Medical Imaging 2010

Image Perception, Observer Performance, and Technology Assessment

David J. Manning
Craig K. Abbey
Editors

17–18 February 2010
San Diego, California, United States

Sponsored by
SPIE

Cosponsored by
Medtronic, Inc. • Aeroflex, Inc. (United States) • Hamamatsu Photonics K.K. • OpenXi (United States)
Tungsten Heavy Powder, Inc. (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) • The Society for Imaging Science and Technology • Medical Image Perception Society (United States) • Radiological Society of North America (United States) • Society for Imaging Informatics in Medicine (United States) • SMI—The Society for Molecular Imaging
The DICOM Standards Committee (United States)

Published by
SPIE

Volume 7627


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


ISSN 1605-7422
ISBN 9780819480286

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 © 2010, 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 1605-7422/10/$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, with papers published first online and then in print and on CD-ROM. Papers are published as they are submitted and meet publication criteria. A unique, consistent, permanent 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 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 10-12, 20-22, 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. Numbers in the index correspond to the last two digits of the six-digit CID number.
## Contents

### SESSION 1 KEYNOTE AND BREAST LESIONS

<table>
<thead>
<tr>
<th>Session</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>7627 02</td>
<td>Maintaining quality in the UK breast screening program (Keynote Paper)</td>
<td>A. Gale, Loughborough Univ. (United Kingdom)</td>
</tr>
<tr>
<td>7627 03</td>
<td>Rating scales for observer performance studies</td>
<td>R. M. Nishikawa, Y. Jiang, C. E. Metz, The Univ. of Chicago (United States)</td>
</tr>
<tr>
<td>7627 04</td>
<td>Evaluating the realism of synthetically generated mammographic lesions: an observer study</td>
<td>M. Berks, D. Barbosa da Silva, The Univ. of Manchester (United Kingdom); C. Boggis, Wythenshawe Hospital (United Kingdom); S. Astley, The Univ. of Manchester (United Kingdom)</td>
</tr>
</tbody>
</table>

### SESSION 2 IMAGE DISPLAY AND PRESENTATION

<table>
<thead>
<tr>
<th>Session</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>7627 05</td>
<td>Use of a visual discrimination model to detect compression artifacts in virtual pathology images</td>
<td>J. P. Johnson, Siemens Corporate Research (United States); E. A. Krupinski, The Univ. of Arizona (United States); M. Yan, Siemens Corporate Research (United States); H. Roehrig, The Univ. of Arizona (United States)</td>
</tr>
<tr>
<td>7627 06</td>
<td>Spatial noise suppression for LCD displays: noise contrast</td>
<td>W. J. Dallas, H. Roehrig, The Univ. of Arizona (United States); J. Fan, GE Healthcare (United States); E. A. Krupinski, The Univ. of Arizona (United States); J. P. Johnson, Siemens Corporate Research (United States)</td>
</tr>
<tr>
<td>7627 07</td>
<td>High-fidelity color video reproduction of open surgery by six-band camera</td>
<td>M. Yamaguchi, Y. Murakami, Tokyo Institute of Technology (Japan); H. Hashizume, Kasaoka Daiichi Hospital (Japan); H. Haneishi, Chiba Univ. (Japan); Y. Kanno, NTT Data i Corp. (Japan); Y. Komiya, Olympus Corp. (Japan)</td>
</tr>
<tr>
<td>7627 08</td>
<td>DICOM GSPS affects on contrast detection threshold</td>
<td>D. L. Leong, Analogic Corp. (United States) and Univ. College Dublin (Ireland); T. Miner Haygood, G. J. Whitman, S. Carkaci, P. M. Tchou, The Univ. of Texas M.D. Anderson Cancer Ctr. (United States); P. C. Brennan, The Univ. of Sydney (Australia)</td>
</tr>
</tbody>
</table>
Comprehensive quantitative image quality evaluation of compressed sensing MRI reconstructions using a weighted perceptual difference model (Case-PDM): selective evaluation, disturbance calibration and aggregative evaluation of noise, blur, aliasing and oil-painting artifacts [7627-08]
J. Miao, Case Western Reserve Univ. (United States); F. Huang, Invivo Corp. (United States); D. L. Wilson, Univ. Hospitals of Cleveland (United States) and Case Western Reserve Univ. (United States)

A gaze-contingent high-dynamic range display for medical imaging applications [7627-09]
W.-C. Cheng, A. Badano, U.S. Food and Drug Administration (United States)

The assessment of stroke multidimensional CT and MR imaging using eye movement analysis: does modality preference enhance observer performance? [7627-10]
L. Cooper, A. Gale, Loughborough Univ. (United Kingdom); J. Saada, S. Gedela, Norfolk and Norwich Univ. Hospital NHS Trust (United Kingdom); H. Scott, Loughborough Univ. (United Kingdom); A. Toms, Norwich Radiology Academy (United Kingdom)

Breast screening: visual search as an aid for digital mammographic interpretation training [7627-11]
Y. Chen, Loughborough Univ. (United Kingdom); A. Turnbull, Derby Breast Screening Ctr. (United Kingdom); J. James, Nottingham Breast Institute (United Kingdom); A. Gale, H. Scott, Loughborough Univ. (United Kingdom)

Visual search characteristics in mammogram reading: SFM vs. FFDM [7627-12]
C. Mello-Thoms, Univ. of Pittsburgh (United States)

Eye-position recording during brain MRI examination to identify and characterize steps of glioma diagnosis [7627-13]
C. Cavaro-Ménard, Univ. of Angers (France); J.-Y. Tanguy, Hospital of Angers (France); P. Le Callet, IRRCyN, CNRS, Univ. of Nantes (France)

Reading a radiologist’s mind: monitoring rising and falling interest levels while scanning chest x-rays [7627-14]
M. Alzubaidi, Arizona State Univ. (United States); A. Patel, Mayo Clinic (United States); S. Panchanathan, J. A. Black, Jr., Arizona State Univ. (United States)

Effects of fixed-rate CT projection data compression on perceived and measured CT image quality [7627-15]
A. Wegener, Samplify Systems (United States); N. Chandra, GE Healthcare (United States); Y. Ling, Samplify Systems (United States); R. Senzig, GE Healthcare (United States); R. Herfkens, Stanford Univ. School of Medicine (United States)

Image fade in computed radiography is exacerbated by increased kVp [7627-17]
M. McEntee, Univ. College Dublin (Ireland); M. Foley, AMNCH Tallaght (Ireland)
Optimal processing of isotropic 3D black-blood MRI for accurate estimation of vessel wall thickness [7627-18]
B. Chiu, N. Balu, L. Dong, X. Zhao, C. Yuan, W. S. Kerwin, Univ. of Washington (United States)

Color calibration and color-managed medical displays: does the calibration method matter? [7627-19]
H. Roehrig, K. Rehm, The Univ. of Arizona (United States); L. D. Silverstein, VCD Sciences, Inc. (United States); W. J. Dallas, The Univ. of Arizona (United States); J. Fan, GE Healthcare (United States); E. A. Krupinski, The Univ. of Arizona (United States)

Evaluating segmentation algorithms for diffusion-weighted MR images: a task-based approach (Best Student Paper Award) [7627-20]
A. K. Jha, M. A. Kupinski, College of Optical Sciences, The Univ. of Arizona (United States); J. J. Rodriguez, R. M. Stephen, A. T. Stopec, The Univ. of Arizona (United States)

SESSION 5  HUMAN PERFORMANCE

Does reader visual fatigue impact interpretation accuracy? [7627-21]
E. A. Krupinski, The Univ. of Arizona (United States); K. S. Berbaum, The Univ. of Iowa (United States)

The varying effects of ambient lighting on low contrast detection tasks [7627-22]
M. F. McEntee, Univ. College Dublin (Ireland); B. Martin, Beaumont Hospital (Ireland)

Nuisance levels of noise effects radiologists’ performance [7627-23]
M. F. McEntee, A. Coffey, Univ. College Dublin (Ireland); J. Ryan, The Univ. of Sydney (Australia); A. O’Beirne, Beaumont Hospital (Ireland); R. Toomey, Univ. College Dublin (Ireland); M. Evanoff, The American Board of Radiology (United States); D. Manning, Univ. of Cumbria (United Kingdom); P. C. Brennan, The Univ. of Sydney (Australia)

Impact of adaptation time on contrast sensitivity [7627-24]
D. Apelt, MeVis BreastCare Solutions GmbH & Co. KG (Germany); H. Strasburger, Univ. of Göttingen (Germany); J. Klein, Fraunhofer MEVIS (Germany); B. Preim, Otto-von-Guericke Univ. (Germany)

Spatial resolution and chest nodule detection: an interesting incidental finding [7627-25]
R. J. Toomey, M. F. McEntee, Univ. College Dublin (Ireland); J. T. Ryan, The Univ. of Sydney (Australia); M. G. Evanoff, American Board of Radiology (United States); A. Hayes, Univ. College Dublin (Ireland); P. C. Brennan, The Univ. of Sydney (Australia)

SESSION 6  MODEL OBSERVERS

The use of steerable channels for detecting asymmetrical signals with random orientations [7627-27]
B. Goossens, L. Platša, E. Vansteenkiste, W. Philips, Ghent Univ. (Belgium)

Personalized numerical observer [7627-28]
J. G. Brankov, Illinois Institute of Technology (United States); P. H. Pretorius, Univ. of Massachusetts Medical School (United States)
Using channelized Hotelling observers to quantify temporal effects of medical liquid crystal displays on detection performance [7627-29]
L. Platiša, B. Goossens, E. Vansteenkiste, Ghent Univ. (Belgium); A. Badano, U.S. Food and Drug Administration (United States); W. Philips, Ghent Univ. (Belgium)

Rapid performance evaluation for ideal FROC and AFROC observers [7627-30]
B. Liu, Univ. of Science and Technology of China (China); P. Khurd, Siemens Corporate Research (United States); G. Gindi, Stony Brook Univ. (United States)

Model observers for complex discrimination tasks: assessments of multiple coronary stent placements [7627-31]
S. Zhang, Univ. of California, Santa Barbara (United States); C. K. Abbey, Univ. of California, Santa Barbara (United States) and Univ. of California, Davis (United States); A. Teymoorian, Univ. of California, Santa Barbara (United States); X. Da, J. S. Whiting, Cedars-Sinai Medical Ctr. (United States); M. P. Eckstein, Univ. of California, Santa Barbara (United States)

Influencing clinicians and healthcare managers: can ROC be more persuasive? [7627-32]
S. Taylor-Phillips, Loughborough Univ. (United Kingdom); M. G. Wallis, Addenbrooke's Hospital (United Kingdom); A. Duncan, Univ. Hospital Coventry (United Kingdom); A. G. Gale, Loughborough Univ. (United Kingdom)

Behavior of the decision variables of the three-class ideal observer for univariate trinormal data [7627-33]
D. C. Edwards, C. E. Metz, The Univ. of Chicago (United States)

Therapy operating characteristic (TOC) curves and their application to the evaluation of segmentation algorithms [7627-34]
H. H. Barrett, D. W. Wilson, M. A. Kupinski, K. Aguwa, College of Optical Sciences, The Univ. of Arizona (United States); L. Ewell, R. Hunter, The Univ. of Arizona (United States); S. Müller, Univ. of Duisberg-Essen (Germany)

Binary ROC curve and three-class 2-D ROC surface [7627-35]
X. He, E. C. Frey, The Johns Hopkins School of Medicine (United States)

Measuring modality ordering consistency of observer performance paradigms [7627-36]
D. P. Chakraborty, Univ. of Pittsburgh (United States); F. Zanca, Univ. Hospitals Leuven (Belgium)

The effect of image interpretation training on the fracture recognition performance of radiographers [7627-37]
M. F. McEntee, N. Bergin, Univ. College Dublin (Ireland)

User modeling for improved computer-aided training in radiology: initial experience [7627-38]
M. A. Mazurowski, J. Y. Lo, G. D. Tourassi, Duke Univ. Medical Ctr. (United States)
<table>
<thead>
<tr>
<th>Paper Number</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>7627-39</td>
<td>A novel methodology for display 2D MTF evaluation: the pixel spread function (PxSF)</td>
<td>A. Vetsuypens, C. Marchessoux, T. Kimpe, Barco N.V. (Belgium)</td>
</tr>
<tr>
<td>7627-40</td>
<td>Mammographic feature type and reader variability by occupation: an ROC study</td>
<td>H. J. Scott, A. G. Gale, Loughborough Univ. (United Kingdom)</td>
</tr>
<tr>
<td>7627-41</td>
<td>Toward validation of a 3D structured background model for breast imaging</td>
<td>I. Reiser, S. Lee, K. Little, R. M. Nishikawa, The Univ. of Chicago (United States)</td>
</tr>
<tr>
<td>7627-42</td>
<td>Fuzzy description of skin lesions</td>
<td>N. Laskaris, L. Ballerini, R. B. Fisher, B. Aldridge, J. Rees, The Univ. of Edinburgh (United Kingdom)</td>
</tr>
<tr>
<td>7627-43</td>
<td>Automated detection of analyzable metaphase chromosome cells depicted on scanned digital microscopic images</td>
<td>Y. Qiu, Univ. of Oklahoma (United States); X. Wang, Univ. of Pittsburgh (United States); X. Chen, Y. Li, H. Liu, Univ. of Oklahoma (United States); S. Li, Univ. of Oklahoma Health Sciences Ctr. (United States); B. Zheng, Univ. of Pittsburgh (United States)</td>
</tr>
<tr>
<td>7627-44</td>
<td>Implication of the first decision on visual information-sampling in the spatial frequency domain in pulmonary nodule recognition</td>
<td>M. W. Pietrzyk, Univ. of Cumbria (United Kingdom) and Lancaster Univ. (United Kingdom); D. Manning, Univ. of Cumbria (United Kingdom); T. Donovan, Univ. of Cumbria (United Kingdom) and Lancaster Univ. (United Kingdom); A. Dix, Lancaster Univ. (United Kingdom)</td>
</tr>
<tr>
<td>7627-45</td>
<td>Effect of background detail on CD curve slope in CT head images</td>
<td>K. M. Ogden, SUNY Upstate Medical Univ. (United States); W. Huda, S. Tipnis, Medical Univ. of South Carolina (United States); M. Roskopf, SUNY Upstate Medical Univ. (United States)</td>
</tr>
<tr>
<td>7627-46</td>
<td>A support vector machine designed to identify breasts at high risk using multi-probe generated REIS signals: a preliminary assessment (Cum Laude Poster Award)</td>
<td>D. Gur, B. Zheng, D. Lederman, Univ. of Pittsburgh (United States); S. Dhurjaty, Dhurjaty Electronics Consulting LLC (United States); J. Sumkin, M. Zuley, Univ. of Pittsburgh (United States)</td>
</tr>
<tr>
<td>7627-47</td>
<td>Comparison of algorithms for ultrasound image segmentation without ground truth</td>
<td>K. Sikka, Indian Institute of Technology Guwahati (India); T. M. Deserno, RWTH Aachen Univ. (Germany)</td>
</tr>
<tr>
<td>7627-48</td>
<td>Optimization of detector thickness for single slice helical CT with ROC study</td>
<td>C. Shi, Y. Xing, Tsinghua Univ. (China)</td>
</tr>
<tr>
<td>7627-49</td>
<td>Quantification of radiographic image quality based on patient anatomical contrast-to-noise ratio: a preliminary study with chest images</td>
<td>Y. Lin, Duke Univ. Medical Ctr. (United States); X. Wang, W. J. Sehnert, D. H. Foos, L. Barski, Carestream Health, Inc. (United States); E. Samei, Duke Univ. Medical Ctr. (United States)</td>
</tr>
</tbody>
</table>
Efficacy of fractal analysis in identifying glaucomatous damage [7627-51]
P. Y. Kim, The Univ. of Memphis (United States); K. M. Iftekharuddin, The Univ. of Memphis (United States) and Southern College of Optometry (United States); P. Gunvant, The Univ. of Memphis (United States), Southern College of Optometry (United States), and Univ. of Louisville (United States); M. Tóth, G. Holló, Semmelweis Univ. (Hungary); E. A. Essock, Univ. of Louisville (United States)

Author Index
Conference Committee

Symposium Chairs

Kevin R. Cleary, Georgetown University Medical Center (United States)
Maryellen L. Giger, The University of Chicago (United States)

Conference Chairs

David J. Manning, University of Cumbria (United Kingdom)
Craig K. Abbey, University of California, Santa Barbara (United States)

Program Committee

Kevin S. Berbaum, The University of Iowa Hospitals and Clinics (United States)
Darrin C. Edwards, The University of Chicago (United States)
Brandon D. Gallas, U.S. Food and Drug Administration (United States)
Matthew A. Kupinski, College of Optical Sciences, The University of Arizona (United States)
Anthony J. Maeder, University of Western Sydney (Australia)
Claudia R. Mello-Thoms, University of Pittsburgh (United States)
Berkman Sahiner, University of Michigan (United States)
David L. Wilson, Case Western Reserve University (United States)

Session Chairs

1 Keynote and Breast Lesions
   Berkman Sahiner, University of Michigan (United States)

2 Image Display and Presentation
   David L. Wilson, Case Western Reserve University (United States)

3 Eyetracking and Vision
   David J. Manning, University of Cumbria (United Kingdom)

4 Technology Assessment and Impact
   Weijie Chen, U.S. Food and Drug Administration (United States)

5 Human Performance
   Claudia R. Mello-Thoms, University of Pittsburgh (United States)

6 Model Observers
   Matthew A. Kupinski, College of Optical Sciences, The University of Arizona (United States)
7 ROC and Decision Metrics
Craig K. Abbey, University of California, Santa Barbara (United States)

8 Characterization and Training
David J. Manning, University of Cumbria (United Kingdom)

Poster Session
Darrin C. Edwards, The University of Chicago (United States)
David J. Manning, University of Cumbria (United Kingdom)