

Medical Imaging 2015

Image Perception, Observer Performance, and Technology Assessment

Claudia R. Mello-Thoms

Matthew A. Kupinski

Editors

25–26 February 2015

Orlando, Florida, United States

Sponsored by

SPIE

Cosponsored by

Alpinion Medical Systems (United States)

Modus Medical Devices Inc. (Canada)

Bruker (United States)

ALIO Industries (United States)

Cooperating Organizations

AAPM—American Association of Physicists in Medicine (United States) • APS—American Physiological Society (United States) • CARS—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

Volume 9416

Proceedings of SPIE, 1605-7422, V. 9416

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

Medical Imaging 2015: Image Perception, Observer Performance, and Technology Assessment,
edited by Claudia R. Mello-Thoms, Matthew A. Kupinski, Proc. of SPIE Vol. 9416, 941601
© 2015 SPIE · CCC code: 1605-7422/15/\$18 · doi: 10.1117/12.2193710

The papers included 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. The papers published in these proceedings 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 this book:

Author(s), "Title of Paper," in *Medical Imaging 2015: Image Perception, Observer Performance, and Technology Assessment*, edited by Claudia R. Mello-Thoms, Matthew A. Kupinski, Proceedings of SPIE Vol. 9416 (SPIE, Bellingham, WA, 2015) Article CID Number.

ISSN: 1605-7422

ISBN: 9781628415063

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 © 2015, 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 1605-7422/15/\$18.00.

Printed in the United States of America.

Publication of record for individual papers is online in the SPIE Digital Library.



SPIDigitalLibrary.org

Paper Numbering: Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print. Papers are published as they are submitted and meet publication criteria. A unique citation identifier (CID) number is assigned to each article at the time of the first 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, print, and electronic versions of the publication. SPIE uses a six-digit CID article numbering system in which:

- 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. The complete citation is used on the first page, and an abbreviated version on subsequent pages.

Contents

- vii *Authors*
- ix *Conference Committee*
- xi *2015 Medical Imaging Award Recipients*

SESSION 1 KEYNOTE AND BREAST I

- 9416 03 **Incorporating breast tomosynthesis into radiology residency: Does trainee experience in breast imaging translate into improved performance with this new modality?** [9416-2]
- 9416 04 **Detection of calcification clusters in digital breast tomosynthesis slices at different dose levels utilizing a SRSAR reconstruction and JAFROC** [9416-3]

SESSION 2 BREAST II

- 9416 05 **Inter- and intra-observer variations in the delineation of lesions in mammograms** [9416-4]
- 9416 06 **Computational assessment of mammography accreditation phantom images and correlation with human observer analysis** [9416-5]
- 9416 07 **iDensity: an automatic Gabor filter-based algorithm for breast density assessment** [9416-6]
- 9416 08 **Assessment of mass detection performance in contrast enhanced digital mammography** [9416-7]
- 9416 09 **The relationship between socio-economic status and cancer detection at screening** [9416-8]
- 9416 0A **The impact of mammographic imaging systems on density measurement** [9416-9]

SESSION 3 OBSERVER PERFORMANCE EVALUATION

- 9416 0B **A phantom-based JAFROC observer study of two CT reconstruction methods: the search for optimisation of lesion detection and effective dose** [9416-10]
- 9416 0D **A multireader diagnostic performance study of low-contrast detectability on a third-generation dual-source CT scanner: filtered back projection versus advanced modeled iterative reconstruction** [9416-12]
- 9416 0E **Demonstration of *multi- and single-reader sample size program for diagnostic studies software*** [9416-13]

9416 OF **Low contrast detectability in CT for human and model observers in multi-slice data sets**
[9416-14]

SESSION 4 CT

- 9416 OG **Influence of the grayscale on phantom-based image quality assessment in x-ray computed tomography** [9416-15]
- 9416 OH **Combination of detection and estimation tasks using channelized scanning linear observer for CT imaging systems** [9416-16]
- 9416 OI **What observer models best reflect low-contrast detectability in CT?** [9416-17]
- 9416 OJ **CT image quality evaluation for detection of signals with unknown location, size, contrast and shape using unsupervised methods** [9416-18]
- 9416 OK **Impact of number of repeated scans on model observer performance for a low-contrast detection task in CT** [9416-19]
- 9416 OL **Using the Wiener estimator to determine optimal imaging parameters in a synthetic-collimator SPECT system used for small animal imaging** [9416-54]

SESSION 5 MODEL OBSERVERS I

- 9416 ON **Optimization of energy window and evaluation of scatter compensation methods in MPS using the ideal observer with model mismatch** [9416-23]
- 9416 OO **Approximate maximum likelihood estimation of scanning observer templates** [9416-24]
- 9416 OP **The effect of signal variability on the histograms of anthropomorphic channel outputs: factors resulting in non-normally distributed data** [9416-25]

SESSION 6 VISUAL SEARCH

- 9416 OQ **Prevalence learning and decision making in a visual search task: an equivalent ideal observer approach** [9416-26]
- 9416 OR **Ideal and visual-search observers: accounting for anatomical noise in search tasks with planar nuclear imaging** [9416-27]
- 9416 OS **Priming cases disturb visual search patterns in screening mammography** [9416-28]
- 9416 OT **Fractal analysis of radiologists' visual scanning pattern in screening mammography** [9416-29]
- 9416 OU **Temporal stability of visual search-driven biometrics** [9416-30]

9416 0V **Towards using eye tracking data to develop visual-search observers for x-ray breast imaging** [9416-31]

SESSION 7 MODEL OBSERVERS II

9416 0W **Improving lesion detectability in PET imaging with a penalized likelihood reconstruction algorithm** [9416-32]

9416 0X **SVM-based visual-search model observers for PET tumor detection** [9416-33]

9416 0Y **The use of kernel local Fisher discriminant analysis for the channelization of the Hotelling model observer** [9416-34]

9416 0Z **Evaluation of six channelized Hotelling observers in combination with a contrast sensitivity function to predict human observer performance** [9416-35]

9416 10 **On anthropomorphic decision making in a model observer** [9416-36]

SESSION 8 TECHNOLOGY ASSESSMENT

9416 12 **Comparison of two stand-alone CADe systems at multiple operating points** [9416-37]

9416 13 **Feasibility of using a biowatch to monitor GSR as a measure of radiologists' stress and fatigue** [9416-38]

9416 15 **Augmenting real-time video with virtual models for enhanced visualization for simulation, teaching, training and guidance** [9416-40]

9416 16 **Objective evaluation of methods to track motion from clinical cardiac-gated tagged MRI without the use of a gold standard** [9416-41]

9416 17 **Developing a clinical utility framework to evaluate prediction models in radiogenomics** [9416-42]

POSTER SESSION

9416 18 **Evaluation of a simulation procedure designed to recognize shape and contour of suspicious masses in mammography** [9416-43]

9416 19 **Implementation and value of using a split-plot reader design in a study of digital breast tomosynthesis in a breast cancer assessment clinic** [9416-55]

9416 1A **Evaluating RVUs as a measure of workload for use in assessing fatigue** [9416-53]

9416 1B **Characterization of breast density in women from Lima, Peru** [9416-52]

9416 1C **Sparsity-driven ideal observer for computed medical imaging systems** [9416-51]

- 9416 1D **Evaluation of angiogram visualization methods for fast and reliable aneurysm diagnosis**
[9416-50]
- 9416 1E **Investigation of methods for calibration of classifier scores to probability of disease
(Cum Laude Poster Award)** [9416-57]
- 9416 1F **Image-domain sampling properties of the Hotelling Observer in CT using filtered back-
projection** [9416-49]
- 9416 1G **The role of digital tomosynthesis in reducing the number of equivocal breast reportings**
[9416-48]
- 9416 1H **Investigation on viewing direction dependent detectability in a reconstructed 3D volume
for a cone beam CT system** [9416-20]
- 9416 1I **The effect of NPS calculation method on power-law coefficient estimation accuracy in
breast texture modeling** [9416-47]
- 9416 1J **Comparing prediction models for radiographic exposures** [9416-45]
- 9416 1K **Objective evaluation of reconstruction methods for quantitative SPECT imaging in the
absence of ground truth** [9416-44]
- 9416 1L **Experience in reading digital images may decrease observer accuracy in mammography**
[9416-46]

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.

Abbey, Craig K., 00
Ahn, Sangtae, 0W
Alagoz, Oguzhan, 17
Alakhras, Maram, 1G
Alamudun, Folami T., 0T
Anastasio, Mark A., 1C
Avanaki, Ali R. N., 10
Azencott, Robert, 0X
Ba, Alexandre, 0F
Baek, Jongduk, 1H
Barufaldi, Bruno, 06
Bensch, Alexander, 15
Bochud, Francois O., 0F
Bohak, Ciril, 1D
Boone, John M., 0O
Bourne, Roger, 1G
Bouwman, Ramona W., 0Z
Brankov, Jovan G., 16
Brennan, Patrick C., 07, 0A, 0S, 19, 1G, 1L
Buelow, Thomas, 05
Burnside, Elizabeth S., 17
Caffo, Brian, 1K
Carmichael, Tandy R., 0U
Carton, Ann-Katherine, 08, 11
Casado, Fanny L., 1B
Castaneda, Benjamin, 1B
Chakraborty, Dev P., 0B
Chen, Baiyu, 0K
Chen, Weijie, 12, 1E
Ching, W., 1J
Clarke, Aileen, 09
Damases, Christine N., 0A
Das, Mini, 0V
Davidson, H. C., 0G
Dawson-Elli, Alexander, 15
de Carvalho, Pablo Milioni, 08
Denney, Thomas S., Jr., 16
Desolneux, Agnès, 11
Dromain, Clarisse, 08
Dustler, M., 04
Eckstein, Miguel P., 0F, 0O
Elshahaby, Fatma E. A., 0P
Espig, Kathryn S., 10
Fan, Jiahua, 0H
Favazza, Christopher, 0K
Ferrer, Jose, 1B
Frey, Eric C., 0N, 0P, 1K
Gamdonkar, Ziba, 07
Ghaly, Michael, 0N, 0P
Gifford, Howard C., 0R, 0V, 0X
Goffi, Marco, 0Z
Grewer, Ruediger, 05
Grimm, Lars J., 03
Guerrero, Jorge, 1B
Hahn, K., 0G
Hamborg, Tom, 09
Hasselbach, Karl, 1A
He, Xin, 0Q
Heese, Harald S., 05
Heilbrun, M. E., 0G
Hillis, Stephen L., 0E
Hogg, Peter, 0B
Hudson, Kathy, 0T
Iordache, Răzvan, 11
Jha, Abhinav K., 0P, 1K
Jiang, Zhengqiang, 0V
Johnson, Karen S., 03
Johnson, Lindsay C., 0L
Kearins, Olive, 09
Kimpe, Tom R. L., 10
Kinahan, Paul E., 0W
Kobbe-Schmidt, Sabine, 0F
Krupinski, Elizabeth A., 13, 1A
Kupinski, Matthew A., 0H, 0L, 1C
Kutra, Dominik, 05
Lau, Kristen C., 06
Lee, Changwoo, 1H
Lee, Warwick, 0S, 1L
Leng, Shuai, 0K
Lesar, Žiga, 1D
Lewis, Sarah J., 0S, 1L
Li, Zhijin, 08, 11
Liang, Zhihua, 0V
Lin, Alexander, 0L
Links, Jonathan M., 0N
Linte, Cristian A., 15
Liu, Jie, 17
Lo, Joseph Y., 03
Lou, Yang, 1C
Ma, Chi, 0K
MacKinnon, Lea, 13, 1A
Maidment, Andrew D. A., 06, 10
Mall, Suneeta, 19
Manjeshwar, Ravindra M., 0W
Manning, David J., 0B
Manrique, Susan, 1B
Markey, Mia K., 0Y
Marolt, Matija, 1D

Mazurowski, Maciej A., 03
 McCollough, Cynthia, 0K
 McEntee, Mark F., 0A, 1J, 1L
 Mello-Thoms, Claudia, 07, 0S, 19, 1G, 1L
 Mileto, Achille, 0D
 Morin-Ducote, Garnetta, 0T
 Muller, Serge, 08, 1I
 Munoz del Rio, Alejandro, 17
 Noo, F., 0G
 Ogboye, Toyin, 09
 Onifilo, Adedayo A., 17
 O'Sullivan, Emma, 09
 Ott, Julien G., 0F
 Page, David C., 17
 Pan, Xiaochuan, 1F
 Parages, Felipe M., 16
 Park, Junhan, 1H
 Peissig, Peggy, 17
 Peterson, Todd E., 0L
 Petersson, H., 04
 Petrick, Nicholas, 12, 1E
 Pezeshk, Aria X., 0J, 12, 1E
 Pinto, Joseph, 1B
 Popescu, Lucretiu M., 0J, 0O
 Potter, Michael, 15
 Racine, Damien, 0F
 Ramirez-Giraldo, Juan Carlos, 0D
 Rassner, U., 0G
 Rawashdeh, Mohammad A., 1L
 Reed, Warren M., 0S, 1L
 Reiner, Bruce I., 13
 Rickard, Mary, 1G
 Robinson, J., 1J
 Ross, Steven G., 0W
 Ryder, Will, 07
 Sahiner, Berkman, 0J, 0Q, 12, 1E
 Samei, Ehsan, 0D, 0I
 Samuelson, Frank W., 0O, 0Q, 1E
 Sanchez, Adrian A., 1F
 Scharzt, Kevin M., 0E
 Schiabel, Homero, 06, 18
 Sen, Anando, 0R, 0X
 Shokouhi, Sepideh, 0L
 Sidky, Emil Y., 1F
 Siqueira, Paula N., 18
 Solomon, Justin, 0D, 0I
 Song, Na, 1K
 Sousa, Maria A. Z., 18
 Szczepura, Katy, 0B
 Taljanovic, Mihra, 1A
 Tan, Alvin N. K., 0S
 Tapia, Kriscia, 1L
 Tay, Kevin, 07
 Taylor-Phillips, Sian, 09
 Thompson, John D., 0B
 Timberg, P., 04
 Tingberg, A., 04
 Tootell, Andrew, 0B
 Tourassi, Georgia, 0T, 0U
 Tseng, Hsin-Wu, 0H
 Vamvakas, Ioannis, 0B
 van Engen, Ruben E, 0Z
 Veldkamp, Wouter J. H., 0Z
 Verdun, Francis R., 0F
 Vrieze, Thomas, 0K
 Wang, Kun, 1C
 Wangerin, Kristen A., 0W
 Wen, Gezheng, 0Y
 Wiemker, Rafael, 05
 Wu, Yirong, 17
 Wunderlich, Adam, 0O
 Yoon, Hong-Jun, 0T, 0U
 Yu, Lifeng, 0K
 Zackrisson, S., 04
 Zeng, Rongping, 0Q
 Zhang, Jing, 03

Conference Committee

Symposium Chairs

David Manning, Lancaster University (United Kingdom)
Steven C. Horii, The University of Pennsylvania Health System
(United States)

Conference Chairs

Claudia R. Mello-Thoms, The University of Sydney (Australia) and
University of Pittsburgh (United States)
Matthew A. Kupinski, College of Optical Sciences, The University of
Arizona (United States)

Conference Program Committee

Craig K. Abbey, University of California, Santa Barbara (United States)
François O. Bochud, Centre Hospitalier Universitaire Vaudois
(Switzerland)
Jovan G. Brankov, Illinois Institute of Technology (United States)
Alastair G. Gale, Loughborough University (United Kingdom)
Howard C. Gifford, University of Houston (United States)
Stephen L. Hillis, The University of Iowa (United States)
Elizabeth A. Krupinski, The University of Arizona (United States)
Maciej A. Mazurowski, Duke University (United States)
Anthony J. Maeder, The University of Western Australia (Australia)
Mark F. McEntee, The University of Sydney (Australia)
Subok Park, U.S. Food and Drug Administration (United States)
David L. Wilson, Case Western Reserve University (United States)
Federica Zanca, Katholieke Universiteit Leuven (Belgium)

Session Chairs

- 1 Keynote and Breast I
Claudia R. Mello-Thoms, The University of Sydney (Australia) and
University of Pittsburgh (United States)
Matthew A. Kupinski, College of Optical Sciences, The University of
Arizona (United States)
- 2 Breast II
Patrick C. Brennan, The University of Sydney (Australia)
- 3 Observer Performance Evaluation
Elizabeth A. Krupinski, The University of Arizona (United States)

- 4 CT
Jovan G. Brankov, Illinois Institute of Technology (United States)
- 5 Model Observers I
Craig K. Abbey, University of California, Santa Barbara (United States)
- 6 Visual Search
Sian Taylor-Phillips, The University of Warwick (United Kingdom)
- 7 Model Observers II
Howard C. Gifford, University of Houston (United States)
- 8 Technology Assessment
Stephen L. Hillis, The University of Iowa (United States)

2015 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



2015 Recipients:

First Place: **Automatic discrimination of color retinal images using the bag of words approach** (9414-54)

I. Sadek, D. Sidibé, F. Meriaudeau, Univ. of Burgundy (France)

Second Place: **Automated pulmonary lobar ventilation measurements using volume-matched thoracic CT and MRI** (9417-42)

F. Guo, S. Svenningsen, E. Bluemke, M. Rajchl, J. Yuan, A. Fenster, G. Parraga, The Univ. of Western Ontario (Canada)

Conference Awards

2015 Recipients:

Cum Laude Poster Award (First Place): **Investigation of methods for calibration of classifier scores to probability of disease** [9416-57]

W. Chen, B. Sahiner, F. Samuelson, A. Pezeshk, N. Petrick, U.S. Food and Drug Administration (United States)

