PROCEEDINGS OF SPIE

Passive Millimeter-Wave Imaging Technology XIII

David A. Wikner Arttu R. Luukanen Editors

8 April 2010 Orlando, Florida, United States

Sponsored and Published by SPIE

Volume 7670

Proceedings of SPIE, 0277-786X, v. 7670

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 *Passive Millimeter-Wave Imaging Technology XIII*, edited by David A. Wikner, Arttu R. Luukanen, Proceedings of SPIE Vol. 7670 (SPIE, Bellingham, WA, 2010) Article CID Number.

ISSN 0277-786X ISBN 9780819481344

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 0277-786X/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 10-1Z, 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

vii Conference Committee

SESSION 1 IMAGING SYSTEMS I

- 7670 02 A microwave imaging spectrometer for security applications [7670-01] M. Jirousek, M. Peichl, H. Suess, German Aerospace Ctr. (Germany)
- 7670 03 Passive millimeter wave imaging and spectroscopy system for terrestrial remote sensing [7670-02]
 N. Gopalsami, S. Liao, E. R. Koehl, T. W. Elmer, A. Heifetz, H.-T. Chien, A. C. Raptis, Argonne National Lab. (United States)
- 7670 04 **Real-time passive terahertz imaging system for standoff concealed weapons imaging** [7670-03]

A. Luukanen, MilliLab, VTT Technical Research Ctr. of Finland (Finland); L. Grönberg, M. Grönholm, P. Lappalainen, M. Leivo, A. Rautiainen, VTT Technical Research Ctr. of Finland (Finland); A. Tamminen, J. Ala-Laurinaho, MilliLab, Aalto Univ. School of Science and Technology (Finland); C. R. Dietlein, E. N. Grossman, National Institute of Standards and Technology (United States)

- Progress report on Safe VISITOR: approaching a practical instrument for terahertz security screening [7670-04]
 E. Heinz, D. Born, G. Zieger, T. May, T. Krause, A. Krüger, M. Schulz, S. Anders, V. Zakosarenko, H.-G. Meyer, IPHT Jena (Germany); M. Starkloff, Supracon AG (Germany); M. Rößler, G. Thorwirth, U. Krause, Jena-Optronik GmbH (Germany)
- 7670 06 Status of VESAS: a fully-electronic microwave imaging radiometer system [7670-05] E. Schreiber, M. Peichl, H. Suess, German Aerospace Ctr. (Germany)
- 7670 07 **Millimeter-wave radar for brown-out landings using passive imager components** [7670-06] C. A. Martin, V. Kolinko, J. A. Lovberg, Trex Enterprises Corp. (United States)

SESSION 2 IMAGING SYSTEMS II

- 7670 08 Standoff concealed weapon detection using a 350-GHz radar imaging system [7670-07]
 D. M. Sheen, T. E. Hall, R. H. Severtsen, D. L. McMakin, B. K. Hatchell, P. L. J. Valdez, Pacific Northwest National Lab. (United States)
- 7670 0A Indirect holographic imaging: evaluation of image quality at 310 GHz [7670-09]
 A. Tamminen, J. Ala-Laurinaho, A. V. Räisänen, MilliLab, Aalto Univ. School of Science and Technology (Finland)

- 7670 0B Sparse sampling and enhanced axial resolution in millimeter-wave holographic imaging [7670-10]
 C. Fernandez-Cull, Duke Univ. (United States); D. A. Wikner, M. Mattheiss, J. N. Mait, U.S. Army Research Lab. (United States); D. Brady, Duke Univ. (United States)
- 7670 0D **Performance limitations of compressive sensing for millimeter wave imaging** [7670-12] J. Lynch, R. Matic, J. Baron, HRL Labs., LLC (United States)

SESSION 3 PHENOMENOLOGY

7670 OE	Millimeter wave measurements of explosives and simulants [7670-13] J. Barber, Battelle Memorial Institute (United States); J. C. Weatherall, SRA International, Inc. (United States); B. T. Smith, U.S. Dept. of Homeland Security (United States); S. Duffy, S. J. Goettler, Global Systems Technologies, Inc. (United States); R. A. Krauss, U.S. Dept. of Homeland Security (United States)
7670 OF	Emission from dielectric materials at millimeter wavelengths in passive thermal environments [7670-14] J. C. Weatherall, SRA International, Inc. (United States)
7670 0G	Body-borne IED detection: NATO DAT#10 BELCOAST 09 demonstration results [7670-15] N. Alexander, I. Gómez, I. Ortega, Alfa Imaging S.A. (Spain); F. Fiore, C. Coman, NATO C3 Agency (Netherlands)
7670 OH	Image registration and fusion of MMW and visual images for concealed object detection [7670-16] H. Lee, S. Yeom, JY. Son, V. P. Guschin, Daegu Univ. (Korea, Republic of)
7670 OJ	Active THz inspection of water content in plants [7670-18] D. Etayo, J. C. Iriarte, I. Palacios, J. Teniente, I. Ederra, R. Gonzalo, Public Univ. of Navarra (Spain)
SESSION 4	DEVICES
7670 OL	A sub-millimeter wave line imaging device [7670-20] O. Furxhi, E. L. Jacobs, The Univ. of Memphis (United States)
7670 OM	A 350-GHz high-resolution high-sensitivity passive video imaging system [7670-21] D. Becker, J. Beall, HM. Cho, W. Duncan, G. Hilton, R. Horansky, K. Irwin, P. Lowell, M. Niemack, N. Paulter, C. Reintsema, F. Schima, R. Schwall, K. W. Yoon, National Institute of Standards and Technology (United States); P. Ade, C. Tucker, Cardiff Univ. (United Kingdom); S. Dicker, Univ. of Pennsylvania (United States); M. Halpern, The Univ. of British Columbia (Canada)

 7670 0N A fully-integrated W-band imaging receiver IC in silicon-germanium BiCMOS technology [7670-22]
 L. Gilreath, Univ. of California, Irvine (United States); V. Jain, SaberTek (United States); H.-C. Yao, L. Zheng, P. Heydari, Univ. of California, Irvine (United States)

7670 00 Orotron-based sub-millimeter-wave source [7670-23]

S. J. Papadakis, J. A. Hoffmann, A. H. Monica, D. M. Deglau, The Johns Hopkins Univ. Applied Physics Lab. (United States); J. Yu, G. S. Nusinovich, T. M. Antonsen, Univ. of Maryland, College Park (United States); R. Osiander, The Johns Hopkins Univ. Applied Physics Lab. (United States)

Author Index

Conference Committee

Symposium Chair

Michael T. Eismann, Air Force Research Laboratory (United States)

Symposium Cochair

William Jeffrey, HRL Laboratories, LLC (United States)

Conference Chairs

David A. Wikner, U.S. Army Research Laboratory (United States) Arttu R. Luukanen, MilliLab (Finland)

Program Committee

 Roger Appleby, QinetiQ Ltd. (United Kingdom)
 Erich N. Grossman, National Institute of Standards and Technology (United States)
 Christopher A. Martin, Trex Enterprises Corporation (United States)

Session Chairs

- Imaging Systems I
 David A. Wikner, U.S. Army Research Laboratory (United States)
 Arttu R. Luukanen, MilliLab (Finland)
- Imaging Systems II
 Erich N. Grossman, National Institute of Standards and Technology (United States)
- 3 Phenomenology Roger Appleby, QinetiQ Ltd. (United Kingdom)
- 4 Devices Christopher A. Martin, Trex Enterprises Corporation (United States)