PROCEEDINGS OF SPIE

# *Infrared Imaging Systems: Design, Analysis, Modeling, and Testing XX*

**Gerald C. Holst**
*Editor*

**14–16 April 2009**
**Orlando, Florida, United States**

*Sponsored and Published by*
SPIE

**Volume 7300**

Proceedings of SPIE, 0277-786X, v. 7300

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 *Infrared Imaging Systems: Design, Analysis, Modeling, and Testing XX*, edited by Gerald C. Holst, Proceedings of SPIE Vol. 7300 (SPIE, Bellingham, WA, 2009) Article CID Number.

ISSN 0277-786X
ISBN 9780819475664

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 © 2009, 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/09/$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 MODELING I**

7300 03 **Optical characteristics of small surface targets, measured in the False Bay, South Africa; June 2007** [7300-02]
A. N. de Jong, P. B. W. Schwering, P. J. Fritz, TNO Defence, Security and Safety (Netherlands); W. H. Gunter, Institute for Maritime Technology (South Africa)

7300 04 **Range performance impact of noise for thermal system modeling** [7300-03]
J. D. Fanning, B. P. Teaney, J. P. Reynolds, T. W. Du Bosq, U.S. Army RDECOM CERDEC NVESD (United States)

7300 05 **Passive IR sensor performance analysis using Mathcad® modeling** [7300-04]
W. Wan, Lockheed Martin Coherent Technologies (United States)

7300 06 **Visual acuity and contrast sensitivity with compressed motion video** [7300-05]
P. Bijl, S. C. de Vries, TNO Defense, Security and Safety (Netherlands)

**SESSION 2 MODELING II**

7300 07 **Perception testing: a key component in modeling and simulation at NVESD** [7300-06]
T. Maurer, O. Nguyen, U.S. Army RDECOM CERDEC NVESD (United States); J. Thomas, EOIR Technologies, Inc. (United States); E. Boettcher, DCS Corp. (United States)

7300 08 **Empirical modeling and results of NIR clutter for tactical missile warning** [7300-07]
J. B. Montgomery, C. T. Montgomery, M & M Aviation (United States); R. B. Sanderson, J. F. McCalmont, Air Force Research Lab. (United States)

7300 09 **Modeling of video compression effects on target acquisition performance** [7300-09]
J. H. Cha, U.S. Army RDECOM CERDEC NVESD (United States); B. Preece, EOIR Technologies, Inc. (United States); R. L. Espinola, U.S. Army RDECOM CERDEC NVESD (United States)

**SESSION 3 MODELING III**

7300 0B **Super-resolution for flash LADAR data** [7300-10]
S. Hu, S. S. Young, Army Research Lab. (United States); T. Hong, National Institute of Standards and Technology (United States); J. P. Reynolds, K. Krapels, B. Miller, J. Thomas, O. Nguyen, U.S. Army RDECOM CERDEC NVESD (United States)

7300 0C **Sensor performance as a function of sampling (d) and optical blur (F λ)** [7300-11]
P. Bijl, M. A. Hogervorst, TNO Defense, Security and Safety (Netherlands)

7300 0D **Validating model predictions of MRT measurements on LWIR imaging systems** [7300-12]
S. D. Burks, K. Garner, S. Miller, B. P. Teaney, U.S. Army RDECOM CERDEC NVESD (United States)

7300 0E **Comparison of perception results with a proposed model for detection of a stationary target from a moving platform** [7300-14]
M. Friedman, T. Du Bosq, J. Reynolds, D. Wilson, U.S. Army RDECOM CERDEC NVESD (United States); R. Kang, Alion Science and Technology Corp. (United States)

**SESSION 4 MODELING IV**

7300 0F **Performance evaluation of image enhancement techniques on a digital image-intensifier** [7300-15]
J. Dijk, P. Bijl, H. Bouma, TNO Defence, Security and Safety (Netherlands)

7300 0G **Limitations of contrast enhancement for infrared target identification** [7300-16]
T. W. Du Bosq, J. D. Fanning, U.S. Army RDECOM CERDEC NVESD (United States)

7300 0H **Multispectral EO/IR sensor model for evaluating UV, visible, SWIR, MWIR and LWIR system performance** [7300-17]
A. K. Sood, R. Richwine, Y. R. Puri, Magnolia Optical Technologies, Inc. (United States); N. K. Dhar, D. L. Polla, Defense Advanced Research Projects Agency (United States); P. S. Wijewarnasuriya, Army Research Lab. (United States)

7300 0I **Identification of ground targets from airborne platforms** [7300-18]
J. Doe, U.S. Army RDECOM CERDEC NVESD (United States); E. Boettcher, DCS Corp. (United States); B. Miller, U.S. Army RDECOM CERDEC NVESD (United States)

**SESSION 5 TARGETS, BACKGROUNDS, AND ATMOSPHERICS I**

7300 0J **Validation of the thermal code of RadTherm-IR, IR-Workbench, and F-TOM** [7300-19]
F. Schwenger, P. Grossmann, A. Malaplate, FGAN-FOM (Germany)

7300 0K **The coupling of MATISSE and the SE-WORKBENCH: a new solution for simulating efficiently the atmospheric radiative transfer and the sea surface radiation** [7300-21]
T. Cathala, N. Douchin, J. Latger, OKTAL Synthetic Environment (France); K. Caillault, S. Fauqueux, T. Huet, L. Lubarre, C. Malherbe, B. Rosier, P. Simoneau, ONERA/DOTA (France)

7300 0L **MATISSE-v1.5 and MATISSE-v2.0: new developments and comparison with MIRAMER measurements** [7300-22]
P. Simoneau, K. Caillault, S. Fauqueux, T. Huet, L. Labarre, C. Malherbe, B. Rosier, ONERA (France)

**SESSION 6 TARGETS, BACKGROUNDS, AND ATMOSPHERICS II**

7300 0M **Measurement and analysis of optical surface properties for input to ShipIR** [7300-23]
D. A. Vaitekunas, W. R. Davis Engineering, Ltd. (Canada); J. Jafolla, P. McKenna, M. Szczesniak, Surface Optics Corp. (United States)

7300 0N **CART III: improved camouflage assessment using moving target indication** [7300-24]
T. Müller, Fraunhofer-Institut für Informations-und Datenverarbeitung (Germany); T. Honke, German armed forces dept. WTD (Germany); M. Müller, Fraunhofer-Institut für Informations-und Datenverarbeitung (Germany)

7300 0O **A structure-based image similarity measure using homogeneity regions** [7300-25]
E. P. Lam, Thales-Raytheon Systems Co. LLC (United States)

7300 0P **Signal modeling of turbulence-distorted imagery** [7300-26]
S. S. Young, Army Research Lab. (United States); R. G. Driggers, Naval Research Lab. (United States); K. Krapels, R. L. Espinola, J. P. Reynolds, J. Cha, U.S. Army RDECOM CERDEC NVESD (United States)

**SESSION 7 SYSTEMS AND TESTING I**

7300 0Q **Comparison of emissivity evaluation methods for infrared sources** [7300-27]
S. D. Scopatz, J. A. Mazzetta, J. E. Sgheiza, M. A. Medina, Electro Optical Industries, Inc. (United States)

7300 0R **Improving MTF measurements of under-sampled optical systems** [7300-28]
J. D. LaVeigne, Santa Barbara Infrared, Inc. (United States); S. D. Burks, U.S. Army RDECOM CERDEC NVESD (United States)

7300 0S **Infrared search and track and imaging system: testing in the laboratory and during flight** [7300-29]
L. E. Guzzetti, L. Busnelli, SELEX GALILEO (Italy)

7300 0T **MWIR and LWIR wavefront sensing with quadri-wave lateral shearing interferometry** [7300-30]
S. Velghe, D. Brahmi, W. Boucher, B. Wattellier, PHASICS S.A. (France); N. Guérineau, R. Haïdar, J. Primot, ONERA (France)

7300 0U **A new fast infrared imaging spectroradiometer** [7300-31]
L. Moreau, C. Roy, C. Vallières, L. Levesque, M.-A. Soucy, ABB Inc. (Canada)

**SESSION 8 SYSTEMS AND TESTING II**

7300 0W **Controllable time dependent and dual band emission infrared source to test missile warning systems in-flight: system characterization** [7300-33]
D. Cabib, L. Davidzon, A. Gil, CI Systems Ltd. (Israel)

7300 0X **MKV carrier vehicle sensor calibration** [7300-34]
J. Tansock, S. Hansen, Utah State Univ. (United States); J. Williams, B. Sisko, K. Pancholi, Missile Defense Agency (United States); A. Plotnik, MIT Lincoln Lab. (United States); J. Albritton, Missile Defense Agency (United States); M. Margulis, M. Kalscheur, D. Welsh, Lockheed Martin Space Systems Co. (United States); D. Dixon, Utah State Univ. (United States); S. Brown, Missile Defense Agency (United States); K. Ip, Lockheed Martin Space Systems Co. (United States); K. Burk, M. Greenman, J. Peterson, A. Bird, D. Marchant, D. Ferguson, B. Haslem, Utah State Univ. (United States); W. Shaw, BAE Systems (United States)

7300 0Y **Large-area blackbody emissivity variation with observation angle** [7300-35]
P. W. Nugent, J. A. Shaw, Montana State Univ. (United States)

7300 0Z **A study of the radiometric calibration of spectral bands in the mid-wave infrared (MWIR) spectral range 1.5-5 µm** [7300-36]
T. Svensson, I. Renhorn, Swedish Defence Research Agency (Sweden); P. Broberg, Luleå Univ. of Technology (Sweden)

7300 10 **A new passive polarimetric imaging system collecting polarization signatures in the visible and infrared bands** [7300-37]
D. A. Lavigne, Defence Research and Development Canada (Canada); M. Breton, AEREX Avionics inc. (Canada); G. Fournier, M. Pichette, Defence Research and Development Canada (Canada); V. Rivet, AEREX Avionics inc. (Canada)

**POSTER SESSION**

7300 11 **Experimental method for observation prediction based on the decision matrix through day/night equipments in NIR and LWIR spectral ranges** [7300-38]
O. C. Borcan, C. A. Spulber, Pro Optica S.A. (Romania)

7300 12 **Evaluation of the different configurations of infrared-type gimbaled cameras in the sense of blur** [7300-39]
B. Özkan, A. Akmeşe, A. Uçar, TÜBITAK-Sage (Turkey)

7300 13 **Novel image fusion quality metrics based on sensor models and image statistics** [7300-41]
F. A. Smith, S. Chari, C. E. Halford, Univ. of Memphis (United States); J. Fanning, J. P. Reynolds, U.S. Army RDECOM CERDEC NVESD (United States)

*Author Index*

# Conference Committee

*Symposium Chair*

**Ray O. Johnson,** Lockheed Martin Corporation (United States)

*Symposium Cochair*

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

*Conference Chair*

**Gerald C. Holst,** JCD Publishing (United States)

*Program Committee*

**Piet Bijl,** TNO Defence, Security and Safety (Netherlands)
**Ronald G. Driggers,** Naval Research Laboratory (United States)
**David P. Forrai,** L-3 Communications Cincinnati Electronics, Inc. (United States)
**Keith A. Krapels,** U.S. Army RDECOM CERDEC NVESD (United States)
**Terrence S. Lomheim,** The Aerospace Corporation (United States)
**Alan Irwin,** Santa Barbara Infrared, Inc. (United States)
**Luanne P. Obert,** U.S. Army RDECOM CERDEC NVESD (United States)
**Hector M. Reyes,** Raytheon Network Centric Systems (United States)
**Endre Repasi,** FGAN-FOM (Germany)
**Joseph P. Reynolds,** U.S. Army RDECOM CERDEC NVESD (United States)
**Ronald B. Sartain,** Army Research Laboratory (United States)
**Michael A. Soel,** FLIR Systems, Inc. (United States)
**Curtis M. Webb,** Northrop Grumman Corporation (United States)

*Session Chairs*

1 Modeling I
**Joseph P. Reynolds,** U.S. Army RDECOM CERDEC NVESD (United States)
**Piet Bijl,** TNO Defence, Security and Safety (Netherlands)

2 Modeling II
**Keith A. Krapels,** U.S. Army RDECOM CERDEC NVESD (United States)
**Terrence S. Lomheim,** The Aerospace Corporation (United States)
**Ronald G. Driggers,** Naval Research Laboratory (United States)

3 Modeling III
**Luanne P. Obert,** U.S. Army RDECOM CERDEC NVESD (United States)
**Hector M. Reyes,** Raytheon Network Centric Systems (United States)

4 Modeling IV
**Ronald B. Sartain,** Army Research Laboratory (United States)
**David P. Forrai,** L-3 Communications Cincinnati Electronics, Inc. (United States)
**Ronald G. Driggers,** Naval Research Laboratory (United States)

5 Targets, Backgrounds, and Atmospherics I
**Endre Repasi,** FGAN-FOM (Germany)
**Michael A. Soel,** FLIR Systems, Inc. (United States)

6 Targets, Backgrounds, and Atmospherics II
**Endre Repasi,** FGAN-FOM (Germany)
**Michael A. Soel,** FLIR Systems, Inc. (United States)

7 Systems and Testing I
**Alan Irwin,** Santa Barbara Infrared, Inc. (United States)
**Curtis M. Webb,** Northrop Grumman Corporation (United States)

8 Systems and Testing II
**Alan Irwin,** Santa Barbara Infrared, Inc. (United States)
**Curtis M. Webb,** Northrop Grumman Corporation (United States)