

PROCEEDINGS OF SPIE

SPIDigitalLibrary.org/conference-proceedings-of-spie

Front Matter: Volume 10581

, "Front Matter: Volume 10581," Proc. SPIE 10581, Medical Imaging 2018: Digital Pathology, 1058101 (1 June 2018); doi: 10.1117/12.2323941

SPIE.

Event: SPIE Medical Imaging, 2018, Houston, Texas, United States

Medical Imaging 2018

Digital Pathology

John E. Tomaszewski

Metin N. Gurcan

Editors

11–12 February 2018

Houston, Texas, United States

Sponsored by

SPIE

Co-sponsored by

DECTRIS Ltd. (Switzerland)

Cooperating Organizations

AAPM—American Association of Physicists in Medicine (United States)

IFCARS—International Foundation for Computer Assisted Radiology and Surgery (Germany)

MIPS—Medical Image Perception Society (United States)

RSNA—Radiological Society of North America (United States)

WMIS—World Molecular Imaging Society

Published by

SPIE

Volume 10581

Proceedings of SPIE, 1605-7422, V. 10581

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

Medical Imaging 2018: Digital Pathology, edited by John E. Tomaszewski,
Metin N. Gurcan, Proc. of SPIE Vol. 10581, 1058101 · © 2018 SPIE
CCC code: 1605-7422/18/\$18 · doi: 10.1117/12.2323941

Proc. of SPIE Vol. 10581 1058101-1

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 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 2018: Digital Pathology*, edited by John E. Tomaszewski, Metin N. Gurcan, Proceedings of SPIE Vol. 10581 (SPIE, Bellingham, WA, 2018) Seven-digit Article CID Number.

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

ISBN: 9781510616516
ISBN: 9781510616523 (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 © 2018, 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 1605-7422/18/\$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	<i>Authors</i>
xi	<i>Conference Committee</i>
xiii	<i>Introduction</i>
xv	<i>Awards</i>

KEYNOTE AND EMERGING TRENDS

10581 03	Creating synthetic digital slides using conditional generative adversarial networks: application to Ki67 staining [10581-13]
10581 04	Single stain normalization for IHC whole slide images [10581-14]

MACHINE LEARNING TRENDS

10581 05	SHIFT: speedy histopathological-to-immunofluorescent translation of whole slide images using conditional generative adversarial networks [10581-1]
10581 06	Tumor microenvironment for follicular lymphoma: structural analysis for outcome prediction [10581-2]
10581 07	Deep positive-unlabeled learning for region of interest localization in breast tissue images [10581-3]
10581 08	An application of transfer learning to neutrophil cluster detection for tuberculosis: efficient implementation with nonmetric multidimensional scaling and sampling [10581-4]
10581 09	Role of training data variability on classifier performance and generalizability [10581-5]

DIAGNOSIS, PROGNOSIS, AND PREDICTIVE ANALYSIS

10581 0A	Computational analysis of the structural progression of human glomeruli in diabetic nephropathy [10581-6]
10581 0B	Examining structural changes in diabetic nephropathy using inter-nuclear distances in glomeruli: a comparison of variously automated methods [10581-7]

- 10581 OC **Deep variational auto-encoders for unsupervised glomerular classification** [10581-8]
- 10581 OD **Combination of nuclear NF- κ B/p65 localization and gland morphological features from surgical specimens is predictive of early biochemical recurrence in prostate cancer patients** [10581-9]
- 10581 OE **A bottom-up approach for tumour differentiation in whole slide images of lung adenocarcinoma** [10581-10]
- 10581 OF **Mitotic cells detection for HEp-2 specimen images using threshold-based evaluation scheme** [10581-11]

DETECTION AND SEGMENTATION

- 10581 OG **Quantifying cell-type interactions and their spatial patterns as prognostic biomarkers in follicular lymphoma** [10581-15]
- 10581 OH **Automated T1 bladder risk stratification based on depth of lamina propria invasion from H and E tissue biopsies: a deep learning approach** [10581-16]
- 10581 OI **Cancer detection in histopathology whole-slide images using conditional random fields on deep embedded spaces** [10581-17]
- 10581 OJ **Validation of multiplex immunohistochemistry assays using automated image analysis** [10581-18]
- 10581 OK **Color deconvolution method with DAB scatter correction for bright field image analysis** [10581-19]
- 10581 OL **Automatic color unmixing of IHC stained whole slide images** [10581-20]

PRECISION MEDICINE AND GRADING

- 10581 OM **RaPtomics: integrating radiomic and pathomic features for predicting recurrence in early stage lung cancer** [10581-21]
- 10581 ON **Deformable registration of histological cancer margins to gross hyperspectral images using demons** [10581-22]
- 10581 OO **Localization and classification of cell nuclei in post-neoadjuvant breast cancer surgical specimen using fully convolutional networks** [10581-23]
- 10581 OP **Context-based interpolation of coarse deep learning prediction maps for the segmentation of fine structures in immunofluorescence images** [10581-24]
- 10581 OQ **Automatic cancer detection and localization on prostatectomy histopathology images** [10581-25]

POSTER SESSION

- 10581 OR **A watershed and feature-based approach for automated detection of lymphocytes on lung cancer images** [10581-26]
- 10581 OS **Automated segmentation of epithelial tissue in prostatectomy slides using deep learning** [10581-27]
- 10581 OT **Registration parameter optimization for 3D tissue modeling from resected tumors cut into serial H and E slides** [10581-28]
- 10581 OU **Determining tumor cellularity in digital slides using ResNet** [10581-29]
- 10581 OV **3D human lung histology reconstruction and registration to in vivo imaging** [10581-30]
- 10581 OX **CNN based segmentation of nuclei in PAP-smear images with selective pre-processing** [10581-32]
- 10581 OY **Tumor proliferation assessment of whole slide images** [10581-33]
- 10581 OZ **H and E stain augmentation improves generalization of convolutional networks for histopathological mitosis detection** [10581-34]
- 10581 IO **Simultaneous segmentation and classification of multichannel immuno-fluorescently labeled confocal microscopy images using deep convolutional neural networks** [10581-35]
- 10581 I1 **Unsupervised pathology image segmentation using representation learning with spherical k-means** [10581-36]
- 10581 I2 **Automatic segmentation of histopathological slides of renal tissue using deep learning** [10581-37]
- 10581 I3 **Scalable storage of whole slide images and fast retrieval of tiles using Apache Spark** [10581-38]
- 10581 I4 **Glomerular detection and segmentation from multimodal microscopy images using a Butterworth band-pass filter** [10581-39]
- 10581 I6 **A performance comparison of low- and high-level features learned by deep convolutional neural networks in epithelium and stroma classification** [10581-41]
- 10581 I7 **Image processing to extend effective OCT penetration depth in tissue** [10581-42]
- 10581 I8 **Registration accuracy between whole slide images and glass slides in eeDAP workflow** [10581-43]
- 10581 I9 **Classification of lung cancer histology images using patch-level summary statistics** [10581-44]
- 10581 IA **Segmentation of black ink and melanin in skin histopathological images** [10581-45]

- 10581 1B **Semantic segmentation for prostate cancer grading by convolutional neural networks**
[10581-46]
- 10581 1C **SlideSeg: a Python module for the creation of annotated image repositories from whole slide images** [10581-47]
- 10581 1D **An unsupervised network for fast microscopic image registration** [10581-48]
- 10581 1E **Landmark-based reconstruction of 3D smooth structures from serial histological sections**
[10581-49]
- 10581 1F **Detecting and segmenting overlapping red blood cells in microscopic images of thin blood smears** [10581-50]

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.

Akbar, Shazia, 0U
Alemi Koohbanani, Navid, 19
Alsubaie, Najah, 0E
Amir Hossain, Md, 1F
Andani, Sonali, 07
Andersson, Emilia, 0K
Andersson, Mats, 0Y
Antani, Sameer, 1F
Arnold, Corey, 1B
Arole, Vidya, 0H
Ashton, Garry, 0G
Astley, Sue, 0G
Atzori, Manfredo, 0Y
Balkenhol, Maschenka, 0Z
Bauman, G., 0Q
Beamer, Gillian, 08
Bera, Kaustav, 0M
Berman, Benjamin P., 18
Bhavsar, Arnav, 0F, 0X
Bidart, Rene, 0O
Brandwein, Margaret, 0T
Bredno, Joerg, 0J
Breen, David E., 17
Brieu, Nicolas, 0P
Bulten, Wouter, 0S
Burlingame, Erik A., 05
Byers, Richard, 0G
Caie, Peter D., 0P
Chang, Young Hwan, 05
Chen, Amy Y., 0N
Chen, W., 06
Chen, Xi, 1D
Chen, Zhuo Georgia, 0N
Chin, J. L., 0Q
Choi, Humberto, 0M
Ciompi, Francesco, 0Z
Clark, Marcus, 10
Corredor, Germán, 0R
Crabb, Brendan, 1C
Day, William, 0J
de Bel, Thomas, 12
de With, Peter H. N., 0I
Doyle, Scott, 09, 0T
Du, Yue, 16
Dyduch, Grzegorz, 1A
El-Deiry, Mark W., 0N
Elliott, Robin, 0D
Fei, Baowei, 0N
Fergie, Martin, 0G
Fitzpatrick, Sophie, 0G
Fogo, Agnes, 0A
Fortin, Dalilah, 0V
Gabrani, Maria, 07
Gaed, M., 0Q
Gallas, Brandon D., 18
Gangeh, Mehrdad J., 0O
Garcia, Fernando U., 17
Gautam, Srishti, 0X
Gavriel, Christos G., 0P
Gavrielides, Marios A., 18
Geijs, D. J., 0L
Gertych, Arkadiusz, 1B
Ghazvinian Zanjani, Farhad, 0I
Ghods, Ali, 0O
Giger, Maryellen L., 10
Ginley, Brandon G., 0A, 14
Gomez, J. A., 0Q
Gong, Qi, 18
Govind, Darshana, 14
Graham, Simon, 19
Gray, Joe W., 05
Griffith, Christopher C., 0N
Grimm, Oliver, 0K
Gunderson, Camille C., 16
Gupta, Krati, 0F
Gupta, Sanjay, 0D
Gurcan, Metin N., 03, 06, 08, 0H
Halicek, Martin, 0N
Han, Hua, 1D
Han, W., 0Q
Harrison, David J., 0P
Hashizume, Makoto, 1E
Hasserjian, R. P., 06
Hedlund, Martin, 0Y
Hermsen, Meyke, 12
Hilbrands, Luuk, 12
Hontani, Hidekata, 1E
Hulsbergen-van de Kaa, Christina A., 0S
Inculet, Richard, 0V
Ing, Nathan, 1B
Intezar, M., 0L
Iwamoto, Chika, 1E
Jacobsson, Ludwig, 0Y
Jaeger, Stefan, 1F
Jain, Sanjay, 0A, 0B, 0C
Janowczyk, Andrew, 0D
Jaworek-Korjakowska, Joanna, 1A
Jen, Kuang-Yu, 0A, 0C

Jimenez-del-Toro, Oscar, 0Y
 Johnson, Carol, 0Q, 0V
 Johnson, Starr, 0T
 K.K., Harinarayan, 0X
 Karssemeijer, Nico, 0Z
 Kawamura, Naoki, 1E
 Khunger, Arjun, 0M
 Khurram, Syed Ali, 19
 Kłeczek, Paweł, 1A
 Knudsen, Beatrice S., 1B
 Kobayashi, Hirokazu, 1E
 Kwan, Keith, 0V
 Landis, Mark, 0V
 Lathen, Gunnar, 0Y
 Lech, Martyna, 1A
 Lee, Cheryl, 0H
 Leo, Patrick, 0D
 Li, Jiayun, 1B
 Liarski, Vladimir, 10
 Linton, Kim, 0G
 Litjens, Geert J. S., 0L, 0S, 0Z, 12
 Little, James V., 0N
 Liu, Hong, 16
 Lopez Barron, Daniel E., 13
 Lorsakul, Auranuch, 0J
 Louie, Alexander, 0V
 Louissaint, A., 06
 Lozanski, Gerard, 03, 06
 Lu, Cheng, 0R
 Lutnick, Brendon, 0C, 14
 Ma, Zhaoxuan, 1B
 Madabhushi, Anant, 0D, 0M, 0R
 Maharaj, Shantel, 17
 Malthaner, Richard, 0V
 Margolin, Adam, A., 05
 Martel, Anne L., 0O, 0U
 Mattonen, Sarah A., 0V
 Maude, Richard J., 1F
 Moallem, Golnaz, 1F
 Mori, Kensaku, 11
 Moriya, Takayasu, 11
 Morrison, Larry, 0J
 Moussa, M., 0Q
 Moxley, Katherine M., 16
 Mueller, Henning, 0Y
 Nagara, Kai, 11
 Nakamura, Shota, 11
 Nandakumar, Gautham, 17
 Nelson, Lilli, 0G
 Niazi, M. Khalid Khan, 08, 0H
 Nie, Yao, 04, 0K
 Nofech-Mozes, Sharon, 0O, 0U
 Norell, Bjorn, 0Y
 Ochs, Robert L., 0J
 Oda, Hirohisa, 11
 Oda, Masahiro, 11
 Ohuchida, Kenoki, 1E
 Olson, Niels, 1C
 Palhares Viana, Matheus, 07
 Palma, David A., 0V
 Parwani, Anil V., 0H
 Patel, Mihir, 0N
 Pati, Pushpak, 07
 Patil, Pradnya, 0M
 Pautler, S. E., 0Q
 Padiaditis, Matthew, 07
 Peikari, Mohammad, 0O, 0U
 Pennell, M., 06
 Pentinga, Sean A. K., 0V
 Poostchi, Mahdieh, 1F
 Qaiser, Talha, 19
 Qiu, Yuchen, 16
 Rajpoot, Nasir, 0E, 19
 Rao, Deepthi, 13
 Rao, Praveen, 13
 Raza, Shan E. Ahmed, 0E
 Rodrigues, George, 0V
 Roessler, Christian, 0K
 Romero, Eduardo, 0R
 Roth, Holger R., 11
 Rousson, Mikael, 0Y
 Rüschoff, Jan Hendrik, 07
 Saba, Nabil F., 0N
 Sahiner, Berkman, 03, 06
 Sainz de Cea, Maria V., 04
 Salama, Sherine, 0O, 0U
 Salemi, Hootan, 1B
 Sao, Anil K., 0F, 0X
 Sarder, Pinaki, 0A, 0B, 0C, 14
 Sari-Sarraf, Hamed, 1F
 Schmidt, Günter, 0P
 Senaras, Caglar, 03, 06
 Shaban, Muhammad, 19
 Shana'ah, A., 06
 Shankar, Eswar, 0D
 Shu, Chang, 1D
 Sibley, Adam R., 10
 Silamut, Kamolrat, 1F
 Simon, Olivier, 0B
 Sirinukunwattana, Korsuk, 0E
 Smeets, Bart, 12
 Snead, David, 0E
 Tadeusiewicz, Ryszard, 1A
 Tavolara, Thomas E., 0H
 Tawfik, Ossama, 13
 Tellez, David, 0Z
 Thai, Theresa C., 16
 Therrien, Ryan, 09
 Thoma, George, 1F
 Tomaszewski, John E., 0A, 0B, 0C, 14
 Tozbikian, Gary, 03
 Tsakiroglou, Anna Maria, 0G
 Vaidya, Pranjal, 0M
 van der Laak, J. A. W. M., 0L, 0S, 0Z, 12
 Velcheti, Vamsidhar, 0M, 0R
 Wang, Xiangxue, 0M, 0R
 Wang, Xu, 0N
 Ward, Aaron D., 0Q, 0V
 West, Catharine, 0G
 Wild, Peter, 07

Xie, Qiwei, 1D
Yacoub, Rabi, 0B, 0C
Yaremko, Brian, 0V
Yarlagadda, Dig Vijay Kumar, 13
Yokota, Tatsuya, 1E
Zarella, Mark D., 17
Zargari, Abolfazl, 16
Zeng, Kang, 0G
Zhang, Roy, 16
Zheng, Bin, 16
Zinger, Svitlana, 0I

Conference Committee

Symposium Chairs

Leonard Berliner, Weill Cornell Medical College (United States) and
New York Presbyterian - Brooklyn Methodist Hospital (United States)
Ronald M. Summers, National Institutes of Health (United States)

Conference Chairs

John E. Tomaszewski, University at Buffalo (United States)
Metin N. Gurcan, Wake Forest Baptist Medical Center (United States)

Conference Program Committee

Selim Aksoy, Bilkent University (Turkey)
Ulysses J. Balis, University of Michigan Health System (United States)
Rohit Bhargava, University of Illinois at Urbana-Champaign
(United States)
Ulf-Dietrich Braumann, Hochschule für Technik, Wirtschaft und Kultur
Leipzig (Germany)
Weijie Chen, U.S. Food and Drug Administration (United States)
Wei-Chung Cheng, U.S. Food and Drug Administration (United States)
Eric Cosatto, NEC Labs. America, Inc. (United States)
Scott Doyle, Rutgers, The State University of New Jersey
(United States)
Michael D. Feldman, The University of Pennsylvania Health System
(United States)
David J. Foran, Rutgers Cancer Institute of New Jersey (United States)
Marios A. Gavrielides, U.S. Food and Drug Administration
(United States)
Tom R. L. Kimpe, Barco N.V. (Belgium)
Elizabeth A. Krupinski, Emory University School of Medicine
(United States)
Richard M. Levenson, University of California, Davis (United States)
Olivier Lezoray, Université de Caen Basse-Normandie (France)
Geert Litjens, Radboud University Medical Center (Netherlands)
Anant Madabhushi, Case Western Reserve University (United States)
Derek R. Magee, University of Leeds (United Kingdom)
Anne L. Martel, Sunnybrook Research Institute (Canada)
Erik Meijering, Erasmus MC (Netherlands)
James P. Monaco, Inspirata, Inc. (United States)
Mehdi Moradi, IBM Research (United States)

Bahram Parvin, Lawrence Berkeley National Laboratory
(United States)
Josien P. W. Pluim, Image Sciences Institute (Netherlands)
Nasir M. Rajpoot, The University of Warwick (United Kingdom)
Gustavo Kunde Rohde, Carnegie Mellon University (United States)
Berkman Sahiner, U.S. Food and Drug Administration (United States)
Chukka Srinivas, Ventana Medical Systems, Inc. (United States)
Darren Treanor, University of Leeds (United Kingdom)
Jeroen van der Laak, Radboud University Medical Center
(Netherlands)
Aaron D. Ward, The University of Western Ontario (Canada)
Martin J. Yaffe, Sunnybrook Research Institute (Canada)
Bülent Yener, Rensselaer Polytechnic Institute (United States)

Session Chairs

- 1 Machine Learning Trends
Anne L. Martel, Sunnybrook Research Institute (Canada)
- 2 Diagnosis, Prognosis, and Predictive Analysis
Aaron D. Ward, Western University (Canada)
- 3 Keynote and Emerging Trends
Metin N. Gurcan, Wake Forest Baptist Medical Center (United States)
- 4 Detection and Segmentation
Selim Aksoy, Bilkent University (Turkey)
- 5 Precision Medicine and Grading
Elizabeth A. Krupinski, Emory University School of Medicine
(United States)

Introduction

This is the sixth year of the Digital Pathology conference that was introduced at the SPIE Medical Imaging Symposium in Orlando, Florida, in 2013. Every year since then, we have seen increased interest, making Digital Pathology one of the prominent conferences at the SPIE Medical Imaging Symposium. The quality of the presented talks, posters, and the resulting papers, as in previous years, continued to be outstanding. This is mainly thanks to our community, who submits some of their best work to this conference, and to the hard work of our program committee, who carefully conduct a rigorous peer-review process to ensure that only the top papers are selected for presentation at the meeting.

The sixth Digital Pathology conference took place 11–12 February at the Marriott Marquis in Houston, Texas, United States. The meeting formally began on 11 February, with a plenary talk given by Dr. Martin Stumpe, entitled, “*Advancing Cancer Diagnostics with Deep Learning.*” Dr. Stumpe leads the Pathology project at Google Research. Dr. Stumpe discussed algorithmic approaches for pathology, including deep learning and some of the challenges faced by researchers in the field. The keynote talk drew in 287 attendees from all the various conferences at the SPIE Medical imaging symposium.

A total of 50 papers were presented during the course of the meeting in both oral and poster form. The sessions included Emerging Trends; Machine Learning Trends; Diagnosis, Prognosis, and Predictive Analysis; Precision Medicine and Grading; and Detection and Segmentation.

We would like to acknowledge the excellent work in the following papers:

Conference finalist of the Robert F. Wagner Best Student Paper Award for Digital Pathology (10581): **Combination of nuclear NF- κ B/p65 localization and gland morphological features from surgical specimens is predictive of early biochemical recurrence in prostate cancer patients**, Student Author: Leo Patrick, Case Western Reserve Univ. (United States) [10581-09]

Cum Laude Poster Award: **Landmark-based reconstruction of 3D smooth structures from serial histological sections**, Naoki Kawamura, Hirokazu Kobayashi, Tatsuya Yokota, Hidekata Hontani, Nagoya Institute of Technology (Japan); Chika Iwamoto, Kenoki Ohuchida, Makoto Hashizume, Kyushu Univ. (Japan) [10581-49]

Honorable Mention Poster Award: **Registration parameter optimization for 3D tissue modeling from resected tumors cut into serial H&E slides**, Starr Johnson, Univ. at Buffalo (United States); Margaret Brandwein, Icahn School of Medicine at Mount Sinai (United States); Scott Doyle, Univ. at Buffalo (United States) [10581-28]

The continued success of the Digital Pathology conference was in no small part to the outstanding efforts of the program committee, who carefully constructed the program, SPIE Symposium Chairs, Drs. Leonard Berliner and Ronald M. Summers, and SPIE staff, who kindly guided us through all the steps of the program organization.

Next year, the Digital Pathology conference at SPIE Medical Imaging will take place in San Diego, California. We look forward to seeing you there for another successful conference.

Metin N. Gurcan
John E. Tomaszewski

2018 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.

2018 Recipients:

First Place: **Dynamic beam filtering for miscentered patients** (10573-29)

Andrew Mao, William Shyr, Grace J. Gang, J. Webster Stayman, Johns Hopkins Univ. (United States)

Second Place: **Tumor margin classification of head and neck cancer using hyperspectral imaging and convolutional neural networks** (10576-4)

Martin Halicek, Georgia Institute of Technology (United States) and Augusta Univ. (United States); James V. Little, Xu Wang, Emory Univ. School of Medicine (United States); Mihir Patel, Emory Univ. School of Medicine (United States) and The Winship Cancer Institute of Emory Univ. (United States); Christopher C. Griffith, Emory Univ. School of Medicine (United States); Amy Y. Chen, Emory Univ. School of Medicine (United States) and The Winship Cancer Institute of Emory Univ. (United States); Baowei Fei, Georgia Institute of Technology & Emory Univ. (United States) and The Winship Cancer Institute of Emory Univ. (United States)

