sponsored by
Alpinion Medical Systems (United States)

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 10138

Proceedings of SPIE 1605-7422, V. 10138

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

Medical Imaging 2017: Imaging Informatics for Healthcare, Research, and Applications
edited by Tessa S. Cook, Jianguo Zhang, Proc. of SPIE Vol. 10138, 1013801
© 2017 SPIE · CCC code: 1605-7422/17/\$18 · doi: 10.1117/12.2277962

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 *Medical Imaging 2017: Imaging Informatics for Healthcare, Research, and Applications*, edited by Tessa S. Cook, Jianguo Zhang, Proceedings of SPIE Vol. 10138 (SPIE, Bellingham, WA, 2017) Seven-digit Article CID Number.

ISSN: 1605-7422

ISSN: 2410-9045 (electronic)

ISBN: 9781510607217

ISBN: 9781510607224 (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

- vii *Authors*
- ix *Conference Committee*
- xi *2017 Medical Imaging Award Recipients*

SESSION 1 CLINICAL APPLICATIONS FOR IMAGE PROCESSING

- 10138 03 **Active contours extension and similarity indicators for improved 3D segmentation of thyroid ultrasound images** [10138-1]
- 10138 04 **Frequency-based similarity detection of structures in human brain** [10138-2]
- 10138 05 **Implementation of a computer-aided detection tool for quantification of intracranial radiologic markers on brain CT images** [10138-3]
- 10138 06 **Optic disc segmentation: level set methods and blood vessels inpainting** [10138-4]
- 10138 07 **Automatic multi-label annotation of abdominal CT images using CBIR** [10138-5]

SESSION 2 BIG DATA AND MACHINE LEARNING

- 10138 08 **Discriminating between benign and malignant breast tumors using 3D convolutional neural network in dynamic contrast enhanced-MR images** [10138-6]
- 10138 09 **Making sense of large data sets without annotations: analyzing age-related correlations from lung CT scans** [10138-7]
- 10138 0A **Local-global classifier fusion for screening chest radiographs** [10138-8]
- 10138 0B **Theoretical and empirical comparison of big data image processing with Apache Hadoop and Sun Grid Engine** [10138-9]
- 10138 0C **DAX - the next generation: towards one million processes on commodity hardware** [10138-10]
- 10138 0D **Digital pathology annotation data for improved deep neural network classification** [10138-11]

SESSION 3 PRECISION MEDICINE

- 10138 0E **Prediction of response to neoadjuvant chemotherapy in breast cancer: a radiomic study** [10138-12]

- 10138 OF **Phenotype analysis of early risk factors from electronic medical records improves image-derived diagnostic classifiers for optic nerve pathology** [10138-13]
- 10138 OG **The development and implementation of MOSAIQ Integration Platform (MIP) based on the radiotherapy workflow** [10138-14]
- 10138 OH **A low noise stenography method for medical images with QR encoding of patient information** [10138-15]
- 10138 OI **Exploring a new quantitative image marker to assess benefit of chemotherapy to ovarian cancer patients** [10138-16]

SESSION 4 ADVANCES IN THE INFORMATICS OF THERAPEUTICS

- 10138 OJ **Evaluation of a web based informatics system with data mining tools for predicting outcomes with quantitative imaging features in stroke rehabilitation clinical trials** [10138-17]
- 10138 OL **Prediction of near-term breast cancer risk using local region-based bilateral asymmetry features in mammography** [10138-19]
- 10138 OM **The development of a decision support system with an interactive clinical user interface for estimating treatment parameters in radiation therapy in order to reduce radiation dose in head and neck patients** [10138-20]

SESSION 6 NOVEL APPLICATIONS IN 3D PRINTING

- 10138 OO **Feasibility of fabricating personalized 3D-printed bone grafts guided by high-resolution imaging** [10138-22]
- 10138 OP **3D printed abdominal aortic aneurysm phantom for image guided surgical planning with a patient specific fenestrated endovascular graft system** [10138-23]
- 10138 OQ **Soft tissue models: easy and inexpensive flexible 3D printing as a help in surgical planning of cardiovascular disorders** [10138-24]
- 10138 OR **Design optimization for accurate flow simulations in 3D printed vascular phantoms derived from computed tomography angiography** [10138-25]
- 10138 OS **Initial simulated FFR investigation using flow measurements in patient-specific 3D printed coronary phantoms** [10138-26]
- 10138 OT **3D printing for orthopedic applications: from high resolution cone beam CT images to life size physical models** [10138-27]

SESSION 7 CLOUD-BASED INNOVATIONS

- 10138 OU **Virtual setting for training in interpreting mammography images** [10138-28]

- 10138 0V **Crowdsourcing for identification of polyp-free segments in virtual colonoscopy videos** [10138-29]
- 10138 0W **MIIP: a web-based platform for medical image interpretation training and evaluation focusing on ultrasound** [10138-30]
- 10138 0X **A cloud collaborative medical image platform oriented by social network** [10138-31]

SESSION 8 INNOVATIONS IN WORKFLOW

- 10138 0Z **MR efficiency using automated MRI-desktop eProtocol** [10138-33]
- 10138 10 **System design for 3D wound imaging using low-cost mobile devices** [10138-34]
- 10138 11 **Assessing the initial adaptability and impact of a mobile dictation and reporting system in the radiology department of an academic hospital** [10138-35]

POSTER SESSION

- 10138 12 **Using deep learning for content-based medical image retrieval** [10138-36]
- 10138 13 **Collaborative SDOCT segmentation and analysis software** [10138-37]
- 10138 14 **DICOM image quantification secondary capture (DICOM IQSC) integrated with numeric results, regions, and curves: implementation and applications in nuclear medicine** [10138-38]
- 10138 15 **High precision localization of intracerebral hemorrhage based on 3D MPR on head CT images** [10138-39]
- 10138 16 **Computerized detection of breast cancer using resonance-frequency-based electrical impedance spectroscopy** [10138-40]
- 10138 17 **Integration of the HTC Vive into the medical platform MeVisLab** [10138-41]
- 10138 18 **Differentiating malignant from benign breast tumors on acoustic radiation force impulse imaging using fuzzy-based neural networks with principle component analysis (Cum Laude Poster Award)** [10138-42]
- 10138 19 **The design and integration of retinal CAD-SR to diabetes patient ePR system** [10138-43]

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.

Abreu, F. D. L., 0U
Aghaei, Faranak, 05, 0I
Almazroa, A., 06
Alodhayb, Sami, 06
Angel, Erin, 0R, 0S
Annapragada, Ananth, 0Q
Antani, Sameer, 07, 0A
Antony, Bhavna J., 13
Araújo, Luciano V., 0X
Arens, C., 03
Baker, Kevin, 0V
Bao, Shunxing, 0B
Bao, Yong, 0G
Barish, Matthew, 0V
Beers, Andrew, 09
Ben-Zikri, Yehuda K., 0T
Bissaco, M. A. Se, 0U
Boyd, Brian D., 0C
Candemir, Sema, 0A
Cao, Xinhua, 14
Carass, Aaron, 13
Chaganti, Shikha, 0F
Chen, Xiaojun, 17
Chou, Yi-Hong, 18
Contreras-Ortiz, Sonia H., 0H
Cornwell, Benjamin O., 05
Curl, Richard E., 0P
Damon, Stephen M., 0C
Dangi, Shusil, 0T
Dave, Jaydev K., 11
de Almeida Germano Boechat, Pedro, 17
DeMarco, John, 0M
Deng, Xiao-wu, 0G
Deserno, Thomas M., 10
Deshpande, Ruchi, 0M
Dicente Cid, Yashin, 09
Ding, Meng, 0A
Dodd, Nicholas, 0Q
Dong, Jiancheng, 19
Dryjski, Maciej L., 0P
Egger, Jan, 17
Ezon, David S., 0Q
Fan, Ming, 08, 0E, 0L, 16
Forsyth, Sydney, 0J
Friebe, M., 03
Gali, Raja L., 11
Gall, Markus, 17
Gao, Fei, 0Z
Gao, Wei, 16
Gao, Yuan-hong, 0G
Gehlot, Vijay, 0D
Gokhale, Aniruddha, 0B
Hann, Alexander, 17
Hansen, C., 03
Hanson, James, 0Z
Harris, Linda M., 0P
He, Zhen-yu, 0G
Heinle, Jeffrey, 0Q
Hong, Abigail L., 0O
Hou, Xiaoshuai, 15
Hsieh, Chi-Wen, 18
Hu, Jiang, 0G
Hu, Lian-ying, 0G
Huang, Xiao-yan, 0G
Huo, Yuankai, 0B
Illanes, A., 03
Ionita, Ciprian N., 0P, 0R, 0S
Izzo, Richard L., 0P, 0R, 0S
Jackson, Amiee, 0T
Jaeger, Stefan, 0A
James, Judy R., 0Z
Jiang, Kui, 19
Jiang, Xiao-bo, 0G
Kalpathy-Cramer, Jayashree, 09
Karibyan, Sarkis, 0J
Kaufman, Arie, 0V
Keenan, Andrew, 0D
Khalid, Arbab, 0O
Kim, Bokkyu, 0J
Kim, Edward, 0D
Kobe, Elizabeth A., 0O
Kohli, Marc, 0A
Kovalev, Vassili, 09
Krishnamurthy, Rajesh, 0Q
Lakshminarayanan, Vasudevan, 06
Landman, Bennett A., 0B, 0C, 0F
Lang, Andrew, 13
Li, Bao-yue, 0G
Li, Jing, 08
Li, Lihua, 08, 0E, 0L, 16
Li, Qiao-qiao, 0G
Li, Xing, 17
Li, Yane, 0L
Lim, Cody, 0J
Lin, Cheng-guang, 0G
Lin, Mao-sheng, 0G
Lindseth, Frank, 0W
Linte, Cristian A., 0T

Liu, Brent J., 0J, 0M, 18, 19
 Liu, Hsiao-Chuan, 18
 Liu, Hui, 0G
 Liu, Joseph, 0M
 Liu, Meng-zhong, 0G
 Long, L. Rodney, 07
 Mamonov, Artem, 09
 Marino, Joseph, 0V
 Martinez-Santos, Juan C., 0H
 Mawn, Louise A., 0F
 Mckenzie, Dean E., 0Q
 Meess, Karen M., 0P
 Mente, SaiLakshmiDeepika, 0D
 Mirhosseini, Seyedkoosha, 0V
 Mirniaharikandehei, Seyedehnafiseh, 0I
 Mitsouras, Dimitrios, 0S
 Müller, Henning, 09
 Muniz, Frederico B., 0X
 Nabar, Kunal P., 0F
 Nadeem, Saad, 0V
 Nelson, Katrina M., 0F
 Newman, Benjamin T., 0O
 Nordrik Hallan, Marte, 0W
 Nunes, Fátima L. S., 0X
 Panda, Anshuman, 0Z
 Park, Ji Hoon, 0J
 Park, Ji Hwan, 0V
 Patil, Omkar, 0I
 Patiño-Vanegas, Alberto, 0H
 Pavlicek, William, 0Z
 Pezzuol, J. L., 0U
 Pignolo, Robert J., 0O
 Plassard, Andrew J., 0B, 0C
 Podgorsak, Alexander R., 0R, 0S
 Poudel, P., 03
 Prince, Jerry L., 13
 Qi, Zhen-yu, 0G
 Raahemifar, Kaamran, 06
 Rajapakse, Chamith S., 0O
 Ravi, Ragini, 0J
 Ray, Bappaditya, 05
 Ray, Lawrence A., 0T
 Rodrigues, S. C. M., 0U
 Ross, Stephen R., 05
 Rudin, Stephen, 0P, 0R, 0S
 Rybicki, Frank J., 0S
 Said, Zaid, 0R, 0S
 Sanchez, Alexander, 0J
 Schiller Tønnessen, Martin, 0W
 Schmalstieg, Dieter, 17
 Shang, Yujuan, 19
 Shepard, Lauren, 0R, 0S
 Shi, Lili, 19
 Shinde, Rohit, 0O
 Shukurova, Malika, 0O
 Shung, K. Kirk, 18
 Siadat, Mohammad-Reza, 04
 Siddiqui, Adnan H., 0P, 0R
 Silva, S. M., 0U
 Sims, Dave I., 04
 Sipzner, Daniel, 0O
 Sirazitdinova, Ekaterina, 10
 Smistad, Erik, 0W
 Sommer, Kelsey, 0R, 0S
 Springer, Michael, 0P, 0R
 Starosolski, Zbigniew, 0Q
 Su, Congzhe, 0Z
 Sun, Jianyong, 12, 15
 Sun, Qinpei, 12
 Sun, Shujie, 15
 Sun, Weiwei, 06
 Sun, Ying, 0G
 Taylor, Warren, 0C
 Tendolini, A., 0U
 Teter, Olivia M., 0O
 Thoma, George R., 07, 0A
 Thomas, Armin, 09
 Tiu, Chui-Mei, 18
 Udupa, Jayaram K., 0O
 Våpenstad, Cecilie, 0W
 Verma, Sneha, 0M
 Voss, Stephan, 14
 Wallner, Jürgen, 17
 Wang, Erik, 0J
 Wang, Ximing, 0J
 Wang, Yunzhi, 05, 0I
 Wei, Yufang, 19
 Weitendorf, Frederick D., 0B
 Wilson, Michael F., 0R, 0S
 Wu, Dee H., 05
 Wu, Guolin, 0E
 Wu, Huiqun, 19
 Wu, Teresa, 0Z
 Xia, Yun-fei, 0G
 Xu, Xiaoyin, 14
 Xu, Yanzhe, 0Z
 Xue, Zhiyun, 07, 0A
 Yang, Xin, 0G
 Yang, Yuanyuan, 12
 Yang, Zhiming, 12
 Yun, Yeyi, 13
 Zhang, Jianguo, 12, 15
 Zhang, Juan, 08, 0E
 Zhang, Min, 0Z
 Zhao, Weijie, 16
 Zheng, Bin, 05, 0E, 0I, 0L, 16
 Zhong, Ning-shan, 0G

Conference Committee

Symposium Chairs

Berkman Sahiner, U.S. Food and Drug Administration (United States)
Leonard Berliner, Weill Cornell Medical College (United States) and
New York Methodist Hospital (United States)

Conference Chairs

Tessa S. Cook, The University of Pennsylvania Health System
(United States)
Jianguo Zhang, Shanghai Institute of Technical Physics (China)

Conference Program Committee

Peter R. Bak, McMaster University (Canada)
Po-Hao Chen, The University of Pennsylvania Health System
(United States)
Thomas M. Deserno, RWTH Aachen (Germany)
Steven C. Horii, The University of Pennsylvania Health System
(United States)
Maria Y. Law, Hong Kong Sanatorium and Hospital (Hong Kong, China)
Heinz U. Lemke, Computer Assisted Radiology and Surgery (Germany)
Brent J. Liu, The University of Southern California (United States)
Brian Park, The University of Pennsylvania Health System (United States)
Eliot L. Siegel, University of Maryland Medical Center (United States)
Wyatt Tellis, University of California, San Francisco (United States)

Session Chairs

- 1 Clinical Applications for Image Processing
Heinz U. Lemke, Computer Assisted Radiology and Surgery (Germany)
- 2 Big Data and Machine Learning
Po-Hao Chen, The University of Pennsylvania Health System
(United States)
Wyatt Tellis, University of California, San Francisco (United States)
- 3 Precision Medicine
Brent J. Liu, The University of Southern California (United States)
- 4 Advances in the Informatics of Therapeutics
Wyatt Tellis, University of California, San Francisco (United States)

- 5 Keynote
Jianguo Zhang, Shanghai Institute of Technical Physics (China)
Eloit L. Siegel, University of Maryland Medical Center (United States)
- 6 Novel Applications in 3D Printing
Steven C. Horii, The University of Pennsylvania Health System
(United States)
Brian Park, The University of Pennsylvania Health System
(United States)
- 7 Cloud-based Innovations
Tessa S. Cook, The University of Pennsylvania Health System
(United States)
- 8 Innovations in Workflow
Thomas M. Deserno, RWTH Aachen (Germany)

2017 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 co-sponsored by:



The Medical Image Perception Society

SPIE.

2017 Recipients:

First Place: **Direct measurement of Lubberts effect in CsI:Tl scintillators using single x-ray photon imaging** (10132-8)

A. Howansky, A. R. Lubinsky, Stony Brook Univ. (United States); S. K. Ghose, Brookhaven National Lab. (United States); K. Suzuki, Hamamatsu Photonics K.K. (Japan); W. Zhao, Stony Brook Univ. (United States)

Second Place: **Evaluation of a high-resolution patient-specific model of the electrically stimulated cochlea** (10135-21)

Ahmet Cakir, Vanderbilt Univ. (United States); Robert T. Dwyer, Vanderbilt Univ. Medical Ctr. (United States); Jack H. Noble, Vanderbilt Univ. (United States)

