PROCEEDINGS OF SPIE

SPIDigitalLibrary.org/conference-proceedings-of-spie

Front Matter: Volume 6939

, "Front Matter: Volume 6939," Proc. SPIE 6939, Thermosense XXX, 693901
(17 March 2008); doi: 10.1117/12.793148

Event: SPIE Defense and Security Symposium, 2008, Orlando, Florida,
United States

PROCEEDINGS OF SPIE

Thermosense XXX

Vladimir P. Vavilov
Douglas D. Burleigh
Editors

18–20 March 2008
Orlando, Florida, USA

Sponsored and Published by
SPIE

Volume 6939

Proceedings of SPIE, 0277-786X, v. 6939

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 *Thermosense XXX*, edited by Vladimir P. Vavilov, Douglas D. Burleigh, Proceedings of SPIE Vol. 6939 (SPIE, Bellingham, WA, 2008) Article CID Number.

ISSN 0277-786X

ISBN 9780819471307

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 © 2008, 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/08/\$18.00.

Printed in the United States of America.

Publication of record for individual papers is online in the SPIE Digital Library.

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 PYROMETRY, TEMPERATURE MEASUREMENTS, AND CALIBRATION I

- 6939 02 **Infrared micro-thermography of an actively heated preconcentrator device** [6939-01]
R. Furstenberg, C. A. Kendziora, S. V. Stepnowski, D. R. Mott, R. A. McGill, Naval Research Lab. (USA)
- 6939 03 **High temperature IR-imager with wide dynamic range for industrial process control** [6939-02]
U. Hoffmann, G. Hofmann, D. Wassilew, N. Heß, M. Zimmerhackl, DIAS Infrared GmbH (Germany)
- 6939 04 **Emissivity independent low-temperature pyrometry** [6939-03]
I. Dolezal, L. Hes, Technical Univ. of Liberec (Czech Republic)

SESSION 2 PYROMETRY, TEMPERATURE MEASUREMENTS, AND CALIBRATION II

- 6939 06 **Infrared calibration development at Fluke Corporation Hart Scientific Division** [6939-05]
F. Liebmann, Fluke Corp. (USA)
- 6939 08 **IEC 62942-1 TS: First international technical specification on the technical data for radiation thermometers** [6939-53]
J. Hollandt, Physikalisch-Technische Bundesanstalt (Germany); O. Struss, Heitronics Infrarot Messtechnik GmbH (Germany); G. Beynon, Land Instruments International (United Kingdom); R. Bosma, NMi Van Swinden Laboratorium B. V. (Netherlands); R. Gaertner, Raytek GmbH (Germany); F. Girard, Istituto Nazionale di Ricerca Metrologica (Italy); M. S. Matveyev, D.I. Mendeleyev Institute for Metrology (Russia); H. C. McEvoy, National Physical Lab. (United Kingdom); G. R. Peacock, Temperatures.com, Inc. (USA); M. Sadli, Lab. National de Metrologie et d'Essais INM/CNAM (France); F. Sakuma, National Metrology Institute of Japan (Japan); H. W. Yoon, National Institute of Standards and Technology (USA); Z. Yuan, National Institute of Metrology (China)

SESSION 3 PROFESSIONAL STANDARDS I

- 6939 09 **Do infrared thermographers need a professional organization?** [6939-07]
G. R. Peacock, Temperatures.com, Inc. (USA)
- 6939 0A **Certification of thermographers** [6939-08]
J. Snell, R. Spring, The Snell Group (USA)

SESSION 4 PROFESSIONAL STANDARDS II	
6939 0B	International standards pertaining to thermography practices, training and certification [6939-09] L. West Åkerblom, FLIR Systems AB (Sweden)
SESSION 5 THERMAL IMAGE FUSION	
6939 0F	Image fusion: multi-focus function and its application [6939-13] Y. Kimura, A. Ichikawa, Nippon Avionics Co., Ltd. (Japan); T. Tamura, K. Endo, NEC San-ei Instruments (Japan)
SESSION 6 IR NEIGHBORS: NIR, VISIBLE AND UV I	
6939 0H	Industrial defect discrimination applying infrared imaging spectroscopy and artificial neural networks [6939-15] P. B. Garcia-Allende, O. M. Conde, F. J. Madruga, A. M. Cubillas, J. M. Lopez-Higuera, Univ. de Cantabria (Spain)
6939 0I	Overview of SWIR detectors, cameras, and applications [6939-16] M. P. Hansen, D. S. Malchow, SUI, Goodrich Corp. (USA)
6939 0J	Calibration of visible and near infrared spectrums for measuring freshness of vegetables [6939-17] F. Abdullah, Univ. Sains Malaysia (Malaysia) and Syiah Kuala Univ. (Indonesia); M. Z. Mat Jafri, M. S. Jaafar, C. J. Wong, Univ. Sains Malaysia (Malaysia)
SESSION 7 IR NEIGHBORS: NIR, VISIBLE AND UV II	
6939 0K	High-voltage electrical survey advances using UV/IR [6939-18] D. A. Ninedorf, Ox Creek Energy Associates, Inc. (USA); R. Stolper, J. Hart, Council for Scientific and Industrial Research (South Africa)
6939 0L	Overview of expanding the longwave NDT into the shortwave spectrum below visible [6939-19] J. K. Eklund, EKLUND INFRARED/Eklund Innovation Inc. (USA)
SESSION 8 RESEARCH TOPICS	
6939 0M	Thermography investigations and numerical analysis of turbulent and laminar flow at light weight structures [6939-20] R. Arndt, Federal Institute for Materials Research and Testing (BAM) (Germany); A. Gaulke, Technical Univ. of Berlin (Germany)
6939 0N	Emissivity modulating electrochromic device [6939-21] H. Demiryont, K. Shannon III, Eclipse Energy Systems, Inc. (USA); A. Williams, Air Force Research Lab. (USA)

- 6939 0O **Using lock-in infrared thermography for the visualization of the hand vascular tree** [6939-22]
N. Bouzida, A. H. Bendada, J.-M. Piau, M. Akhloufi, X. Maldague, M. Raymond, Laval Univ. (Canada)
- 6939 0P **Active thermography for potato characterization** [6939-23]
S.-J. Hsieh, C.-C. Sun, Texas A&M Univ. (USA)

SESSION 9 PRODUCTS AND PROCESSES

- 6939 0Q **Arc welding quality monitoring by means of near infrared imaging spectroscopy** [6939-24]
P. B. Garcia-Allende, J. Mirapeix, A. Cobo, O. M. Conde, J. M. Lopez-Higuera, Univ. de Cantabria (Spain)
- 6939 0R **Infrared thermography applied for outdoor power substations** [6939-25]
L. dos Santos, Furnas Centrais Elétricas (Brazil); E. C. Bortoni, L. E. Souza, G. S. Bastos, M. A. C. Craveiro, Itajubá Federal Univ. (Brazil)

SESSION 10 ENVIRONMENTAL INVESTIGATIONS

- 6939 0S **Aerial measurements of convection cell elements in heated lakes** [6939-27]
E. Villa-Aleman, S. R. Salaymeh, T. B. Brown, A. J. Garret, L. S. Nichols, M. M. Pendergast, Savannah River National Lab. (USA)
- 6939 0T **Direct measurement of heat flux from cooling lake thermal imagery** [6939-26]
A. J. Garrett, E. Villa-Aleman, R. J. Kurzeja, M. M. Pendergast, Savannah River National Lab. (USA)

SESSION 11 NDT OF BUILDINGS AND CIVIL STRUCTURES

- 6939 0U **Thermography as a tool for building applications and diagnostics** [6939-29]
N. P. Avdelidis, Metallurgical Industrial Research & Technology Development Ctr. (Greece); T. K. Kauppinen, Technical Research Ctr. of Finland (Finland)
- 6939 0V **A nondestructive method for diagnosis of insulated building walls using infrared thermography in real situation** [6939-30]
M. H. A. Larbi Youcef, A. Mazioud, C.E.R.T.E.S., IUT, Univ. Paris XII (France); P. Bremond, Cedip Infrared Systems (France); L. Ibos, Y. Candau, C.E.R.T.E.S., IUT, Univ. Paris XII (France); M. Piro, EDF R&D (France); A. Filloux, Alpheeis (France)
- 6939 0W **Crack detection and fatigue related delamination in FRP composites applied to concrete** [6939-31]
J. Brown, R. Baker, L. Kallemeyn, A. Zendler, Hope College (USA)
- 6939 0X **Square pulse thermography in frequency domain** [6939-32]
R. Arndt, Federal Institute for Materials Research and Testing (BAM) (Germany)

- 6939 0Y **Building material characterization by using IR thermography for efficient heating systems** [6939-33]
P. Bison, E. Grinzato, CNR-ITC (Italy)
- 6939 10 **Quantitative evaluation of defect depth in concrete structures using Fourier analysis for sequential thermal data** [6939-35]
S. Nakamura, Sumitomo-Osaka Cement Co., Ltd. (Japan); T. Sakagami, Osaka Univ. (Japan); S. Harada, Sumitomo-Osaka Cement Co., Ltd. (Japan); S. Kubo, Osaka Univ. (Japan)
- 6939 11 **Localization of wood floor structure by infrared thermography** [6939-54]
C. Cochior Plescanu, M. Klein, C. Ibarra-Castanedo, A. Bendada, X. Maldague, Univ. Laval (Canada)

SESSION 12 NDT NUMERICAL ANALYSIS AND THEORY

- 6939 13 **Accuracy issues in modeling thermal NDT problems** [6939-37]
V. Vavilov, Tomsk Polytechnic Univ. (Russia); S. Marinetti, ITC-CNR (Italy); D. Nesteruk, Tomsk Polytechnic Univ. (Russia)
- 6939 14 **A straightforward graphical user interface for basic and advanced signal processing of thermographic infrared sequences** [6939-38]
M. T. Klein, C. Ibarra-Castanedo, X. P. Maldague, A. Bendada, Univ. Laval (Canada)
- 6939 15 **Thermographic signal processing through correlation operators in pulsed thermography** [6939-39]
M. T. Klein, C. Ibarra-Castanedo, A. Bendada, X. P. Maldague, Univ. Laval (Canada)
- 6939 16 **Quantitative characterization of resistive defects in thick composites using step heating thermography** [6939-40]
A. A. Badghaish, D. C. Fleming, Florida Institute of Technology (USA)

SESSION 13 NDT METHODS AND APPLICATIONS

- 6939 18 **A study of active thermography approaches for the non-destructive testing and evaluation of aerospace structures** [6939-42]
N. P. Avdelidis, National Technical Univ. of Athens (Greece); C. Ibarra-Castanedo, Univ. Laval (Canada); Z. P. Marioli-Riga, Hellenic Aerospace Industry (Greece); A. Bendada, X. P. V. Maldague, Univ. Laval (Canada)
- 6939 19 **Fuselage inspection of Boeing 737 using lock-in thermography** [6939-43]
M. Tarin, MovIMED (USA); A. Kasper, Automation Technology GmbH (Germany)

SESSION 14 MATERIALS EVALUATION: THERMAL AND FATIGUE PROPERTIES

- 6939 1F **Detection of delamination defect inside timber by sonic IR** [6939-49]
M. Y. Choi, J. H. Park, Korea Research Institute of Standards and Science (South Korea); W. T. Kim, Kongju National Univ. (South Korea); K. S. Kang, Korea Research Institute of Standards and Science (South Korea)

- 6939 1G **Thermal stress analysis of a circular holed specimen** [6939-50]
W. T. Kim, Kongju National Univ. (South Korea); M. Y. Choi, J. H. Park, K. S. Kang, Korea
Research Institute of Standards and Science (South Korea)
- 6939 1H **Simulating thermal NDT of bonded structures by FEM** [6939-51]
X. Guo, F. Qie, Beihang Univ. (China)
- 6939 1I **Dimensionless heat transfer model to compress and analyze pulsed thermography data for
NDT of materials** [6939-52]
J. C. Ramirez-Granados, G. Paez, M. Strojnik, Ctr. de Investigaciones en Optica, A.C.
(Mexico)

Author Index

Conference Committee

Symposium Chair

Larry B. Stotts, Defense Advanced Research Projects Agency (USA)

Symposium Cochair

Ray O. Johnson, Lockheed Martin Corporation (USA)

Program Track Chair

Gabor F. Fulop, Maxtech International, Inc. (USA)

Conference Chairs

Vladimir P. Vavilov, Tomsk Polytechnic University (Russia)

Douglas D. Burleigh, La Jolla Cove Consulting (USA)

Program Committee

Lee R. Allen, Allen Applied Infrared Technology (USA)

Nicolas P. Avdelidis, EBETAM S.A. (Greece)

Pierre Bremond, Cedip Infrared Systems (France)

Antonio Colantonio, Public Works and Government Services Canada (Canada)

Fred Colbert, Colbert Infrared Services (USA)

K. Elliott Cramer, NASA Langley Research Center (USA)

Ralph B. Dinwiddie, Oak Ridge National Laboratory (USA)

Ermanno G. Grinzato, Consiglio Nazionale delle Ricerche (Italy)

Sheng-Jen Hsieh, Texas Agricultural & Mechanical University (USA)

Herbert Kaplan, Honeyhill Technical Company (USA)

Timo T. Kauppinen, VTT (Finland)

Dennis H. LeMieux, Siemens Corporate Research (USA)

Sven-Åke Ljungberg, University of Gävle (Sweden)

Robert P. Madding, FLIR Systems, Inc. (USA)

Xavier P. V. Maldague, Université Laval (Canada)

G. Raymond Peacock, Temperatures.com, Inc. (USA)

Piotr Pregowski, Pregowski Infrared Services (Poland)

Austin A. Richards, FLIR Systems (USA)

Andrés E. Rozlosnik, SI Termografía Infrarroja (Argentina)

Morteza Safai, The Boeing Company (USA)

Takahide Sakagami, Osaka University (Japan)

R. James Seffrin, Infrasppection Institute (USA)

Steven M. Shepard, Thermal Wave Imaging, Inc. (USA)

John R. Snell, Snell Infrared (USA)
Gregory R. Stockton, Stockton Infrared Thermographic Services, Inc.
(USA)
Lisa West Åkerblom, FLIR Systems AB (Sweden)

Session Chairs

- 1 Pyrometry, Temperature Measurements, and Calibration I
G. Raymond Peacock, Temperatures.com, Inc. (USA)
Robert P. Madding, FLIR Systems, Inc. (USA)
- 2 Pyrometry, Temperature Measurements, and Calibration II
G. Raymond Peacock, Temperatures.com, Inc. (USA)
Robert P. Madding, FLIR Systems, Inc. (USA)
- 3 Professional Standards I
Lisa West Åkerblom, FLIR Systems AB (Sweden)
Antonio Colantonio, Public Works and Government Services Canada
(Canada)
- 4 Professional Standards II
Lisa West Åkerblom, FLIR Systems AB (Sweden)
Antonio Colantonio, Public Works and Government Services Canada
(Canada)
- 5 Thermal Image Fusion
Herbert Kaplan, Honeyhill Technical Company (USA)
- 6 IR Neighbors: NIR, Visible and UV I
Herbert Kaplan, Honeyhill Technical Company (USA)
Jan K. Eklund, EKLUND INFRARED, Inc. (USA)
- 7 IR Neighbors: NIR, Visible and UV II
Herbert Kaplan, Honeyhill Technical Company (USA)
Jan K. Eklund, EKLUND INFRARED, Inc. (USA)
- 8 Research Topics
Morteza Safai, The Boeing Company (USA)
Gary L. Orlove, FLIR Systems, Inc. (USA)
- 9 Products and Processes
Andrés E. Rozlosnik, SI Termografía Infrarroja (Argentina)
Gregory R. Stockton, Stockton Infrared Thermographic Services, Inc.
(USA)

- 10 Environmental Investigations
Gregory R. Stockton, Stockton Infrared Thermographic Services, Inc.
(USA)
Andrés E. Rozlosnik, SI Termografía Infrarroja (Argentina)
- 11 NDT of Buildings and Civil Structures
Kathryn M. Knettel, United Space Alliance, LLC (USA)
Nicolas P. Avdelidis, EBETAM S.A. (Greece)
Timo T. Kauppinen, VTT (Finland)
- 12 NDT Numerical Analysis and Theory
Vladimir P. Vavilov, Tomsk Polytechnic University (Russia)
Douglas D. Burleigh, La Jolla Cove Consulting (USA)
K. Elliott Cramer, NASA Langley Research Center (USA)
- 13 NDT Methods and Applications
Douglas D. Burleigh, La Jolla Cove Consulting (USA)
Vladimir P. Vavilov, Tomsk Polytechnic University (Russia)
Ermanno G. Grinzato, Consiglio Nazionale delle Ricerche (Italy)
- 14 Materials Evaluation: Thermal and Fatigue Properties
Takahide Sakagami, Osaka University (Japan)
Pierre Bremond, Cedip Infrared Systems (France)
Jeff R. Brown, Hope College (USA)