PROCEEDINGS OF SPIE

SPIDigitalLibrary.org/conference-proceedings-of-spie

Front Matter: Volume 8693

, "Front Matter: Volume 8693," Proc. SPIE 8693, Smart Sensor Phenomena, Technology, Networks, and Systems Integration 2013, 869301 (23 April 2013); doi: 10.1117/12.2029533

SPIE.

Event: SPIE Smart Structures and Materials + Nondestructive Evaluation and Health Monitoring, 2013, San Diego, California, United States

PROCEEDINGS OF SPIE

Smart Sensor Phenomena, Technology, Networks, and Systems Integration 2013

**Kara J. Peters
Wolfgang Ecke
Theodoros E. Matikas**
Editors

**10–14 March 2013
San Diego, California, United States**

Sponsored by
SPIE

Cosponsored by
American Society of Mechanical Engineers (United States)

Cooperating Organizations
Intelligent Materials Forum (Japan)
Jet Propulsion Laboratory (United States)
National Science Foundation (United States)

Published by
SPIE

Volume 8693

Proceedings of SPIE 0277-786X, V.8693

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

Smart Sensor Phenomena, Technology, Networks, and Systems Integration 2013, edited by
Kara J. Peters, Wolfgang Ecke, Theodoros E. Matikas, Proc. of SPIE Vol. 8693, 869301
© 2013 SPIE · CCC code: 0277-786X/13/\$18 · doi: 10.1117/12.2029533

Proc. of SPIE Vol. 8693 869301-1

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 *Smart Sensor Phenomena, Technology, Networks, and Systems Integration 2013*, edited by Kara J. Peters, Wolfgang Ecke, Theodoros E. Matikas, Proceedings of SPIE Vol. 8693 (SPIE, Bellingham, WA, 2013) Article CID Number.

ISSN: 0277-786X

ISBN: 9780819494764

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 © 2013, 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/13/\$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 as they are published online, and connects the same identifier to all online, print, and electronic versions of the publication. SPIE uses a six-digit CID article numbering system in which:

- The first four digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc.

The CID Number appears on each page of the manuscript. The complete citation is used on the first page, and an abbreviated version on subsequent pages. Numbers in the index correspond to the last two digits of the six-digit CID Number.

Contents

vii *Conference Committee*

SESSION 1 FIBER BRAGG GRATING SENSOR NETWORKS

- 8693 02 **A locally exact strain-to-displacement approach for shape reconstruction of slender objects using fiber Bragg gratings (Invited Paper)** [8693-1]
M. D. Todd, The Univ. of California, San Diego (United States); C. J. Stull, Los Alamos National Lab. (United States); M. Dickerson, 3 Phoenix, Inc. (United States)
- 8693 03 **Dynamic shape sensing using a fiber Bragg grating mesh** [8693-2]
D. Bailey, N. Stan, S. Chadderdon, D. Perry, S. Schultz, R. Selfridge, Brigham Young Univ. (United States)
- 8693 04 **Filter-based interrogation unit for optical wavelength shift sensors** [8693-3]
R. Wuchrer, T. Härtling, Fraunhofer-Institut für Zerstörungsfreie Prüfverfahren (Germany)
- 8693 05 **Plasmonic gradient structures of nanoparticle arrays for optical sensing applications** [8693-4]
S. Derenko, R. Wuchrer, Fraunhofer IZFP, Dresden Branch (Germany); A. Sarangan, Univ. of Dayton (United States); C. Schuster, T. Härtling, Fraunhofer IZFP, Dresden Branch (Germany)

SESSION 2 TEMPERATURE SENSING

- 8693 07 **Hybrid imaging of damage progress in composites through thermal imaging and embedded sensing** [8693-6]
S. Pawar, K. Peters, North Carolina State Univ. (United States)
- 8693 08 **Highly localized thermal response measurements in composites using embedded fiber Bragg grating temperature sensors** [8693-7]
B. Jenkins, P. Joyce, D. Mechtel, K. Mildner, K. Elam, J. Watkins, US Naval Academy (United States)
- 8693 09 **Fabrication and thermal characteristics of Ti-Ag-Ni coated regenerated grating sensors for high-temperature sensing** [8693-8]
Y. Tu, Y.-H. Qi, S.-T. Tu, East China Univ. of Science and Technology (China)

SESSION 3 DISTRIBUTED SENSOR INFORMATION PROCESSING

- 8693 0B **Intelligent fiber optic statistical mode sensors using novel features and artificial neural networks** [8693-11]
H. S. Efendioglu, O. Toker, Fatih Univ. (Turkey); T. Yildirim, Yildiz Technical Univ. (Turkey); K. Fidanboyu, Fatih Univ. (Turkey)

SESSION 4 SENSORS FOR COMPOSITES TESTING I

- 8693 0C **The role of experimental validation in achieving reliable measurement data with applied FBG strain sensors (Invited Paper)** [8693-12]
W. R. Habel, V. G. Schukar, N. Kusche, Bundesanstalt für Materialforschung und -prüfung (Germany)
- 8693 0D **A comparative analysis of FBG and low-coherence fiber-optic sensors for SHM of composite structures** [8693-13]
Z. DjinoVIC, Integrated Microsystems Austria GmbH (Austria); M. Tomic, Univ. of Belgrade (Serbia); M. Stojkovic, Integrated Microsystems Austria GmbH (Austria)

SESSION 5 SENSORS FOR COMPOSITES TESTING II

- 8693 0E **A chirped long period grating sensor for monitoring flow direction and cure of a resin** [8693-14]
R. Y. N. Wong, E. Chehura, S. W. James, R. P. Tatam, Cranfield Univ. (United Kingdom)
- 8693 0F **Multiplexed fibre optic sensors for monitoring resin infusion, flow, and cure in composite material processing** [8693-15]
E. Chehura, R. Jarzebinska, E. F. R. Da Costa, A. A. Skordos, S. W. James, Cranfield Univ. (United Kingdom); I. K. Partridge, Cranfield Univ. (United Kingdom) and Univ. of Bristol (United Kingdom); R. P. Tatam, Cranfield Univ. (United Kingdom)
- 8693 0G **Environmental barrier coating (EBC) durability modeling using a progressive failure analysis approach part II** [8693-16]
A. Abdul-Aziz, NASA Glenn Research Ctr. (United States); J. Arias, F. Abdi, AlphaSTAR Corp. (United States); R. T. Bhatt, J. E. Grady, D. Zhu, NASA Glenn Research Ctr. (United States)
- 8693 0H **Characterization of fatigue damage in adhesively bonded lap joints through dynamic, full-spectral interrogation of fiber Bragg grating sensors** [8693-34]
S. Webb, P. Shin, K. Peters, M. A. Zikry, North Carolina State Univ. (United States); S. Chadderton, N. Stan, R. Selfridge, S. Schultz, Brigham Young Univ. (United States)

SESSION 6 ACOUSTIC EMISSION AND ULTRASOUND SENSORS

- 8693 0I **Multi-element, high-temperature integrated ultrasonic transducers for structural health monitoring** [8693-18]
J. Veilleux, S. E. Kruger, K.-T. Wu, A. Blouin, National Research Council Canada (Canada)
- 8693 0J **Acoustic emission for fatigue damage monitoring in cross-welded aluminum plates** [8693-20]
D. G. Aggelis, Vrije Univ. Brussel (Greece); I. F. Spiridon, T. E. Matikas, The Univ. of Ioannina (Greece)
- 8693 0K **Monitoring of glass-ceramic composites under static and dynamic loading by combined NDE methods** [8693-21]
E. Z. Kordatos, The Univ. of Ioannina (Greece); D. G. Aggelis, Free Univ. of Brussels (Belgium); K. G. Dassios, T. E. Matikas, The Univ. of Ioannina (Greece)

- 8693 OL **Large-area piezoceramic coating with IDT electrodes for ultrasonic sensing applications** [8693-22]
V. T. Rathod, D. Roy Mahapatra, Indian Institute of Science (India); A. A. Jeyaseelan, S. Dutta, National Aerospace Labs. (India)

SESSION 7 SENSORS FOR TURBINE ENGINES

- 8693 OM **Optical strain and crack-detection measurements on a rotating disk** [8693-23]
M. Woike, A. Abdul-Aziz, M. Clem, G. Fralick, NASA Glenn Research Ctr. (United States)
- 8693 ON **Turbine engine rotor health monitoring and durability evaluation using spin tests data** [8693-24]
A. Abdul-Aziz, M. R. Woike, M. Clem, G. Y. Baaklini, NASA Glenn Research Ctr. (United States)
- 8693 OO **Investigation of a cross-correlation based optical strain measurement technique for detecting radial growth on a rotating disk** [8693-25]
M. M. Clem, M. R. Woike, NASA Glenn Research Ctr. (United States); A. Abdul-Aziz, Cleveland State Univ. (United States)

SESSION 8 OPTICAL BASED IMAGING

- 8693 OP **Large field optical tomography system** [8693-26]
B. Fischer, C. Wolf, T. Härtling, Fraunhofer-Institut für Zerstörungsfreie Prüfverfahren (Germany)
- 8693 OQ **Polarization control in optical fibers and applications in optical microscopy and spectroscopy** [8693-27]
C. Zeh, Fraunhofer-Institut für Zerstörungsfreie Prüfverfahren (Germany); R. Illing, Technische Univ. Dresden (Germany); B. Köhler, Fraunhofer-Institut für Zerstörungsfreie Prüfverfahren (Germany); J. Opitz, Fraunhofer-Institut für Zerstörungsfreie Prüfverfahren (Germany) and Technische Univ. Dresden (Germany); L. M. Eng, Technische Univ. Dresden (Germany); T. Härtling, Fraunhofer-Institut für Zerstörungsfreie Prüfverfahren (Germany)
- 8693 OR **Time-resolved luminescence measurements on upconversion phosphors for electron beam sterilization monitoring** [8693-28]
M. Reitzig, T. Härtling, M. Winkler, Fraunhofer-Institut für Zerstörungsfreie Prüfverfahren (Germany); P. Powers, The Univ. of Dayton (United States); S. Derenko, Fraunhofer-Institut für Zerstörungsfreie Prüfverfahren (Germany); C. Toro, Univ. de Concepción (Chile); O. Röder, J. Opitz, Fraunhofer-Institut für Zerstörungsfreie Prüfverfahren (Germany)

SESSION 9 NEW SENSOR TECHNOLOGIES

- 8693 OS **Microstructured optical fiber monitor for cryogenic applications** [8693-29]
S. Filiche, E. Battinelli, R. Wynne, Villanova Univ. (United States)

- 8693 0U **Enzyme-linked monoclonal antibody microstructured optical fiber monitor** [8693-17]
J. DellAntonio, N. Giambrone, F. Anuszewski, R. Wynne, W. Kelly, Villanova Univ. (United States)
- 8693 0V **Improvements in electric field sensor sensitivity by exploiting a tangential field configuration** [8693-30]
S. Chadderdon, L. Woodard, D. Perry, R. Selfridge, S. Schultz, Brigham Young Univ. (United States)

Author Index

Conference Committee

Symposium Chairs

Norbert Meyendorf, Fraunhofer-Institut für Zerstörungsfreie
Prüfverfahren (Germany) and University of Dayton (United States)
Norman Wereley, University of Maryland, College Park (United States)

Symposium Cochairs

Victor Giurgiutiu, University of South Carolina (United States)
Christopher S. Lynch, University of California, Los Angeles
(United States)

Conference Chair

Kara J. Peters, North Carolina State University (United States)

Conference Cochairs

Wolfgang Ecke, Institut für Photonische Technologien e.V. (Germany)
Theodoros E. Matikas, University of Ioannina (Greece)

Conference Program Committee

Farhad Ansari, University of Illinois at Chicago (United States)
George Y. Baaklini, NASA Glenn Research Center (United States)
Horst J. Baier, Technische Universität München (Germany)
Curtis E. Banks, NASA Marshall Space Flight Center (United States)
Xiaoyi Bao, University of Ottawa (Canada)
Hartmut Bartelt, Institut für Photonische Technologien e.V. (Germany)
Rolf Brönnimann, EMPA (Switzerland)
Brian Culshaw, University of Strathclyde (United Kingdom)
Chiara Daraio, California Institute of Technology (United States)
Gerald Gerlach, Technische Universität Dresden (Germany)
Wolfgang R. Habel, Bundesanstalt für Materialforschung und -prüfung
(Germany)
Daniele Inaudi, Smartec S.A. (Switzerland)
Kerop D. Janoyan, Clarkson University (United States)
Leszek Jaroszewicz, Military University of Technology (Poland)
YeonWan Koh, FIBERPRO, Inc. (Korea, Republic of)
Silvio E. Kruger, National Research Council Canada (Canada)
Jinsong Leng, Harbin Institute of Technology (China)
Alexis Mendez, MCH Engineering LLC (United States)

Norbert G. Meyendorf, Fraunhofer-Institut für Zerstörungsfreie Prüfverfahren (United States)
Bernd Michel, Fraunhofer-Institut für Elektronische Nanosysteme (Germany)
Jeff W. Miller, Micron Optics, Inc. (United States)
Marc Nikles, Omnisens S.A. (Switzerland)
Ioannis E. Psarobas, University of Patras (Greece)
Richard Selfridge, Brigham Young University (United States)
Nobuo Takeda, The University of Tokyo (Japan)
Roderick C. Tennyson, Fiber Optic Systems Technology (Canada)
Michael D. Todd, University of California, San Diego (United States)
Eric Udd, Columbia Gorge Research (United States)
Zhishen Wu, Ibaraki University (Japan)
Chung-Bang Yun, Ulsan National Institute of Science and Technology (Korea, Republic of)
Zhi Zhou, Dalian University of Technology (China)

Session Chairs

- 1 Fiber Bragg Grating Sensor Networks
Kara J. Peters, North Carolina State University (United States)
- 2 Temperature Sensing
Theodoros E. Matikas, University of Ioannina (Greece)
- 3 Distributed Sensor Information Processing
Michael D. Todd, University of California, San Diego (United States)
- 4 Sensors for Composites Testing I
Kara J. Peters, North Carolina State University (United States)
- 5 Sensors for Composites Testing II
Kara J. Peters, North Carolina State University (United States)
- 6 Acoustic Emission and Ultrasound Sensors
Stephen Schultz, Brigham Young University (United States)
- 7 Sensors for Turbine Engines
Mark R. Woike, NASA Glenn Research Center (United States)
- 8 Optical Based Imaging
Theodoros E. Matikas, University of Ioannina (Greece)
- 9 New Sensor Technologies
Rosalind M. Wynne, Villanova University (United States)