Fifty years of SPIE Medical Imaging proceedings papers

Robert M. Nishikawa, a,* Thomas M. Deserno, b Anant Madabhushi, c,d Elizabeth A. Krupinski, e Ronald M. Summers, f Christoph Hoeschen, g Claudia Mello-Thoms, h Kyle J. Myers, i Mathew A. Kupinski, j and Jeffrey H. Siewerdsen k

aUniversity of Pittsburgh, Department of Radiology, Pittsburgh, Pennsylvania, United States

bPeter L. Reichertz Institute for Medical Informatics of TU Braunschweig and Hannover Medical School, Braunschweig, Germany

cCase Western Reserve University, Department of Biomedical Engineering, Cleveland, Ohio, United States
dLouis Stokes Cleveland Veterans Administration Medical Center, Cleveland, Ohio, United States
eEmory University, Department of Radiology and Imaging Sciences, Atlanta, Georgia, United States

fNational Institutes of Health, Radiology and Imaging Sciences, Clinical Center, Bethesda, Maryland, United States
gOtto-von-Guericke University Magdeburg, Institute for Medical Technology, Magdeburg, Germany

hUniversity of Iowa, Department of Radiology, Iowa City, United States

iFormerly, U.S. Food and Drug Administration, Silver Spring, Maryland, United States
jThe University of Arizona, Wyant College of Optical Sciences and Department of Medical Imaging, Tucson, United States

kJohns Hopkins University, Department of Biomedical Engineering, Baltimore, Maryland, United States

Abstract

Purpose: To commemorate the 50th anniversary of the first SPIE Medical Imaging meeting, we highlight some of the important publications published in the conference proceedings.

Approach: We determined the top cited and downloaded papers. We also asked members of the editorial board of the Journal of Medical Imaging to select their favorite papers.

Results: There was very little overlap between the three methods of highlighting papers. The downloads were mostly recent papers, whereas the favorite papers were mostly older papers.

Conclusions: The three different methods combined provide an overview of the highlights of the papers published in the SPIE Medical Imaging conference proceedings over the last 50 years.

© 2022 Society of Photo-Optical Instrumentation Engineers (SPIE) [DOI: 10.1117/1.JMI.9.S1.012207]

Keywords: medical imaging; SPIE Medical Imaging; conference proceedings.

Paper 21293SSVR received Nov. 1, 2021; accepted for publication Apr. 12, 2022; published online Jun. 23, 2022.

1 Introduction

The SPIE seminar “Application of Optical Instrumentation in Medicine” was held in Chicago on November 29 and 30, 1972. This was the first meeting of what is now known as the
SPIE Medical Imaging conference. Milestones are important to mark as they are an opportunity to reflect on what has transpired and where we are going. This contribution will highlight some of the important papers published in the conference proceedings.

2 Methods

We first looked at common metrics such as citations and downloads, which are reported here. We used Lens.org to create the citation lists. It is worth noting that Lens.org, in general, produces fewer citation numbers than a Google search. The download count was taken directly from the SPIE website.

It is not uncommon for a conference paper to be converted to peer-reviewed publication by the authors. So, although the conference paper and the corresponding presentation may have had significance to the field, it is likely that the citations and downloads were for the peer-reviewed versions.

Given this problem, we chose a different tack, albeit one that is very subjective. We asked members of the current Journal of Medical Imaging (JMI) editorial board to write about their favorite SPIE conference paper, and those are also given here. The advantage of asking board members is that, collectively, their expertise spans the subjects presented at Medical Imaging, so it is likely more representative of topics covered.

3 Results

3.1 Citations

Table 1 gives the top 10 conference proceeding papers (across all symposia) cited by decade. As the size and reputation of the SPIE Medical Imaging conference grew, it became more likely that a paper presented at the conference would be cited, and recent papers have fewer citations because they have had less time to be cited compared with older papers.

The highest cited paper was by Cruz-Roa and colleagues, published in 2014, with 216 citations. It was also selected as a “favorite” paper (see next section). The second highest cited paper was by Bunch et al., with 199 citations. This paper describes a method to quantify the area under the free-response operator characteristic curve, and it was a seminal paper in the field. Despite that it was presented in 1977, it is highly cited due in large part to there being no subsequent peer-reviewed publication.

3.2 Downloads

Table 2 lists the top 50 downloaded papers from the conference proceedings. Since downloading from the SPIE website is relatively new, instead of highlighting by decade as with citations, we list the top 50 downloaded conference proceedings papers.

Most of the papers are from the last 10 years ($n = 41$, with only three pre-2000). None of the top downloaded papers were papers selected by the JMI editorial committee. Eleven papers were common to the download and citation lists: papers 7, 9, 10, 30, 35, 39, and 41 corresponding to the 2010 to 2019 list; papers 29 and 38 from the 2000 to 2009 list; and papers 21 and 50 from 1998.

Surprisingly, the top downloaded paper ($n = 4030$), by Wu et al., has only been cited 11 times.

3.3 Personal Favorites

Here, we list papers chosen by some members of the JMI Editorial Board, the person who chose it, and a brief explanation of why they did. The papers are listed in chronological order. The first two papers listed were also among the most cited papers.
Table 1  The top 10 cited papers published in the SPIE Medical Imaging conference proceedings by decade.

| Authors                  | Title                                                                 | Year | Proceedings title                                      | Volume | Number of citations |
|--------------------------|------------------------------------------------------------------------|------|--------------------------------------------------------|--------|--------------------|
| Years: 1972 to 1979      |                                                                        |      |                                                        |        |                    |
| Bunch et al.\(^1\)       | A free-response approach to the measurement and characterization of radiographic-observer performance | 1977 | Application of Optical Instrumentation in Medicine VI | 127    | 199                |
| Winkler\(^2\)            | Quality control in diagnostic radiology                               | 1975 | Application of Optical Instrumentation in Medicine IV | 70     | 71                 |
| Frost et al.\(^3\)       | A digital video acquisition system for extraction of subvisual information in diagnostic medical imaging | 1977 | Application of Optical Instrumentation in Medicine VI | 127    | 34                 |
| Yester and Barnes\(^4\)  | Geometrical limitations of computed tomography (CT) scanner resolution | 1977 | Application of Optical Instrumentation in Medicine VI | 127    | 33                 |
| Jucius and Kambic\(^5\)  | Radiation dosimetry in computed tomography (CT)                      | 1977 | Application of Optical Instrumentation in Medicine VI | 127    | 33                 |
| Wagner and Weaver\(^6\)  | An assortment of image quality indexes for radiographic film-screen combinations – can they be resolved? | 1972 | Application of Optical Instrumentation in Medicine I  | 35     | 26                 |
| Burgess et al.\(^7\)     | Detection of bars and discs in quantum noise                          | 1979 | Application of Optical Instrumentation in Medicine VII| 173    | 20                 |
| Kinsey et al.\(^8\)      | Application of digital image change detection to diagnosis and follow-up of cancer involving the lungs | 1975 | Application of Optical Instrumentation in Medicine IV | 70     | 16                 |
| Hanson\(^9\)             | Detectability in the presence of computed tomographic reconstruction noise | 1977 | Application of Optical Instrumentation in Medicine VI | 127    | 15                 |
| Doi and Rossmann\(^10\)  | Evaluation of focal spot distribution by RMS value and its effect on blood vessel imaging in angiography | 1974 | Application of Optical Instrumentation in Medicine III| 47     | 14                 |
| Years: 1980 to 1989      |                                                                        |      |                                                        |        |                    |
| Lewitt et al.\(^11\)     | Fourier method for correction of depth-dependent collimator blurring  | 1989 | Medical Imaging III: Image Processing                  | Volume | Citing Works Count |
| Evans et al.\(^12\)      | Anatomical-functional correlative analysis of the human brain using three-dimensional imaging systems | 1989 | Medical Imaging III: Image Processing                  | 1092   | 108                |

Downloaded From: https://www.spiedigitallibrary.org/journals/Journal-of-Medical-Imaging on 15 Nov 2022
Terms of Use: https://www.spiedigitallibrary.org/terms-of-use
Table 1 (Continued).

| Authors            | Title                                                                 | Year | Proceedings title                                                                 | Volume | Number of citations |
|--------------------|----------------------------------------------------------------------|------|----------------------------------------------------------------------------------|--------|---------------------|
| LeFree et al.      | Digital radiographic assessment of coronary arterial geometric diameter and videodensitometric cross-sectional area | 1986 | Application of Optical Instrumentation in Medicine XIV and Picture Archiving and Communication Systems | 1092   | 106                 |
| Pizer et al.       | Adaptive histogram equalization for automatic contrast enhancement of medical images | 1986 | Application of Optical Instrumentation in Medicine XIV and Picture Archiving and Communication Systems | 626    | 60                  |
| Gamboa-Aldeco et al. | Correlation of 3D surfaces from multiple modalities in medical imaging | 1986 | Application of Optical Instrumentation in Medicine XIV and Picture Archiving and Communication Systems | 626    | 42                  |
| Hoffmann et al.    | Automated tracking of the vascular tree in DSA images using a double-square-box region-of-search algorithm | 1986 | Application of Optical Instrumentation in Medicine XIV and Picture Archiving and Communication Systems | 626    | 41                  |
| Hanson             | Variations in task and the ideal observer                            | 1983 | Application of Optical Instrumentation in Medicine XI                             | 626    | 40                  |
| Hohne et al.       | Display of multiple 3D-objects using the generalized voxel-model     | 1988 | Medical Imaging II                                                               | 419    | 39                  |
| Kuklinski et al.   | Application of fractal texture analysis to segmentation of dental radiographs | 1989 | Medical Imaging III: Image Processing                                            | 914    | 35                  |
| Loo et al.         | An empirical investigation of variability in contrast-detail diagram measurements | 1983 | Application of Optical Instrumentation in Medicine XI                             | 1092   | 34                  |
| Years: 1990 to 1999 |                                                                      |      |                                                                                  |        |                     |
| Evans et al.       | Warping of a computerized 3-D atlas to match brain image volumes for quantitative neuroanatomical and functional analysis | 1991 | Medical Imaging V: Image Processing                                              | 1445   | 190                 |
| Udupa et al.       | 3DVIEWNIX: an open, transportable, multidimensional, multimodality, multiparametric imaging software system | 1994 | Medical Imaging 1994: Image Capture, Formatting, and Display                      | 2164   | 129                 |
| Abboud et al.      | Finite element modeling for ultrasonic transducers                   | 1998 | Medical Imaging 1998: Ultrasonic Transducer Engineering                           | 3341   | 119                 |
| Lee et al.         | New digital detector for projection radiography                      | 1995 | Medical Imaging 1995: Physics of Medical Imaging                                  | 2432   | 115                 |
| McKeighen          | Design guidelines for medical ultrasonic arrays                      | 1998 | Medical Imaging 1998: Ultrasonic Transducer Engineering                           | 3341   | 94                  |
Table 1 (Continued).

| Authors            | Title                                                                                                                                  | Year | Proceedings title                                                                 | Volume | Number of citations |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------------------------------------------------------------|--------|--------------------|
| Seibert et al.26   | Flat-field correction technique for digital detectors                                                                              | 1998 | Medical Imaging 1998: Physics of Medical Imaging                                    | 3336   | 92                 |
| Barrett et al.27    | Stabilized estimates of Hotelling-observer detection performance in patient-structured noise                                          | 1998 | Medical Imaging 1998: Image Perception                                             | 3340   | 78                 |
| Hasegawa et al.28   | Description of a simultaneous emission-transmission CT system                                                                        | 1990 | Medical Imaging IV: Image Formation                                                | 1231   | 74                 |
| Cotton and Claridge33 | Developing a predictive model of human skin coloring                                                                                | 1996 | Medical Imaging 1996: Physics of Medical Imaging                                   | 2708   | 71                 |
| Koch et al.30       | X-ray camera for computed microtomography of biological samples with micrometer resolution using Lu₃Al₅O₁₂ and Y₃Al₅O₁₂ scintillators | 1999 | Medical Imaging 1999: Physics of Medical Imaging                                  | 3659   | 70                 |
| Chaussat et al.31   | New CsIa-Si 17 x 17 X-ray flat panel detector provides superior detectivity and immediate direct digital output for general radiography systems | 1998 | Medical Imaging 1998: Physics of Medical Imaging                                  | 3336   | 70                 |
| Years: 2000 to 2009 |                                                                                                                                       |      |                                                                                   |        |                    |
| Mertelmeier et al.32 | Optimizing filtered backprojection reconstruction for a breast tomosynthesis prototype device                                      | 2006 | Medical Imaging 2006: Physics of Medical Imaging                                  | 6142   | 157                |
| Gueld et al.33      | Quality of DICOM header information for image categorization                                                                       | 2002 | Medical Imaging 2002: PACS and Integrated Medical Information Systems: Design and Evaluation | 4685   | 148                |
| Lehmann et al.34    | The IRMA code for unique classification of medical images                                                                           | 2003 | Medical Imaging 2003: PACS and Integrated Medical Information Systems: Design and Evaluation | 5033   | 144                |
| Seifert et al.35    | Hierarchical parsing and semantic navigation of full body CT data                                                                         | 2009 | Medical Imaging 2009: Image Processing                                            | 7259   | 128                |
| Clunie36            | Lossless compression of grayscale medical images: effectiveness of traditional and state of the art approaches                       | 2000 | Medical Imaging 2000: PACS Design and Evaluation: Engineering and Clinical Issues | 3980   | 111                |
| Mizutani et al.37   | Automated microaneurysm detection method based on double ring filter in retinal fundus images                                         | 2009 | Medical Imaging 2009: Computer-Aided Diagnosis                                    | 7260   | 97                 |
| Authors          | Title                                                                 | Year | Proceedings title                                                                 | Volume | Number of citations |
|------------------|----------------------------------------------------------------------|------|-----------------------------------------------------------------------------------|--------|--------------------|
| Michael Fitzpatrick\(^\text{38}\) | Fiducial registration error and target registration error are uncorrelated | 2009 | Medical Imaging 2009: Visualization, Image-Guided Procedures, and Modeling          | 7261   | 95                 |
| Zou and Silver\(^\text{39}\)    | Analysis of fast kV-switching in dual energy CT using a pre-reconstruction decomposition technique | 2008 | Medical Imaging 2008: Physics of Medical Imaging                                   | 6913   | 89                 |
| Lankton et al.\(^\text{40}\)    | Hybrid geodesic region-based curve evolutions for image segmentation  | 2007 | Medical Imaging 2007: Physics of Medical Imaging                                   | 6510   | 89                 |
| Bissonnette et al.\(^\text{41}\) | Digital breast tomosynthesis using an amorphous selenium flat panel detector | 2005 | Medical Imaging 2005: Physics of Medical Imaging                                   | 5745   | 88                 |
| Years: 2010 to 2019 |                                                                                       |      |                                                                                    |        |                    |
| Cruz-Roa et al.\(^\text{42}\)   | Automatic detection of invasive ductal carcinoma in whole slide images with convolutional neural networks | 2014 | Medical Imaging 2014: Digital Pathology                                           | 9041   | 261                |
| Bar et al.\(^\text{43}\)         | Deep learning with non-medical training used for chest pathology identification      | 2015 | Medical Imaging 2015: Computer-Aided Diagnosis                                     | 9414   | 187                |
| Roth et al.\(^\text{44}\)        | Deep convolutional networks for pancreas segmentation in CT imaging                  | 2015 | Medical Imaging 2015: Image Processing                                            | 9413   | 109                |
| Sun et al.\(^\text{45}\)         | Computer aided lung cancer diagnosis with deep learning algorithms                  | 2016 | Medical Imaging 2016: Computer-Aided Diagnosis                                     | 9785   | 108                |
| Hwang et al.\(^\text{46}\)       | A novel approach for tuberculosis screening based on deep convolutional neural networks | 2016 | Medical Imaging 2016: Computer-Aided Diagnosis                                     | 9785   | 86                 |
| Liu et al.\(^\text{47}\)         | Prostate cancer diagnosis using deep learning with 3D multiparametric MRI           | 2017 | Medical Imaging 2017: Computer-Aided Diagnosis                                     | 10134  | 72                 |
| Wang et al.\(^\text{48}\)        | Cascaded ensemble of convolutional neural networks and handcrafted features for mitosis detection | 2014 | Medical Imaging 2014: Digital Pathology                                           | 9041   | 71                 |
| Kappler et al.\(^\text{49}\)     | First results from a hybrid prototype CT scanner for exploring benefits of quantum-counting in clinical CT | 2012 | Medical Imaging 2012: Physics of Medical Imaging                                   | 8313   | 68                 |
| Kim et al.\(^\text{50}\)         | A deep semantic mobile application for thyroid cytopathology                         | 2016 | Medical Imaging 2016: PACS and Imaging Informatics: Next Generation and Innovations | 9789   | 66                 |
| Anirudh et al.\(^\text{51}\)     | Lung nodule detection using 3D convolutional neural networks trained on weakly labeled data | 2016 | Medical Imaging 2016: Computer-Aided Diagnosis                                     | 9785   | 62                 |
Table 2  The top 50 downloads for papers published in the SPIE Medical Imaging conference proceedings.

| Authors          | Title                                                                                                                                 | Year | Volume | Number of downloads |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------|------|--------|---------------------|
| Wu et al.        | Fully automated chest wall line segmentation in breast MRI using context information                                                | 2012 | 8315   | 4030                |
| Fang et al.      | Unsupervised learning-based deformable registration of temporal chest radiographs to detect interval change                              | 2020 | 11313  | 2528                |
| Koenrades et al. | Validation of an image registration and segmentation method to measure stent graft motion on ECG-gated CT using a physical dynamic stent graft model | 2017 | 10134  | 2112                |
| Wegmayr et al.   | Classification of brain MRI with big data and deep 3D convolutional neural networks                                                  | 2018 | 10575  | 1878                |
| Ayyagari et al.  | Image reconstruction using priors from deep learning                                                                              | 2018 | 10574  | 1858                |
| Ruiter et al.    | USCT data challenge                                                                                                                  | 2017 | 10139  | 1707                |
| Bar et al.       | Deep learning with non-medical training used for chest pathology identification                                                       | 2015 | 9414   | 1457                |
| Mattes et al.    | Nonrigid multimodality image registration                                                                                            | 2001 | 4322   | 1398                |
| Cruz-Roa et al.  | Automatic detection of invasive ductal carcinoma in whole slide images with convolutional neural networks                              | 2014 | 9041   | 1304                |
| Sun et al.       | Computer aided lung cancer diagnosis with deep learning algorithms                                                                   | 2016 | 9785   | 1300                |
| Alex et al.      | Generative adversarial networks for brain lesion detection                                                                            | 2017 | 10133  | 1290                |
| Ramachandran S et al. | Using YOLO based deep learning network for real time detection and localization of lung nodules from low dose CT scans                 | 2018 | 10575  | 1183                |
| Umehara et al.   | Super-resolution convolutional neural network for the improvement of the image quality of magnified images in chest radiographs     | 2017 | 10133  | 1174                |
| Madani et al.    | Chest x-ray generation and data augmentation for cardiovascular abnormality classification                                            | 2018 | 10574  | 1142                |
| Gjestebry et al. | Deep learning methods to guide CT image reconstruction and reduce metal artifacts                                                    | 2017 | 10132  | 1122                |
| Jnawali et al.   | Deep 3D convolution neural network for CT brain hemorrhage classification                                                             | 2018 | 10575  | 1096                |
| Wei et al.       | Anomaly detection for medical images based on a one-class classification                                                              | 2018 | 10575  | 1048                |
| Eppenhof et al.  | Deformable image registration using convolutional neural networks                                                                       | 2018 | 10574  | 1005                |
| Vassallo et al.  | Hologram stability evaluation for Microsoft HoloLens                                                                                | 2017 | 10136  | 1002                |
| Dong et al.      | Sinogram interpolation for sparse-view micro-CT with deep learning neural network                                                     | 2019 | 10948  | 983                 |
| Seibert et al.   | Flat-field correction technique for digital detectors                                                                               | 1998 | 3336   | 838                 |
| Authors | Title | Year | Volume | Number of downloads |
|---------|-------|------|--------|--------------------|
| 22 Bowles et al. | Modelling the progression of Alzheimer’s disease in MRI using generative adversarial networks | 2018 | 10574 | 815 |
| 23 Funke et al. | Generative adversarial networks for specular highlight removal in endoscopic images | 2018 | 10576 | 807 |
| 24 Duric et al. | Breast imaging with the SoftVue imaging system: first results | 2013 | 8675 | 786 |
| 25 Choi et al. | Fast low-dose compressed-sensing (CS) image reconstruction in four-dimensional digital tomosynthesis using on-board imager (OBI) | 2018 | 10573 | 782 |
| 26 Mescher and Lemmer | Hybrid organic-inorganic perovskite detector designs based on multilayered device architectures: simulation and design | 2019 | 10948 | 777 |
| 27 Jerman et al. | Beyond Frangi: an improved multiscale vesselness filter | 2015 | 9413 | 771 |
| 28 Lauritsch and Haerer | Theoretical framework for filtered back projection in tomosynthesis | 1998 | 3338 | 750 |
| 29 Mizutani et al. | Automated microaneurysm detection method based on double ring filter in retinal fundus images | 2009 | 7260 | 735 |
| 30 Roth et al. | Deep convolutional networks for pancreas segmentation in CT imaging | 2015 | 9413 | 735 |
| 31 de Vos et al. | 2D image classification for 3D anatomy localization: employing deep convolutional neural networks | 2016 | 9784 | 727 |
| 32 Ionita et al. | Challenges and limitations of patient-specific vascular phantom fabrication using 3D Polyjet printing | 2014 | 9038 | 724 |
| 33 Clark et al. | Multi-energy CT decomposition using convolutional neural networks | 2018 | 10573 | 715 |
| 34 Peng et al. | Design, optimization and testing of a multi-beam micro-CT scanner based on multi-beam field emission x-ray technology | 2010 | 7622 | 712 |
| 35 Liu et al. | Prostate cancer diagnosis using deep learning with 3D multiparametric MRI | 2017 | 10134 | 702 |
| 36 Tsehay et al. | Convolutional neural network based deep-learning architecture for prostate cancer detection on multiparametric magnetic resonance images | 2017 | 10134 | 686 |
| 37 Graff | A new, open-source, multi-modality digital breast phantom | 2016 | 9783 | 684 |
| 38 Mertelmeier et al. | Optimizing filtered backprojection reconstruction for a breast tomosynthesis prototype device | 2006 | 6142 | 671 |
| 39 Hwang et al. | A novel approach for tuberculosis screening based on deep convolutional neural networks | 2016 | 9785 | 660 |
| 40 Hamidian et al. | 3D convolutional neural network for automatic detection of lung nodules in chest CT | 2017 | 10134 | 636 |
| 41 Anirudh et al. | Lung nodule detection using 3D convolutional neural networks trained on weakly labeled data | 2016 | 9785 | 632 |
| 42 Moriya et al. | Unsupervised segmentation of 3D medical images based on clustering and deep representation learning | 2018 | 10578 | 623 |
3.3.1 An assortment of image quality indexes for radiographic film-screen combinations: can they be resolved?

Wagner and Weaver

Kyle Myers: Bob Wagner’s 1972 paper on figures of merit launched his career and began that long trajectory of papers at SPIE Medical Imaging that pushed forward the development of figures of merit for the evaluation of medical imaging systems. Note that it was presented at the first Medical Imaging meeting.

Christoph Hoeschen: I also really liked that paper when coming across this nearly 30 years after it had been published, really explaining a lot to me. Currently, some approaches of vendors and regulators in Europe are looking again into potentially useful figures of merit in medical imaging especially in CT.

3.3.2 Variations in task and the ideal observer

Hanson

Jeffrey Siewerdsen: Ken Hanson was one of the giant pioneers of modern image science (alongside Wagner, Myers, and Barrett and some others), and I always found Ken’s formulation of “task” in a mathematical sense to be so enjoyable and profound. He was not alone, of course—joined by those other giants—but I always found his papers on “task” to focus on the task concept in ways that were beautifully explained both analytically and intuitively. I believe it made its way in to ICRU 54, and it was my original inspiration for “task-based optimization” for digital x-ray detectors etc. and of course, he was at least 25 years ahead of his time regarding “task-based” assessment of image quality, which is now ubiquitous in a more general sense.

3.3.3 Principles governing the transfer of signal modulation and photon noise by amplifying and scattering mechanisms

Dillon et al.
Robert Nishikawa: This paper launched research into cascaded linear systems analysis. It was the beginning of intense investigation by several groups, including Rabbani, Van Metter and Shaw, Nishikawa and Yaffe, Cunningham, Siewerdsen, Maidment, Zhao, and others. From this research emerged the field of virtual clinical trials.

3.3.4 Detection and discrimination of known signals in inhomogeneous, random backgrounds

Barrett et al.⁹²

Kyle Myers: Over the next years at SPIE Medical Imaging, starting in 1981, there were some back-and-forth papers by Harry Barrett (who was working on coded apertures for nuclear medicine applications) and Bob Wagner (who in 1981, published a paper that coded apertures could be inferior to an aperture with poor resolution), eventually leading them to co-write the paper from 1989 that tells a joint story. In a nutshell (last line of the abstract), “predictions of image quality based on stylized tasks with uniform background must be viewed with caution.” We can trace virtual clinical trials back to these early works.

3.3.5 Clinical evaluation of PACS: modeling diagnostic value

Kundel et al.⁹³

Elizabeth A. Krupinski: I like this paper because it, very early on in PACS development, put the user center-stage and focused on the importance of the user, task, information flow and diagnostic value and outcomes. These principles remain critical today in any system evaluation, but are often not taken into account. This paper reminds us that the user/radiologist should drive technology adoption and implementation not just the availability of technology.

3.3.6 Mammographic structure: data preparation and spatial statistics analysis

Burgess⁹⁴

Christoph Hoeschen: The paper of Art Burgess was actually presented in the first SPIE Medical Imaging conference I had the chance to attend. At that time, I was trying in my PhD thesis to determine the information content of structures in real patient images. The paper by Art Burgess showed how important approaches are to characterize content of the images. Since he is referring to the power spectrum of the images it is a little different approach than what I did but it showed the general importance very well. His paper was mentioned in various later contributions trying for example to build detection tasks and characterizing the background for this. Actually, in a current approach for a project funded by the European Commission (EC), where we try to determine objective image quality from patient images and relate this to subjective image quality measures, we use the power spectrum again. In addition, I think the paper is mathematically very clear and well written.

Robert Nishikawa: While not the first paper to study anatomical noise and human and model observers, it established the power law relationship of mammographic anatomical noise and its effect on lesion detectability. Burgess showed, what was at the time unintuitive, that anatomical noise was the dominant noise source for detecting masses, and that quantum noise was only important for the detection of microcalcifications. This research was the starting point for studies on the design of anatomical phantoms, detectability in two-dimensional (2D) versus three-dimensional (3D) imaging, improving task-based modeling and analyses, and model observer studies using more realistic backgrounds.

3.3.7 Megalopinakophobia: its symptoms and cures

Barrett et al.⁹⁵

Mathew Kupinski: This paper is extremely useful as it describes a number of methods for dealing with large matrices and the computation of image quality for the Hotelling observer and other similar observer models. I also really enjoy the cheekiness of the paper as the title word...
“megalopinakophobia” translates to “fear of large matrices.” This paper could easily have been a peer-reviewed publication but represents a great contribution to the SPIE literature.

3.3.8 Content-based image retrieval in medical applications for picture archiving and communication systems
Lehmann et al.\textsuperscript{96}

3.3.9 Extended query refinement for content-based access to large medical image databases.
Lehmann et al.\textsuperscript{97}

Thomas M. Deserno: Content-based image retrieval (CBIR) was introduced to medical applications in the early 2000s. Since then, CBIR has been applied in medical research and is now established in some commercial systems, too. Presented almost 20 years ago at Medical Imaging, these SPIE papers\textsuperscript{96,97} were one of the first transferring CBIR into the medical domain, long before the follow-ups were published peer-reviewed in the Methods of Information in Medicine (2004)\textsuperscript{98} and in the Journal of Digital Imaging (2008),\textsuperscript{99} respectively. The latter received the Journal of Digital Imaging 2008 Best Paper Award, First Place (technical). This demonstrates that outstanding research is presented at SPIE Medical Imaging a couple of years before it becomes published in journals. This is the reason why I’m enjoying the meeting year by year, as so many new ideas are presented here first.

3.3.10 Comparative study of retinal vessel segmentation methods on a new publicly available database
Niemeijer et al.\textsuperscript{85}

Ronald Summers: This paper is an early example of a publicly released dataset for algorithm performance comparisons. It has been cited 511 times according to Web of Knowledge [the most according to a search for “SPIE Medical Imaging” that found 28,828 results from the Conference Proceedings Citation Index—Science (CPCI-S)]. Publicly released datasets have had a major impact on the development of object recognition, segmentation, and computer-aided diagnosis across many areas of medical imaging. Challenges (competitions) using public datasets have inspired many trainees and early career investigators to specialize in medical image analysis.

3.3.11 Reader error, object recognition, and visual search
Kundel\textsuperscript{100}

3.3.12 How to minimize perceptual error and maximize expertise in medical imaging
Kundel\textsuperscript{101}

Claudia Mello-Thoms: The reason why I selected these papers is because reader error in medical imaging is still at the same rates that it was 40 years ago when Dr. Kundel started doing his research, despite the advances in technology. In these papers,\textsuperscript{100,101} he created a taxonomy of error where he divided them in three categories, technological (which is not common), perceptual and cognitive. Perceptual errors are still responsible for about 60% of false negatives in medical imaging, whereas cognitive errors are responsible for about the remaining 40%. Despite the many interventions derived to improve the rates of perceptual errors, they all have failed, and we still do not understand what really causes these errors. We know that visual search plays a role in both perceptual and cognitive errors, but we don’t know how to improve visual search so as to reduce the 40 million errors per year that occur worldwide in medical imaging.
3.3.13 Mitosis detection in breast cancer pathology images by combining handcrafted and convolutional neural network features

Wang et al.102

Anant Madabhushi: The paper set the stage for combining hand-crafted engineered feature approaches with deep learning for breast cancer digital pathology. While a number of papers have subsequently dealt with the topic of combining hand-crafted and deep learning based approaches for digital pathology and medical imaging applications, this was one of the early examples showing the possibility of this type of integration. This conference proceeding was ultimately published in JMI. At the time of writing the journal version of the paper was the second most highly cited paper in JMI (266), the conference paper has been cited over a 100 times already.

4 Concluding Remarks

As highlighted here, papers presented at the SPIE Medical Imaging conference have had a large and significant impact on the field of medical imaging. The meeting has grown over the last 50 years to become one of the most important meetings on the technical and practical aspects of medical imaging, for the latest concept and results are presented in SPIE Medical Imaging proceedings, long before they get published in the established journals in our field. In 2000, SPIE published the three-volume *Handbook of Medical Imaging*.103-105 Many of the authors of this compendium were regular attendees of the SPIE Medical Imaging conference, and they provided a comprehensive overview of the many topics presented at the meeting.

Disclosures

Ronald Summers receives royalties for patents or software licenses from iCAD, Philips, PingAn, ScanMed, Translation Holdings and research funding through a Cooperative Research and Development Agreement with PingAn. Anant Madabhushi is an equity holder in Elucid Bioimaging and in Inspirata Inc. In addition, he has served as a scientific advisory board member for Inspirata Inc., Astrazeneca, Bristol Meyers-Squibb, and Merck. Currently he serves on the advisory board of Aiforia Inc. and currently consults for Caris, Roche, Cernostics, and Aiforia. He also has sponsored research agreements with Philips, AstraZeneca, Boehringer-Ingelheim, and Bristol Meyers-Squibb. His technology has been licensed to Elucid Bioimaging. He is also involved in three different R01 grants with Inspirata Inc. Jeffrey Siewerdsen has research, licensing, and/or advising relationships with Elekta Oncology (Stockholm, Sweden), Siemens Healthineers (Forchheim, Germany), Carestream Health (Rochester, USA), Medtronic (Minneapolis, USA), PXI (Toronto, Canada), Izotropic (Surrey, Canada), and The Phantom Lab (Greenwich, USA).

Acknowledgments

We thank Gwen Weerts, SPIE Journals manager, for collecting the download list and assisting on the citation lists. This part of this work was supported in part by the Intramural Research Program of the National Institutes of Health Clinical Center (RMS). The opinions expressed herein are those of the authors and do not necessarily represent those of the National Institutes of Health or the Department of Health and Human Services.

References

1. P. C. Bunch et al., “A free-response approach to the measurement and characterization of radiographic-observer performance,” *Proc. SPIE* **0127**, 124–135 (1977).
2. N. T. Winkler, “Quality control in diagnostic radiology,” *Proc. SPIE* **0070**, 125–131 (1976).
3. M. M. Frost et al., “A digital video acquisition system for extraction of subvisual information in diagnostic medical imaging,” *Proc. SPIE* **0127**, 208–215 (1977).
4. M. V. Yester and G. T. Barnes, “Geometrical limitations of computed tomography (CT) scanner resolution,” *Proc. SPIE* **0127**, 296–303 (1977).
5. R. A. Jucius and G. X. Kambic, “Radiation dosimetry in computed tomography (CT),” *Proc. SPIE* **0127**, 286–295 (1977).
6. R. F. Wagner and K. E. Weaver, “An assortment of image quality indexes for radiographic film-screen combinations – can they be resolved?” *Proc. SPIE* **0035**, 83–94 (1972).
7. A. E. Burgess, K. Humphrey, and R. F. Wagner, “Detection of bars and discs in quantum noise,” *Proc. SPIE* **0173**, 34–40 (1979).
8. J. H. Kinsey et al., “Application of digital image change detection to diagnosis and follow-up of cancer involving the lungs,” *Proc. SPIE* **0070**, 99–112 (1976).
9. K. M. Hanson, “Detectability in the presence of computed tomographic reconstruction noise,” *Proc. SPIE* **0127**, 304–312 (1977).
10. K. Doi and K. Rossmann, “Evaluation of focal spot distribution by RMS value and its effect on blood vessel imaging in angiography,” *Proc. SPIE* **0047**, 207–213 (1975).
11. R. M. Lewitt, P. R. Edholm, and W. Xia, “Fourier method for correction of depth-dependent collimator blurring,” *Proc. SPIE* **1092**, 232–243 (1989).
12. A. C. Evans et al., “Anatomical-functional correlative analysis of the human brain using three dimensional imaging systems,” *Proc. SPIE* **1092**, 264–274 (1989).
13. M. T. LeFree et al., “Digital radiographic assessment of coronary arterial geometric diameter and videodensitometric cross-sectional area,” *Proc. SPIE* **0626**, 334–341 (1986).
14. S. M. Pizer et al., “Adaptive histogram equalization for automatic contrast enhancement of medical images,” *Proc. SPIE* **0626**, 242–250 (1986).
15. A. Gamboa-Aldeco, L. L. Fellingham, and G. T. Y. Chen, “Correlation of 3D surfaces from multiple modalities in medical imaging,” *Proc. SPIE* **0626**, 467–473 (1986).
16. K. R. Hoffmann et al., “Automated tracking of the vascular tree in DSA images using a double-square-box region-of-search algorithm,” *Proc. SPIE* **0626**, 326–333 (1986).
17. K. M. Hanson, “Variations in task and the ideal observer,” *Proc. SPIE* **0419**, 60–67 (1983).
18. K.-H. Hohne et al., “Display of multiple 3D-objects using the generalized voxel-model,” *Proc. SPIE* **0914**, 850–854 (1988).
19. W. S. Kuklinski et al., “Application of fractal texture analysis to segmentation of dental radiographs,” *Proc. SPIE* **1092**, 111–117 (1989).
20. L. N. D. Loo et al., “An empirical investigation of variability in contrast-detail diagram measurements,” *Proc. SPIE* **0419**, 69–76 (1983).
21. A. C. Evans et al., “Warping of a computerized 3-D atlas to match brain image volumes for quantitative neuroanatomical and functional analysis,” *Proc. SPIE* **1445**, 236–246 (1991).
22. J. K. Udupa et al., “3DVIEWNIX: an open, transportable, multidimensional, multimodality, multiparametric imaging software system,” *Proc. SPIE* **2164**, 58–73 (1994).
23. N. N. Abboud et al., “Finite element modeling for ultrasonic transducers,” *Proc. SPIE* **3341**, 19–42 (1998).
24. D. L. Y. Lee, L. K. Cheung, and L. S. Jeromin, “New digital detector for projection radiography,” *Proc. SPIE* **2432**, 237–249 (1995).
25. R. E. McKeighen, “Design guidelines for medical ultrasonic arrays,” *Proc. SPIE* **3341**, 2–18 (1998).
26. J. A. Seibert, J. M. Boone, and K. K. Lindfors, “Flat-field correction technique for digital detectors,” *Proc. SPIE* **3336**, 348–354 (1998).
27. H. H. Barrett et al., “Stabilized estimates of Hotelling-observer detection performance in patient-structured noise,” *Proc. SPIE* **3340**, 27–43 (1998).
28. B. H. Hasegawa et al., “Description of a simultaneous emission-transmission CT system,” *Proc. SPIE* **1231**, 50–60 (1990).
29. S. Cotton and E. Claridge, “Developing a predictive model of human skin coloring,” *Proc. SPIE* **2708**, 1 (1996).
30. A. Koch et al., “X-ray camera for computed microtomography of biological samples with micrometer resolution using Lu₃Al₅O₁₂ and Y₃Al₅O₁₂ scintillators,” Proc. SPIE 3659, 170–179 (1999).
31. A. Chausat et al., “New CsI/a-Si 17”×17” x-ray flat-panel detector provides superior detectivity and immediate direct digital output for general radiography systems,” Proc. SPIE 3336, 45–56 (1998).
32. T. Mertelmeier et al., “Optimizing filtered backprojection reconstruction for a breast tomosynthesis prototype device,” Proc. SPIE 6142, 61420F (2006).
33. M. O. Gueld et al., “Quality of DICOM header information for image categorization,” Proc. SPIE 4685, 280–287 (2002).
34. T. M. Lehmann et al., “The IRMA code for unique classification of medical images,” Proc. SPIE 5033, 440–451 (2003).
35. S. Seifert et al., “Hierarchical parsing and semantic navigation of full body CT data,” Proc. SPIE 7259, 725902 (2009).
36. D. A. Clunie, “Lossless compression of grayscale medical images: effectiveness of traditional and state-of-the-art approaches,” Proc. SPIE 3980, 74–84 (2000).
37. A. Mizutani et al., “Automated microaneurysm detection method based on double ring filter in retinal fundus images,” Proc. SPIE 7260, 72601N (2009).
38. J. M. Fitzpatrick, “Fiducial registration error and target registration error are uncorrelated,” Proc. SPIE 7261, 726102 (2009).
39. Y. Zou and M. D. Silver, “Analysis of fast kV-switching in dual energy CT using a pre-reconstruction decomposition technique,” Proc. SPIE 6913, 691313 (2008).
40. S. Lankton et al., “Hybrid geodesic region-based curve evolutions for image segmentation,” Proc. SPIE 6510, 65104U (2007).
41. M. Bissonnette et al., “Digital breast tomosynthesis using an amorphous selenium flat panel detector,” Proc. SPIE 5745, 529–540 (2005).
42. A. Cruz-Roa et al., “Automatic detection of invasive ductal carcinoma in whole slide images with convolutional neural networks,” Proc. SPIE 9041, 904107 (2014).
43. Y. Bar et al., “Deep learning with non-medical training used for chest pathology identification,” Proc. SPIE 9414, 94140V (2015).
44. H. R. Roth et al., “Deep convolutional networks for pancreas segmentation in CT imaging,” Proc. SPIE 9413, 94131G (2015).
45. W. Sun, B. Zheng, and W. Qian, “Computer aided lung cancer diagnosis with deep learning algorithms,” Proc. SPIE 9785, 97850Z (2016).
46. S. Hwang et al., “A novel approach for tuberculosis screening based on deep convolutional neural networks,” Proc. SPIE 9785, 97852W (2016).
47. S. Liu et al., “Prostate cancer diagnosis using deep learning with 3D multiparametric MRI,” Proc. SPIE 10134, 1013428 (2017).
48. H. Wang et al., “Cascaded ensemble of convolutional neural networks and handcrafted features for mitosis detection,” Proc. SPIE 9041, 90410B (2014).
49. S. Kappler et al., “First results from a hybrid prototype CT scanner for exploring benefits of quantum-counting in clinical CT,” Proc. SPIE 8313, 83130X (2012).
50. E. Kim, M. Corte-Real, and Z. W. Baloch, “A deep semantic mobile application for thyroid cytopathology,” Proc. SPIE 9789, 97890A (2016).
51. R. Anirudh et al., “Lung nodule detection using 3D convolutional neural networks trained on weakly labeled data,” Proc. SPIE 9785, 978532 (2016).
52. S. Wu et al., “Fully automated chest wall line segmentation in breast MRI by using context information,” Proc. SPIE 8315, 831507 (2012).
53. Q. Fang et al., “Unsupervised learning-based deformable registration of temporal chest radiographs to detect interval change,” Proc. SPIE 11313, 113132X (2020).
54. M. A. Koenrades et al., “Validation of an image registration and segmentation method to measure stent graft motion on ECG-gated CT using a physical dynamic stent graft model,” Proc. SPIE 10134, 1013418 (2017).
55. V. Wegmayr, S. Aitharaju, and J. Buhmann, “Classification of brain MRI with big data and deep 3D convolutional neural networks,” Proc. SPIE 10575, 105751S (2018).
56. D. Ayyagari et al., “Image reconstruction using priors from deep learning,” *Proc. SPIE* 10574, 105740H (2018).
57. N. V. Ruiter et al., “USCT data challenge,” *Proc. SPIE* 10139, 101391N (2017).
58. D. Mattes et al., “Nonrigid multimodality image registration,” *Proc. SPIE* 4322, 1609–1620 (2001).
59. V. Alex et al., “Generative adversarial networks for brain lesion detection,” *Proc. SPIE* 10133, 101330G (2017).
60. S. Ramachandran S. et al., “Using YOLO based deep learning network for real time detection and localization of lung nodules from low dose CT scans,” *Proc. SPIE* 10575, 105751I (2018).
61. K. Umehara et al., “Super-resolution convolutional neural network for the improvement of the image quality of magnified images in chest radiographs,” *Proc. SPIE* 10133, 101331P (2017).
62. A. Madani et al., “Chest x-ray generation and data augmentation for cardiovascular abnormality classification,” *Proc. SPIE* 10574, 105741M (2018).
63. L. Gjestebry et al., “Deep learning methods to guide CT image reconstruction and reduce metal artifacts,” *Proc. SPIE* 10132, 101322W (2017).
64. K. Jnawali et al., “Deep 3D convolutional neural network for CT brain hemorrhage classification,” *Proc. SPIE* 10575, 105751C (2018).
65. Q. Wei et al., “Anomaly detection for medical images based on a one-class classification,” *Proc. SPIE* 10575, 105751M (2018).
66. K. A. J. Eppenhof et al., “Deformable image registration using convolutional neural networks,” *Proc. SPIE* 10136, 1013614 (2017).
67. R. Vassallo et al., “Hologram stability evaluation for Microsoft HoloLens,” *Proc. SPIE* 10136, 1013614 (2017).
68. X. Dong, S. Vekhande, and G. Cao, “Sinogram interpolation for sparse-view micro-CT with deep learning neural network,” *Proc. SPIE* 10948, 109482O (2019).
69. C. Bowles et al., “Modelling the progression of Alzheimer’s disease in MRI using generative adversarial networks,” *Proc. SPIE* 10574, 105741K (2018).
70. I. Funke et al., “Generative adversarial networks for specular highlight removal in endoscopic images,” *Proc. SPIE* 10576, 1057604 (2018).
71. N. Duric et al., “Breast imaging with the SoftVue imaging system: first results,” *Proc. SPIE* 8675, 86750K (2013).
72. S. Choi et al., “Fast low-dose compressed-sensing (CS) image reconstruction in four-dimensional digital tomosynthesis using on-board imager (OBI),” *Proc. SPIE* 10573, 1057325 (2018).
73. H. Mescher and U. Lemmer, “Novel hybrid organic-inorganic perovskite detector designs based on multilayered device architectures: simulation and design,” *Proc. SPIE* 10948, 109480W (2019).
74. T. Jerman et al., “Beyond Frangi: an improved multiscale vesseness filter,” *Proc. SPIE* 9413, 94132A (2015).
75. G. Lauritsch and W. H. Haerer, “Theoretical framework for filtered back projection in tomosynthesis,” *Proc. SPIE* 3338, 1127–1137 (1998).
76. B. D. de Vos et al., “2D image classification for 3D anatomy localization: employing deep convolutional neural networks,” *Proc. SPIE* 9784, 97841Y (2016).
77. C. N. Ionita et al., “Challenges and limitations of patient-specific vascular phantom fabrication using 3D Polyjet printing,” *Proc. SPIE* 9038, 90380M (2014).
78. D. P. Clark, M. Holbrook, and C. T. Badea, “Multi-energy CT decomposition using convolutional neural networks,” *Proc. SPIE* 10573, 105731O (2018).
79. R. Peng et al., “Design, optimization and testing of a multi-beam micro-CT scanner based on multi-beam field emission x-ray technology,” *Proc. SPIE* 7622, 76221G (2010).
80. Y. K. Tsehay et al., “Convolutional neural network based deep-learning architecture for prostate cancer detection on multiparametric magnetic resonance images,” *Proc. SPIE* 10134, 1013405 (2017).
81. C. G. Graff, “A new, open-source, multi-modality digital breast phantom,” *Proc. SPIE* 9783, 978309 (2016).
82. S. Hamidian et al., “3D convolutional neural network for automatic detection of lung nodules in chest CT,” *Proc. SPIE* **10134**, 1013409 (2017).
83. T. Moriya et al., “Unsupervised segmentation of 3D medical images based on clustering and deep representation learning,” *Proc. SPIE* **10578**, 1057820 (2018).
84. A. Almazroa et al., “Retinal fundus images for glaucoma analysis: the RIGA dataset,” *Proc. SPIE* **10579**, 105790B (2018).
85. M. Niemeijer et al., “Comparative study of retinal vessel segmentation methods on a new publicly available database,” *Proc. SPIE* **5370**, 648–656 (2004).
86. J. Maier et al., “Deep scatter estimation (DSE): feasibility of using a deep convolutional neural network for real-time x-ray scatter prediction in cone-beam CT,” *Proc. SPIE* **10573**, 105731L (2018).
87. C. Zhang and Y. Xing, “CT artifact reduction via U-net CNN,” *Proc. SPIE* **10574**, 105741R (2018).
88. R. Pohle and K. D. Toennies, “Segmentation of medical images using adaptive region growing,” *Proc. SPIE* **4322**, 1337–1346 (2001).
89. J. Moore et al., “OMERO and Bio-Formats 5: flexible access to large bioimaging datasets at scale,” *Proc. SPIE* **9413**, 941307 (2015).
90. B. Gaonkar et al., “Deep learning in the small sample size setting: cascaded feed forward neural networks for medical image segmentation,” *Proc. SPIE* **9785**, 978521 (2016).
91. P. L. Dillon et al., “Principles governing the transfer of signal modulation and photon noise by amplifying and scattering mechanisms,” *Proc. SPIE* **0535**, 82–99 (1985).
92. H. H. Barrett et al., “Detection and discrimination of known signals in inhomogeneous, random backgrounds,” *Proc. SPIE* **1090**, 176–182 (1989).
93. H. L. Kundel, S. B. Seshadri, and R. L. Arenson, “Clinical evaluation of PACS: modeling diagnostic value,” *Proc. SPIE* **1234**, 214–217 (1990).
94. A. E. Burgess, “Mammographic structure: data preparation and spatial statistics analysis,” *Proc. SPIE* **3661**, 304–315 (1999).
95. H. H. Barrett et al., “Megalopinakophobia: its symptoms and cures,” *Proc. SPIE* **4320**, 299–307 (2001).
96. T. M. Lehmann et al., “Content-based image retrieval in medical applications for picture archiving and communication systems,” *Proc. SPIE* **5033**, 109–117 (2003).
97. T. M. Lehmann et al., “Extended query refinement for content-based access to large medical image databases,” *Proc. SPIE* **5371**, 90–98 (2004).
98. T. M. Lehmann et al., “Content-based image retrieval in medical applications,” *Methods Inf. Med.* **43**(4), 354–361 (2004).
99. T. M. Deserno et al., “Extended query refinement for medical image retrieval,” *J. Digit Imaging* **21**(3), 280–289 (2008).
100. H. L. Kundel, “Reader error, object recognition, and visual search,” *Proc. SPIE* **5372** (2004).
101. H. L. Kundel, “How to minimize perceptual error and maximize expertise in medical imaging,” *Proc. SPIE* **6516**, 651508 (2007).
102. H. Wang et al., “Cascaded ensemble of convolutional neural networks and handcrafted features for mitosis detection,” *Proc. SPIE* **9041**, 9041B (2014).
103. R. Van Metter, J. Buetel, and H. Kundel, *Handbook of Medical Imaging, Volume 1. Physics and Psychophysics*, SPIE, Bellingham, Washington (2000).
104. J. Fitzpatrick and M. Sonka, *Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis*, SPIE, Bellingham, Washington (2000).
105. Y. Kim and S. Hori, *Handbook of Medical Imaging, Volume 3. Display and PACS*, SPIE, Bellingham, Washington (2000).

Biographies of the authors are not available.