

Medical Imaging 2010

***Ultrasonic Imaging, Tomography,
and Therapy***

Jan D'hooge
Stephen A. McAleavey
Editors

14–15 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 7629

Proceedings of SPIE, 1605-7422, v. 7629

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:

Author(s), "Title of Paper," in *Medical Imaging 2010: Ultrasonic Imaging, Tomography, and Therapy*, edited by Jan D'hooge, Stephen A. McAleavey, Proceedings of SPIE Vol. 7629 (SPIE, Bellingham, WA, 2010) Article CID Number.

ISSN 1605-7422
ISBN 9780819480309

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.

The logo for SPIE Digital Library features the word "SPIE" in a bold, sans-serif font above the words "Digital Library" in a smaller, lighter font. To the right of the text is a stylized graphic consisting of three vertical bars of increasing height, resembling a bar chart or a signal waveform.

SPIDigitalLibrary.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 10-1Z, 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. Numbers in the index correspond to the last two digits of the six-digit CID number.

Contents

ix *Conference Committee*

SESSION 1 3D IMAGING

- 7629 02 **Automated 3D whole-breast ultrasound imaging: results of a clinical pilot study** [7629-01]
A. Leproux, M. van Beek, Philips Research (Netherlands); U. de Vries, M. Wasser, Leids Univ. Medisch Ctr. (Netherlands); L. Bakker, Philips Research (Netherlands); O. Cuisenaire, Philips Healthcare (France); M. van der Mark, Philips Research (Netherlands); R. Entekin, Philips Healthcare (United States)
- 7629 03 **Reconstruction error in 3D ultrasound imaging with mechanical probes** [7629-02]
J. Cao, K. Karadayi, Univ. of Washington (United States); R. Managuli, Univ. of Washington (United States) and Hitachi Medical Systems America (United States); Y. Kim, Univ. of Washington (United States)
- 7629 04 **3D motion and strain estimation of the heart: initial clinical findings** [7629-03]
D. Barbosa, K. Hristova, D. Loeckx, F. Rademakers, P. Claus, J. D'hooge, Katholieke Univ. Leuven (Belgium)
- 7629 05 **Registration of x-ray mammograms and three-dimensional speed of sound images of the female breast** [7629-04]
T. Hopp, M. Holzapfel, N. V. Ruiters, Karlsruhe Institute of Technology (Germany); C. Li, N. Duric, Karmanos Cancer Institute (United States)
- 7629 06 **Breast imaging with ultrasound tomography: a comparative study with MRI** [7629-05]
B. Ranger, P. Littrup, N. Duric, C. Li, S. Schmidt, J. Lupinacci, L. Myc, A. Szczepanski, O. Rama, L. Bey-Knight, Karmanos Cancer Institute, Wayne State Univ. (United States)

SESSION 2 IMAGE PROCESSING

- 7629 07 **A 1D wavelet filtering for ultrasound images despeckling** [7629-06]
S. Dahdouh, M. Dubois, E. Frenoux, A. Osorio, Lab. d'Informatique pour la Mécanique et les Sciences de l'Ingénieur, CNRS (France)
- 7629 08 **Advanced noise reduction in placental ultrasound imaging using CPU and GPU: a comparative study** [7629-07]
G. Zombori, J. Ryan, Univ. College Dublin (Ireland); F. McAuliffe, National Maternity Hospital, Univ. College Dublin (Ireland); L. Rainford, M. Moran, Univ. College Dublin (Ireland); P. Brennan, The Univ. of Sydney (Australia)

- 7629 09 **Automatic detection and measurement of femur length from fetal ultrasonography** [7629-08]
P. Mukherjee, International Institute of Information Technology (India); G. Swamy, GE Global Research (India); M. Gupta, GE Healthcare (India); U. Patil, K. B. Krishnan, GE Global Research (India)
- 7629 0A **Trajectory-based deformation correction in ultrasound images** [7629-09]
S.-Y. Sun, B. W. Anthony, M. W. Gilbertson, Massachusetts Institute of Technology (United States)
- 7629 0B **Real-time ultrasound simulation for low cost training simulators** [7629-10]
S. U. Gjerald, Norwegian Univ. of Science and Technology (Norway); R. Brekken, T. A. N. Hernes, Norwegian Univ. of Science and Technology (Norway) and SINTEF (Norway)
- 7629 0C **Ultrasound image quality assessment: a framework for evaluation of clinical image quality** [7629-11]
M. C. Hemmsen, Technical Univ. of Denmark (Denmark) and BK Medical (Denmark); M. M. Petersen, Rigshospitalet (Denmark); S. I. Nikolov, BK Medical (Denmark); M. B. Nielsen, Rigshospitalet (Denmark); J. A. Jensen, Technical Univ. of Denmark (Denmark)

SESSION 3 ULTRASOUND IMAGE FORMATION

- 7629 0D **Accurate step-FMCW ultrasound ranging and comparison with pulse-echo signaling methods** [7629-12]
S. Natarajan, Ctr. for Advanced Surgical and Interventional Technology, Univ. of California, Los Angeles (United States) and Univ. of California, Los Angeles (United States); R. S. Singh, Ctr. for Advanced Surgical and Interventional Technology, Univ. of California, Los Angeles (United States), Univ. of California, Los Angeles (United States), and Univ. of California, Santa Barbara (United States); M. Lee, B. P. Cox, Ctr. for Advanced Surgical and Interventional Technology, Univ. of California, Los Angeles (United States) and Univ. of California, Los Angeles (United States); M. O. Culjat, Ctr. for Advanced Surgical and Interventional Technology, Univ. of California, Los Angeles (United States), Univ. of California, Los Angeles (United States), and Univ. of California, Santa Barbara (United States); W. S. Grundfest, Ctr. for Advanced Surgical and Interventional Technology, Univ. of California, Los Angeles (United States) and Univ. of California, Los Angeles (United States); H. Lee, Ctr. for Advanced Surgical and Interventional Technology, Univ. of California, Los Angeles (United States), Univ. of California, Los Angeles (United States), and Univ. of California, Santa Barbara (United States)
- 7629 0E **Optoacoustic spectroscopic imaging of radiolucent foreign bodies** [7629-13]
L. Page, S. Maswadi, R. D. Glickman, The Univ. of Texas Health Science Ctr. at San Antonio (United States)
- 7629 0F **Tomographic reconstruction of the pulse-echo spatiotemporal impulse response** [7629-14]
N. Q. Nguyen, Univ. of Illinois at Urbana-Champaign (United States); C. K. Abbey, Univ. of California, Santa Barbara (United States); R. D. Yapp, M. F. Insana, Univ. of Illinois at Urbana-Champaign (United States)
- 7629 0G **Assessment of harmonic source correction for ultrasound medical imaging** [7629-15]
S. W. Dianis, O. T. von Ramm, Duke Univ. (United States)

- 7629 OH **Detection of multiple electrical sources in tissue using ultrasound current source density imaging** [7629-16]
Z. Wang, P. Ingram, R. Olafsson, The Univ. of Arizona (United States); Q. Li, R. S. Witte, The Univ. of Arizona (United States) and College of Optical Sciences, The Univ. of Arizona (United States)

SESSION 4 ULTRASOUND TOMOGRAPHY

- 7629 OI **Robust ultrasound travel-time tomography using the bent ray model** [7629-18]
A. Hormati, I. Jovanović, O. Roy, M. Vetterli, Ecole Polytechnique Fédérale de Lausanne (Switzerland)
- 7629 OJ **Sound speed estimation using wave-based ultrasound tomography: theory and GPU implementation** [7629-17]
O. Roy, I. Jovanović, A. Hormati, R. Parhizkar, M. Vetterli, Ecole Polytechnique Fédérale de Lausanne (Switzerland)
- 7629 OK **Inverse scattering and refraction corrected reflection for breast cancer imaging** [7629-19]
J. Wiskin, D. Borup, S. Johnson, M. Berggren, D. Robinson, J. Smith, TechniScan Medical Systems, Inc. (United States); J. Chen, Y. Parisky, Breast Care & Imaging Ctr. of Orange County (United States); J. Klock, TechniScan Medical Systems, Inc. (United States)
- 7629 OL **The different structural scales of the breast and their impact on time-of-flight and diffraction tomography** [7629-20]
P. Huthwaite, Imperial College London (United Kingdom); F. Simonetti, Imperial College London (United Kingdom) and Los Alamos National Lab. (United States); L. Huang, Los Alamos National Lab. (United States)
- 7629 OM **In-vivo imaging results with ultrasound tomography: report on an ongoing study at the Karmanos Cancer Institute** [7629-21]
N. Duric, P. Littrup, P. Chandiwala-Mody, C. Li, S. Schmidt, L. Myc, O. Rama, L. Bey-Knight, J. Lupinacci, B. Ranger, A. Szczepanski, E. West, Karmanos Cancer Institute (United States)
- 7629 ON **Volumetric breast density evaluation by ultrasound tomography and magnetic resonance imaging: a preliminary comparative study** [7629-22]
L. Myc, N. Duric, P. Littrup, C. Li, B. Ranger, J. Lupinacci, S. Schmidt, O. Rama, L. Bey-Knight, Karmanos Cancer Institute, Wayne State Univ. (United States)

SESSION 5 TRANSDUCERS

- 7629 OO **Fabrication and characterization of an indium tin oxide acoustoelectric hydrophone** [7629-23]
P. Ingram, The Univ. of Arizona (United States); C. L. Greenlee, College of Optical Sciences, The Univ. of Arizona (United States); Z. Wang, R. Olafsson, The Univ. of Arizona (United States); R. A. Norwood, College of Optical Sciences, The Univ. of Arizona (United States); R. S. Witte, The Univ. of Arizona (United States)
- 7629 OP **Novel interconnection and fabrication method for high-frequency ultrasound arrays** [7629-24]
E. A. Simpson, H. S. Lay, G. R. Lockwood, Queen's Univ. (Canada)

- 7629 0Q **Simulation-based optimization of the acoustoelectric hydrophone for mapping an ultrasound beam** [7629-25]
Z. Wang, P. Ingram, R. Olafsson, The Univ. of Arizona (United States); C. L. Greenlee, R. A. Norwood, College of Optical Sciences, The Univ. of Arizona (United States); R. S. Witte, The Univ. of Arizona (United States) and College of Optical Sciences, The Univ. of Arizona (United States)
- 7629 0R **Fabrication of a conformal ring-annular ultrasound array** [7629-26]
A. E. Dann, D. B. Bennett, Ctr. for Advanced Surgical and Interventional Technology, Univ. of California, Los Angeles (United States) and Univ. of California, Los Angeles (United States); R. S. Singh, Ctr. for Advanced Surgical and Interventional Technology, Univ. of California, Los Angeles (United States), Univ. of California, Los Angeles (United States), and Univ. of California, Santa Barbara (United States); J.-J. Lemaire, Ctr. Hospitalier Universitaire de Clermont-Ferrand, Clermont Univ. (France) and Univ. d'Auvergne (France); W. S. Grundfest, Ctr. for Advanced Surgical and Interventional Technology, Univ. of California, Los Angeles (United States) and Univ. of California, Los Angeles (United States); M. O. Culjat, Ctr. for Advanced Surgical and Interventional Technology, Univ. of California, Los Angeles (United States), Univ. of California, Los Angeles (United States), and Univ. of California, Santa Barbara (United States)
- 7629 0S **Designing multistatic ultrasound imaging systems using software analysis** [7629-27]
M. Lee, Ctr. for Advanced Surgical and Interventional Technology, Univ. of California, Los Angeles (United States); R. S. Singh, M. O. Culjat, Ctr. for Advanced Surgical and Interventional Technology, Univ. of California, Los Angeles (United States) and Univ. of California, Santa Barbara (United States); S. Stubbs, Univ. of California, Santa Barbara (United States); S. Natarajan, Ctr. for Advanced Surgical and Interventional Technology, Univ. of California, Los Angeles (United States); E. R. Brown, Univ. of California, Santa Barbara (United States); W. S. Grundfest, Ctr. for Advanced Surgical and Interventional Technology, Univ. of California, Los Angeles (United States); H. Lee, Univ. of California, Santa Barbara (United States)

SESSION 6 KEYNOTE AND ULTRASOUND AND GUIDED THERAPY: JOINT SESSION WITH CONFERENCE 7625

- 7629 0U **An MRI-compatible three-axis focused ultrasound system for performing drug delivery studies in small animal models** [7629-29]
A. C. Waspe, Sunnybrook Health Sciences Ctr. (Canada) and Univ. of Toronto (Canada); A. Chau, A. Kukic, Sunnybrook Health Sciences Ctr. (Canada); R. Chopra, K. Hynynen, Sunnybrook Health Sciences Ctr. (Canada) and Univ. of Toronto (Canada)
- 7629 0V **The ACUSITT ultrasonic ablator: the first steerable needle with an integrated interventional tool** [7629-30]
E. C. Burdette, Acoustic MedSystems, Inc. (United States); D. C. Rucker, Vanderbilt Univ. (United States); P. Prakash, C. J. Diederich, Univ. of California, San Francisco (United States); J. M. Croom, Vanderbilt Univ. (United States); C. Clarke, P. Stolka, The Johns Hopkins Univ. (United States); T. Juang, Univ. of California, San Francisco (United States); E. M. Boctor, The Johns Hopkins Univ. (United States); R. J. Webster III, Vanderbilt Univ. (United States)

SESSION 7 VASCULAR AND LIVER

- 7629 OW **Quantification of turbulence intensity in patients with symptomatic carotid atherosclerosis: a pilot study** [7629-31]
M. L. Thorne, Robarts Research Institute (Canada) and The Univ. of Western Ontario (Canada); R. N. Rankin, London Health Sciences Ctr. (Canada); T. L. Poepping, The Univ. of Western Ontario (Canada); D. W. Holdsworth, Robarts Research Institute (Canada) and The Univ. of Western Ontario (Canada)
- 7629 OX **Global optimization for motion estimation with applications to ultrasound videos of carotid artery plaques** [7629-32]
S. Murillo, The Univ. of New Mexico (United States) and VisionQuest Biomedical, LLC (United States); M. Pattichis, The Univ. of New Mexico (United States); P. Soliz, S. Barriga, VisionQuest Biomedical, LLC (United States); C. P. Loizou, Intercollege, Limassol Campus (Cyprus); C. S. Pattichis, Univ. of Cyprus (Cyprus)
- 7629 OY **IVUS-based histology of atherosclerotic plaques: improving longitudinal resolution** [7629-33]
A. Taki, Technische Univ. München (Germany); O. Pauly, Univ. of Tehran (Iran, Islamic Republic of); S. K. Setarehdan, Sabanci Univ. (Turkey); G. Unal, N. Navab, Technische Univ. München (Germany)
- 7629 OZ **Ultrasound-directed robotic system for thermal ablation of liver tumors: a preliminary report** [7629-34]
J. Zheng, J. Tian, Y. Dai, X. Zhang, D. Dong, M. Xu, Medical Image Processing Group, Institute of Automation (China)
- 7629 10 **Liver fibrosis grading using multiresolution histogram information in real-time elastography** [7629-35]
A. Albouy-Kissi, L. Sarry, ERIM Lab., Instituts Universitaires de Technologie (France); S. Massoulier, C. Bonny, K. Randl, A. Abergel, Ctr. Hospitalier Universitaire de Clermont-Ferrand (France)
- 7629 11 **Replace-approximation method for ambiguous solutions in factor analysis of ultrasonic hepatic perfusion (Best Student Paper Award)** [7629-36]
J. Zhang, M. Ding, M. Yuchi, W. Hou, H. Ye, W. Qiu, Huazhong Univ. of Science and Technology (China)

POSTER SESSION

- 7629 13 **A novel method for monitoring liver ablation using ultrasound elastography** [7629-38]
H. Rivaz, The Johns Hopkins Univ. (United States); A. Kapoor, National Institutes of Health (United States); I. Fleming, G. D. Hager, E. M. Boctor, The Johns Hopkins Univ. (United States)
- 7629 14 **Improved 3D reconstruction algorithm for ultrasound B-scan image with freehand tracker** [7629-39]
S. Zhao, J. Suri, Eigen Inc. (United States)

- 7629 15 **Coronary 3D reconstruction using IVUS images only: a numeric phantom investigation** [7629-40]
M. M. S. Matsumoto, Instituto do Coração da Univ. São Paulo (Brazil); F. M. Cardoso, Instituto Tecnológico de Aeronáutica (Brazil); P. A. Lemos, Instituto do Coração da Univ. São Paulo (Brazil); S. S. Furuie, Instituto do Coração da Univ. São Paulo (Brazil) and Escola Politécnica da Univ. de São Paulo (Brazil)
- 7629 16 **Image enhancement for sonograms acquired by high frame rate mode** [7629-41]
W.-L. Lee, National Dong Hwa Univ. (Taiwan) and Tzu Chi College of Technology (Taiwan); M.-J. Chen, National Dong Hwa Univ. (Taiwan)
- 7629 17 **Simulation and training of ultrasound supported anaesthesia: a low-cost approach** [7629-42]
T. Schaaf, M. Lamontain, J. Hilpert, F. Schilling, T. Tolxdorff, Charité Universitätsmedizin Berlin (Germany)
- 7629 18 **A feasibility study of epicardial coronary angiography from microbubble-contrasted tridimensional echocardiography: segmentation approaches** [7629-43]
D. M. Lage, J. M. Tsutsui, Instituto do Coração da Univ. São Paulo (Brazil); S. S. Furuie, Escola Politécnica da Univ. de São Paulo (Brazil)
- 7629 19 **Detecting breast microcalcifications using super-resolution and wave-equation ultrasound imaging: a numerical phantom study (Cum Laude Poster Award)** [7629-44]
L. Huang, Los Alamos National Lab. (United States); F. Simonetti, P. Huthwaite, Imperial College London (United Kingdom); R. Rosenberg, M. Williamson, Univ. of New Mexico (United States)
- 7629 1B **Application of external tracking in ultrasound elasticity imaging** [7629-46]
P. Foroughi, G. D. Hager, The Johns Hopkins Univ. (United States); F. K. Wacker, The Johns Hopkins Medical Institutions (United States); E. M. Boctor, The Johns Hopkins Univ. (United States) and The Johns Hopkins Medical Institutions (United States)
- 7629 1C **Monitoring breast masses with ultrasound tomography in patients undergoing neoadjuvant chemotherapy** [7629-47]
J. Lupinacci, N. Duric, P. Littrup, D. Wang, C. Li, S. Schmidt, B. Ranger, E. West, A. Szczepanski, O. Rama, L. Bey-Knight, L. Myc, Karmanos Cancer Institute, Wayne State Univ. (United States)
- 7629 1D **Novel reconstruction and feature exploitation techniques for sensorless freehand 3D ultrasound** [7629-48]
H. Rivaz, H. J. Kang, P. J. Stolka, R. Zellars, F. Wacker, G. Hager, E. Boctor, The Johns Hopkins Univ. (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

Jan D'hooge, Katholieke Universiteit Leuven (Belgium)
Stephen A. McAleavey, University of Rochester (United States)

Program Committee

Jeffrey C. Bamber, University of London (United Kingdom)
Johan G. Bosch, Erasmus University Rotterdam (Netherlands)
Stanislav Y. Emelianov, The University of Texas at Austin (United States)
James F. Greenleaf, Mayo Clinic (United States)
Michael F. Insana, University of Illinois at Urbana-Champaign (United States)
Jørgen Arendt Jensen, Technical University of Denmark (Denmark)
K. Kirk Shung, University of Southern California (United States)
Kai E. Thomenius, General Electric Company (United States)
William F. Walker, University of Virginia (United States)

Session Chairs

- 1 3D Imaging
Stephen A. McAleavey, University of Rochester (United States)
- 2 Image Processing
Johan G. Bosch, Erasmus University Rotterdam (Netherlands)
- 3 Ultrasound Image Formation
Jan D'hooge, Katholieke Universiteit Leuven (Belgium)
- 4 Ultrasound Tomography
Stephen A. McAleavey, University of Rochester (United States)
- 5 Transducers
Kai E. Thomenius, General Electric Company (United States)

- 6 Keynote and Ultrasound and Guided Therapy: Joint Session with
Conference 7625
Jan D'hooge, Katholieke Universiteit Leuven (Belgium)
Kenneth H. Wong, Virginia Polytechnic Institute and State University
(United States)
- 7 Vascular and Liver
Michael F. Insana, University of Illinois at Urbana-Champaign
(United States)