

PROCEEDINGS OF SPIE

# ***Head- and Helmet-Mounted Displays XIII: Design and Applications***

**Randall W. Brown  
Peter L. Marasco  
Thomas H. Harding  
Sion A. Jennings**  
*Editors*

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

*Sponsored and Published by*  
SPIE

**Volume 6955**

Proceedings of SPIE, 0277-786X, v. 6955

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 *Head- and Helmet-Mounted Displays XIII: Design and Applications*, edited by Randall W. Brown, Peter L. Marasco, Thomas H. Harding, Sion A. Jennings, Proceedings of SPIE Vol. 6955 (SPIE, Bellingham, WA, 2008) Article CID Number.

ISSN 0277-786X  
ISBN 9780819471468

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.

  
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*

---

## PLENARY SESSION: DISPLAYS

---

- 6955 02 **Display content in advanced NVG and HMD systems: a pilot/flight surgeon's concerns (Plenary Paper)** [6955-05]  
J. C. Antonio, NAVAIR/NAWCAD (USA)

---

## SESSION 1 SYSTEMS

---

- 6955 03 **The development of a high-resolution HMD with a wide FOV using the shuttle optical system** [6955-01]  
K. Inoguchi, M. Matsunaga, S. Yamazaki, Canon Inc. (Japan)
- 6955 04 **Helmet-mounted display (HMD) upgrade for the US Army's AVCATT simulation program** [6955-02]  
J. E. Melzer, J. W. Porter, Rockwell Collins, Inc. (USA)
- 6955 05 **The Cobra helmet mounted display system for Gripen** [6955-03]  
J. Larsson, T. Blomqvist, Saab Aerosystems (Sweden)
- 6955 06 **TopOwl night vision improvements** [6955-04]  
O. Lemoine, J. C. Ebert, F. Saviot, M. Charbonneau, Thales Avionics France (France);  
B. Coumert, Thales Angénieux France (France)

---

## SESSION 2 HMD COMPONENTS

---

- 6955 07 **All solid state electrochromic device for helmet-mounted displays** [6955-06]  
H. Demiryont, K. Shannon III, J. Isidorsson, Eclipse Energy Systems, Inc. (USA); S. Dixon,  
A. Pinkus, Air Force Research Lab. (USA)
- 6955 08 **Active matrix organic light emitting diode (OLED)-XL life test results** [6955-07]  
D. A. Fellowes, M. V. Wood, A. R. Hastings, Jr., U.S. Army RDECOM CERDEC Night Vision and  
Electronic Sensors Directorate (USA); A. P. Ghosh, O. Prache, eMagin Corp. (USA)
- 6955 0A **A new optical HMT system based on image processing** [6955-10]  
K. Tawada, K. Hirooka, Shimadzu Corp. (Japan)
- 6955 0B **A full-color SXGA TN AMLCD for military head-mounted displays and viewer applications** [6955-11]  
O. Woodard, J. Lo, M. Khandaker, J. Gassel, F. Herrmann, H. Ong, B. Y. Tsaur, Kopin Corp.  
(USA); C. Reese, U.S. Army RDECOM CERDEC Night Vision & Electronic Sensors Directorate  
(USA)

---

**SESSION 3 DESIGN ISSUES**

---

- 6955 0C **Visual issues associated with the use of the integrated helmet and display sighting system (IHADSS) in the Apache helicopter: three decades in review** [6955-12]  
K. L. Hiatt, U.S. Army Research Institute of Environmental Medicine (USA); C. E. Rash, U.S. Army Aeromedical Research Lab. (USA); K. Heinecke, United States Military Academy (USA)
- 6955 0D **Visual perceptual issues of the integrated helmet and display sighting system (IHADSS): four expert perspectives** [6955-13]  
C. E. Rash, U.S. Army Aeromedical Research Lab. (USA); K. Heinecke, United States Military Academy (USA); G. Francis, Purdue Univ. (USA); K. L. Hiatt, U.S. Army Research Institute of Environmental Medicine (USA)
- 6955 0F **Perceptual design tradeoff considerations for viewing I<sup>2</sup> and FLIR with current helmet-mounted displays** [6955-15]  
M. E. Kalich, T. H. Harding, C. E. Rash, U.S. Army Aeromedical Research Lab. (USA)
- 6955 0G **Spatial constraints for 3D perception in helmet-mounted displays** [6955-28]  
A.-E. Priot, Institut de Médecine Aérospatiale du Service de Santé des Armées (France); M. Charbonneau, Thales Aerospace (France); D. Paillé, ESSILOR (France)

---

**SESSION 4 HUMAN FACTORS**

---

- 6955 0H **Effects of field of view on human locomotion** [6955-16]  
A. Toet, M. van der Hoeven, M. Kahrimanović, N. J. Delleman, TNO Human Factors (Netherlands)
- 6955 0I **Aurally aided visual search performance in a dynamic environment** [6955-17]  
J. P. McIntire, General Dynamics Advanced Information Systems (USA); P. R. Havig, Air Force Research Lab. (USA); S. N. J. Watamaniuk, R. H. Gilkey, Wright State Univ. (USA)
- 6955 0J **Comparative effects of vergence/accommodation conflicts with different interocular separation and viewing distances** [6955-18]  
M. Charbonneau, Thales Avionics S.A. (France); A.-E. Priot, C. Roumes, Institut de Médecine Aérospatiale du Service de Santé des Armées (France); A. Léger, Thales Avionics S.A. (France)
- 6955 0K **The yaw, pitch, and roll of the head in a straight ahead orientation** [6955-19]  
L. A. Temme, D. L. Still, A. J. M. Houtsma, U.S. Army Aeromedical Research Lab. (USA)
- 6955 0L **Toward the HMD as a cognitive prosthesis (Best Paper Award)** [6955-20]  
J. E. Melzer, Rockwell Collins, Inc. (USA)

---

**SESSION 5 TESTING**

---

- 6955 0M **Low light comparison of target visibility with night vision goggles** [6955-21]  
G. Craig, National Research Council Canada (Canada); M. Brulotte, Transport Canada (Canada); S. Carignan, T. Macuda, S. Jennings, National Research Council Canada (Canada)

6955 ON **Development of NVG test maneuvers for civilian aircraft** [6955-22]  
S. Jennings, G. Craig, S. Carignan, H. Fischer, National Research Council Canada (Canada); M. Brulotte, Transport Canada (Canada)

6955 OO **Safety qualification and operational assessment of a night vision cueing and display system** [6955-23]  
J. M. Barnaba, C. W. Wilson, M. Baez-Vazquez, U.S. Air Force (USA)

---

**SESSION 6 AUGMENTED/VIRTUAL REALITY**

6955 OP **Stereoscopic helmet mounted system for real time 3D environment reconstruction and indoor ego-motion estimation** [6955-24]  
G. Donato, Joint Research Ctr., European Commission (Italy) and Brunel Univ. (United Kingdom); V. M. Sequeira, Joint Research Ctr., European Commission (Italy); A. Sadka, Brunel Univ. (United Kingdom)

6955 OQ **An augmented reality binocular system (ARBS) for air traffic controllers** [6955-29]  
J. E. Fulbrook, DCS Corp. (USA); J. W. Ruffner, SI International, Inc. (USA); R. Labbe, DCS Corp. (USA)

6955 OS **Evaluation of tangible user interfaces for command and control in virtual environments** [6955-26]  
P. Havig, Air Force Research Lab. (USA); J. McIntire, General Dynamics Advanced Information Systems (USA); A. Compton, E. Heft, Air Force Research Lab. (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)

## *Program Track Chairs*

**Clarence E. Rash**, U.S. Army Aeromedical Research Laboratory (USA)

**Jacques G. Verly**, Université de Liège (Belgium)

## *Conference Chairs*

**Randall W. Brown**, Air Force Research Laboratory (USA)

**Peter L. Marasco**, Air Force Research Laboratory (USA)

## *Conference Cochairs*

**Thomas H. Harding**, U.S. Army Aeromedical Research Laboratory (USA)

**Sion A. Jennings**, National Research Council Canada (Canada)

## *Program Committee*

**Randall E. Bailey**, NASA Langley Research Center (USA)

**Laurence Durnell**, QinetiQ Ltd. (United Kingdom)

**Paul R. Havig**, Air Force Research Laboratory (USA)

## *Session Chairs*

- 1 Systems  
**Thomas H. Harding**, U.S. Army Aeromedical Research Laboratory (USA)
- 2 HMD Components  
**Sion A. Jennings**, National Research Council Canada (Canada)
- 3 Design Issues  
**Peter L. Marasco**, Air Force Research Laboratory (USA)
- 4 Human Factors  
**Paul R. Havig**, Air Force Research Laboratory (USA)

- 5 Testing  
**Randall W. Brown**, Air Force Research Laboratory (USA)
- 6 Augmented/Virtual Reality  
**Randall E. Bailey**, NASA Langley Research Center (USA)