

PROCEEDINGS OF SPIE

***Technologies for  
Synthetic Environments:  
Hardware-in-the-Loop Testing XIII***

**Robert Lee Murrer, Jr.**  
*Editor*

**17–18 March 2008  
Orlando, Florida, USA**

*Sponsored and Published by  
SPIE*

**Volume 6942**

Proceedings of SPIE, 0277-786X, v. 6942

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 *Technologies for Synthetic Environments: Hardware-in-the-Loop Testing XIII*, edited by Robert Lee Murrer, Jr., Proceedings of SPIE Vol. 6942 (SPIE, Bellingham, WA, 2008) Article CID Number.

ISSN 0277-786X  
ISBN 9780819471338

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](http://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.

**SPIE**   
Digital Library

[SPIDigitalLibrary.org](http://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

vii *Conference Committee*

---

## SESSION 1 FLIGHT MOTION SIMULATORS, FACILITIES, AND LADAR

---

- 6942 02 **Major specification discriminators affecting advanced motion simulator configurations** [6942-01]  
R. W. Mitchell, Ideal Aerosmith, Inc. (USA)
- 6942 03 **Keeping up with dynamics of next generation missiles** [6942-02]  
M. A. Warden, R. Hauser, P. Hofstetter, M. Kägi, M. Meier, W. Rindlisbacher, A. Stomas, P. Wälti, Acutronic Switzerland AG (Switzerland)
- 6942 04 **An object-oriented simulation architecture for utilizing hardware-in-the-loop simulation within a many-on-many engagement scenario** [6942-03]  
R. Brindley, Simulation Technologies, Inc. (USA); S. Mobley, U.S. Army Aviation and Missile Research, Development, and Engineering Command (USA); J. Gareri, Simulation Technologies, Inc. (USA)
- 6942 05 **Integrated defense system framework and high fidelity hardware-in-the-loop sensor stimulators** [6942-04]  
J. A. Buford, Jr., T. C. Barnett Jr., B. W. Vatz II, M. J. Williams, J. Van Bebber, U.S. Army Aviation and Missile Research, Development and Engineering Ctr. (USA); C. Burson, Simulation Technologies, Inc. (USA)
- 6942 06 **High accuracy LADAR scene projector calibration sensor development** [6942-05]  
H. J. Kim, U.S. Army RDECOM, Aviation & Missile RDEC (USA); M. C. Cornell, C. B. Naumann, M. H. Bowden, Optical Sciences Corp. (USA)

---

## SESSION 2 SCENE PROJECTOR SYSTEMS I

---

- 6942 07 **Development of infrared scene projectors for testing fire-fighter cameras** [6942-06]  
J. E. Neira, J. P. Rice, F. K. Amon, National Institute of Standards and Technology (USA)
- 6942 08 **Two-band DMD-based infrared scene simulator** [6942-07]  
J. R. Dupuis, D. J. Mansur, G. Genetti, OPTRA, Inc. (USA)
- 6942 09 **The infrared and semi-active laser simulation capabilities at the multi-spectral system simulation (MSS) HWIL facility** [6942-08]  
D. A. Saylor, Optical Sciences Corp. (USA); J. Terry, J. Morris, US Army AMRDEC (USA)

---

**SESSION 3 SCENE PROJECTOR SYSTEMS II**

---

- 6942 0C **Development of photonic crystal-based scene projection technology** [6942-11]  
J. Caulfield, Cyan Systems (USA); B. Burckel, G. Ten Eyck, I. El-Kady, F. McCormick, Sandia National Lab. (USA); J. Curzan, M. Massie, Nova Sensors (USA); R. Stockbridge, D. Snyder, U.S. Air Force AFRL/RWGG (USA)
- 6942 0D **Testing and results of an infrared polarized scene generator concept demonstrator** [6942-12]  
P. S. Erbach, J. L. Pezzaniti, D. B. Chenault, Polaris Sensor Technologies, Inc. (USA); D. Saylor, Optical Sciences Corp., Inc. (USA); H. S. Lowry, Aerospace Testing Alliance (USA)

---

**SESSION 4 DIODE-BASED SCENE PROJECTOR SYSTEMS**

---

- 6942 0E **Thermal simulations of packaged IR LED arrays** [6942-13]  
J. V. Lawler, J. Currano, ATEC, Inc. (USA)
- 6942 0G **Development of a mid-infrared interband cascade LED array** [6942-15]  
J. L. Bradshaw, J. D. Bruno, F. J. Towner, C. A. Shiner, J. T. Pham, Maxion Technologies, Inc. (USA); S. D. Suchalkin, G. L. Belenky, SUNY Stony Brook (USA)
- 6942 0I **Performance of 64x64 MWIR super lattice light-emitting diode (SLED) array for IR scene generation** [6942-17]  
N. C. Das, Army Research Lab. (USA); F. Kiamilev, Univ. of Delaware (USA); J. P. Prineas, J. T. Olesberg, E. J. Koerperick, L. M. Murray, T. F. Boggess, Univ. of Iowa (USA)
- 6942 0J **Hybrid infrared scene projector (HIRSP): a high dynamic range infrared scene projector, part II** [6942-18]  
T. M. Cantey, M. Bowden, Optical Sciences Corp. (USA); D. Cosby, G. Ballard, U.S. Army Aviation and Missile Research, Development and Engineering Ctr. (USA)

---

**SESSION 5 SCENE GENERATION TECHNOLOGIES**

---

- 6942 0K **Real-time dynamic PC image generation techniques for high performance and high dynamic range fidelity** [6942-19]  
D. H. Bunfield, D. E. Trimble, T. Fronckowiak, Jr., Davidson Technologies, Inc. (USA); G. Ballard, J. Morris, U.S. Army Aviation and Missile Research, Development and Engineering Ctr. (USA)
- 6942 0L **Polarization measurements made on LFRA and OASIS emitter arrays** [6942-28]  
J. Geske, Aerius Photonics, LLC (USA); K. Sparkman, J. Oleson, J. Laveigne, Santa Barbara Infrared, Inc. (USA); B. Sieglinger, S. Marlow, MacAulay-Brown Inc./KHILS (USA); H. Lowry, J. Burns, Arnold Engineering Development Ctr. (USA)

---

**SESSION 6 SCENE PROJECTOR CALIBRATION AND CHARACTERIZATION I**

---

6942 OM **Technical issues in the development of scene-projection systems for sensor calibration, characterization, and HWIL testing at AEDC [6942-21]**  
H. S. Lowry, M. F. Breeden, D. H. Crider, S. L. Steely, R. A. Nicholson, J. M. Labello, Arnold Engineering Development Ctr. (USA)

6942 ON **Resistor array infrared projector nonuniformity correction: search for performance improvement III [6942-22]**  
R. A. Joyce, L. Świerkowski, O. M. Williams, Defence Science and Technology Organisation (Australia)

---

**SESSION 7 SCENE PROJECTOR CALIBRATION AND CHARACTERIZATION II**

---

6942 OQ **Background gradient reduction of an infrared scene projector mounted on a flight motion simulator [6942-26]**  
T. M. Cantey, M. H. Bowden, Optical Sciences Corp. (USA); G. Ballard, U.S. Army Aviation and Missile Research, Development and Engineering Ctr. (USA)

6942 OR **Performance improvements in large format resistive array (LFRA) infrared scene projectors (IRSP) [6942-27]**  
K. Sparkman, J. LaVeigne, J. Oleson, G. Franks, S. McHugh, Santa Barbara Infrared, Inc. (USA); J. Lannon, RTI International (USA); S. Solomon, Acumen Scientific (USA)

*Author Index*



# Conference Committee

## *Symposium Chair*

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

## *Symposium Cochair*

**Ray O. Johnson**, Lockheed Martin Corporation (USA)

## *Track Chair*

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

## *Conference Chair*

**Robert Lee Murrer, Jr.**, Millennium Engineering and Integration Company (USA)

## *Conference Cochair*

**James A. Buford, Jr.**, U.S. Army Aviation and Missile Research, Development and Engineering Center (USA)

## *Program Committee*

**Mary A. Amick**, U.S. Air Force (USA)

**David Brett Beasley**, Optical Sciences Corporation (USA)

**Paul T. Bryant**, Left Coast Consulting (USA)

**Charles F. Coker**, Air Force Research Laboratory (USA)

**David S. Cosby**, U.S. Army Research, Development and Engineering Command (USA)

**Naresh C. Das**, Army Research Laboratory (USA)

**George C. Goldsmith, II**, U.S. Air Force (USA)

**Alexander G. Hayes**, MIT Lincoln Laboratory (USA)

**Jay B. James**, FLIR Systems, Inc. (USA)

**John M. Lannon**, RTI International (USA)

**Heard S. Lowry**, Aerospace Testing Alliance (USA)

**Scott B. Mobley**, U.S. Army Aviation and Missile Command (USA)

**Randy A. Nicholson**, Aerospace Testing Alliance (USA)

**Robert M. Patchan**, The Johns Hopkins University Applied Physics Laboratory (USA)

**Donald R. Snyder**, Air Force Research Laboratory (USA)

**Steven L. Solomon**, Acumen Scientific (USA)

**Rhoe A. Thompson**, Air Force Research Laboratory (USA)

**Owen M. Williams**, Defence Science and Technology Organisation (Australia)

## Session Chairs

- 1 Flight Motion Simulators, Facilities, and LADAR  
**James A. Buford, Jr.**, U.S. Army Aviation and Missile Research, Development and Engineering Center (USA)  
**Donald R. Snyder**, Air Force Research Laboratory (USA)  
**Mary A. Amick**, U.S. Air Force (USA)
- 2 Scene Projector Systems I  
**Robert Lee Murrer, Jr.**, Millennium Engineering and Integration Company (USA)  
**George C. Goldsmith, II**, U.S. Air Force (USA)  
**Rhoe A. Thompson**, Air Force Research Laboratory (USA)
- 3 Scene Projector Systems II  
**Robert Lee Murrer, Jr.**, Millennium Engineering and Integration Company (USA)
- 4 Diode-Based Scene Projector Systems  
**Heard S. Lowry**, Aerospace Testing Alliance (USA)  
**David Brett Beasley**, Optical Sciences Corporation (USA)  
**Paul T. Bryant**, Left Coast Consulting (USA)
- 5 Scene Generation Technologies  
**David S. Cosby**, U.S. Army Research, Development and Engineering Command (USA)  
**Charles F. Coker**, Air Force Research Laboratory (USA)
- 6 Scene Projector Calibration and Characterization I  
**Owen M. Williams**, Defence Science and Technology Organisation (Australia)  
**Naresh C. Das**, Army Research Laboratory (USA)  
**Scott B. Mobley**, U.S. Army Aviation and Missile Command (USA)
- 7 Scene Projector Calibration and Characterization II  
**Owen M. Williams**, Defence Science and Technology Organisation (Australia)  
**Naresh C. Das**, Army Research Laboratory (USA)  
**Scott B. Mobley**, U.S. Army Aviation and Missile Command (USA)