PROCEEDINGS OF SPIE

SPIDigitalLibrary.org/conference-proceedings-of-spie

Front Matter: Volume 9197

, "Front Matter: Volume 9197," Proc. SPIE 9197, An Optical Believe It or Not: Key Lessons Learned III, 919701 (5 December 2014); doi: 10.1117/12.2085358

SPIE.

Event: SPIE Optical Engineering + Applications, 2014, San Diego, California, United States

PROCEEDINGS OF SPIE

An Optical Believe It or Not: Key Lessons Learned III

Mark A. Kahan

Editor

18 August 2014

San Diego, California, United States

Sponsored and Published by
SPIE

Volume 9197

Proceedings of SPIE 0277-786X, V. 9197

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

An Optical Believe It or Not: Key Lessons Learned III, edited by Mark A. Kahan, Proc. of SPIE
Vol. 9197, 919701 · © 2014 SPIE · CCC code: 0277-786X/14/\$18 · doi: 10.1117/12.2085358

Proc. of SPIE Vol. 9197 919701-1

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 *An Optical Believe It or Not: Key Lessons Learned III*, edited by Mark A. Kahan, Proceedings of SPIE Vol. 9197 (SPIE, Bellingham, WA, 2014) Article CID Number.

ISSN: 0277-786X
ISBN: 9781628412246

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 © 2014, 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/14/\$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 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

v	<i>Authors</i>
vii	<i>Conference Committee</i>
ix	<i>Introduction</i>
xiii	<i>Radiance and photon noise: imaging in geometrical optics, physical optics, quantum optics and radiology (Plenary Paper) [9193-200]</i>

OPTICAL ENGINEERING PLENARY SESSION

9197 02	Optical design for consumer products (Plenary Paper) [9197-201]
---------	--

LESSONS LEARNED OVER DECADES

9197 03	Two to the sixth and counting: a lifetime of optical experiences (Keynote Paper) [9197-1]
9197 04	Timing is the elusive connector of dreams (Invited Paper) [9197-2]

LESSONS LEARNED FROM NEW ADVENTURES

9197 05	Perspective on new technology product introduction (Invited Paper) [9197-3]
9197 06	Bumps in the road (Invited Paper) [9197-4]
9197 07	Lessons learned from starting Rochester Precision Optics (Invited Paper) [9197-5]
9197 08	Use it or lose it [9197-6]

LESSONS LEARNED FROM CLOSE CALLS, HUMAN FALLIBILITY, AND PROJECT MANAGEMENT

9197 09	Learning from near-misses to avoid future catastrophes (Invited Paper) [9197-7]
9197 0A	Managing human fallibility in critical aerospace situations (Invited Paper) [9197-8]
9197 0B	Sound bites: a discussion on lessons learned from the integration of space sensors [9197-9]

LESSONS LEARNED FROM OPTICS, OPTO-MECHANICS, AND THERMO-OPTICS

9197 0C	That can't possibly be right! Lessons learned in software modeling [9197-10]
---------	---

- 9197 0D **History of the formerly top secret KH-9 Hexagon spy satellite** [9197-11]
- 9197 0E **A smart rock (Invited Paper)** [9197-12]
- 9197 0F **See evil, hear evil (Invited Paper)** [9197-13]
- 9197 0G **Stress failure vignettes: errors of 10,000, the help of Humpty-Dumpty, and others** [9197-14]
- 9197 0H **How to break a lens** [9197-15]
- 9197 0J **Lessons learned: design, start-up, and operation of cryogenic systems** [9197-17]

Authors

Numbers in the index correspond to the last two digits of the six-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first four digits reflect the volume number. Base 36 numbering is employed for the last two digits and indicates the order of articles within the volume. Numbers start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B...0Z, followed by 10-1Z, 20-2Z, etc.

Bagley, R. E., 0J
Barrett, Harrison H., ix
Bell, W. M., 0J
Breckinridge, James B., 06
Caucci, Luca, ix
DeCew, Alan E., Jr., 0H
Dillon, Robin L., 09
Gupta, Anurag, 02
Hatheway, Alson E., 08
Hurley, William P., 07
Kirkpatrick, Douglas A., 05
Lones, Joe J., 04
Lones, Lance, 04
Mayo, Jim, 03
Merrill, C., 0B
Motew, S., 0J
Myers, Kyle J., ix
Pepi, John W., 0G
Pfisterer, Richard N., 0C
Pressel, Phil, 0D, 0E, 0F
Tew, Larry, 0A
Young, P.-W., 0J

Conference Committee

Program Track Chairs

José Sasián, College of Optical Sciences, The University of Arizona
(United States)

R. John Koshel, College of Optical Sciences, The University of Arizona
(United States)

Conference Chair

Mark A. Kahan, Synopsys, Inc. (United States)

Conference Program Committee

George Z. Angeli, LSST Corporation (United States)

Paul Atcheson, Ball Aerospace & Technologies Corporation
(United States)

Steven J. Battel, Battel Engineering, Inc. (United States)

Robert P. Breault, Breault Research Organization, Inc. (United States)

James T. Carnevale, Raytheon Company (United States)

William J. Cassarly, Synopsys, Inc. (United States)

Daniel R. Coulter, Jet Propulsion Laboratory (United States)

Charles D. Cox, UTC Aerospace Systems (United States)

Marc T. Daigle, Optical Alchemy Inc. (United States)

Alan E. DeCew Jr., MIT Lincoln Laboratory (United States)

Ronald G. Driggers, U.S. Naval Research Laboratory (United States)

Mark A. Ealey, University of Kansas (United States)

David F. Everett, NASA Goddard Space Flight Center (United States)

James L. Fanson, Jet Propulsion Laboratory (United States)

G. Groot Gregory, Synopsys, Inc. (United States)

Alson E. Hatheway, Alson E. Hatheway Inc. (United States)

Joseph B. Houston Jr., Houston Research Associates (United States)

Tony Hull, The University of New Mexico (United States)

Gary W. Matthews, Exelis Inc. (United States)

Duncan T. Moore, University of Rochester (United States)

Harold Schall, The Boeing Company (United States)

Robert R. Shannon, College of Optical Sciences, The University of
Arizona (United States)

Michael J. Sholl, University of California, Berkeley (United States)

H. Philip Stahl, NASA Marshall Space Flight Center (United States)

David A. Thomas, University of Kansas (United States)

Linda C. Usher, Executive Search Group (United States)

James C. Wyant, College of Optical Sciences, The University of
Arizona (United States)

Introduction

This conference is the third SPIE Conference dedicated to the sharing of key optical lessons-learned. Nearly all optical engineers, scientists, researchers, or managers have dealt with the unexpected. Many of these situations in hindsight are quite funny, and have buried within them key optically related lessons learned. The problem with simply listing lessons learned is that as a simple listing, they are hard to remember clearly. Thus history repeats itself much to our collective debit. This conference was configured to allow for adding a bit of humor into the mix. By presenting a collection of small interesting stories or optical, managerial, and/or Project-related parables, it helps us all remember the important take-aways. Though we allowed each presentation to be somewhat embellished by the author (within editorial limits), with names, places, and dates sometimes changed to protect those involved, this year there was also an emphasis on hard-truths. Please note that even when humor is used, all presentations have a basis in truth as self-avowed by the author and “the devil’s advocate” by the Chair, and all talks included at least one, if not more than one, lesson learned, that have serious optical content.

Papers were specifically requested on past, current and /or evolving optically related developments that satisfy the following somewhat all-inclusive criteria:

- Have been subject to surprises, anomalies, and/or unanticipated business factors which, in hindsight, are funny and which have a key optical lesson-learned/take-away
- Where (optically related) specifications went terribly wrong
- Any aspect of the build-cycle could be included be it in conceptualization, design, development, fabrication (any somewhat optically related process), test, or end-use
- Any discipline could be included if/as it ties to optics (e.g. project management, principal investigator roles, opto-mechanics, thermo-optics, electro-optics, optical-physics, etc.)
- Any personnel problem could be included if/as it relates to an optical truth (this could include hiring, training or the lack thereof).
- Any optically related piece-parts could be included, from raw materials to heat treats to coatings, to mechanisms, etc.
- Any optical environment was acceptable, e.g. from underwater to outer-space to child-proof toys to shot-from-a-gun
- Any size was acceptable, e.g. from nano/MEMS, to deployable multi-meter optics
- Any unusual scheduling and/or financing problem was acceptable as long as it was optically driven
- Aspects that tied to IP, patents, and/or other legalities could be the subject of interest, and

- Inter-company relationships and/or relationships with clients, suppliers, and or vendors could be included—if the author so dared, and could sanitize the text to avoid liable (and as long as there was a key optically related take-away, though these could be in an optical business-based sense).

Of special interest were stories where, despite any humor, the optically related lessons-learned were serious and would help to form a body of knowledge that can grow and be used as an evolving check-list for other on-going or future optically related adventures.

Again this year, we had some exceptional speakers that have had direct/hands-on involvement in a tremendous amount of important and diverse roles in optical history. These sessions are a chance for us to share this information and capture key takeaways that can be used by all—be you new to the industry or a seasoned veteran. Our hope is these talks will help to keep us out of trouble, even if only to clarify our own thoughts and/or help justify budgets so that management will adequately fund our endeavors.

We won't trivialize the punch-lines by doing a simple summary here. The authors' papers deserve serious attention and a set of crib-notes doesn't do these sometimes-complex subjects justice. It's not so much that the concepts are so terribly complex; it's that the situations that lead to some of the Lessons Learned have slippery-slope contextual aspects that are relatively subtle, or there are logical short circuits that come into play. Just one past example would be from HST. End-to-end testing was eliminated to save money. The presumption was that as long as two totally different piece-part tests agreed, all would eventually be well. But then schedules got tight, logic gave way to what folks knew in their hearts was right—that the Reflecting Null Corrector used to Finalize the Primary Mirror was all that really mattered, and that the supposedly less accurate Refracting Null could be ignored (Not!). Of course in ignoring the Refracting Null's test results the initial premise was violated that required two different tests which had to agree, and agreement should mean quantitatively match-up accounting for the respective tests' tolerance bands. (As we know, although on paper the Reflecting Null Corrector was better than the Refractive Null Corrector which was used to rough-in the Primary Mirror, the reflecting Null Corrector was not built to specifications.)

By not shorting out your need to examine the papers presented, we're actually invoking a Lesson Learned. Simple Summary Charts often can lead to a false sense of understanding. But with that stated, we do intend to keep tabs on the various Lessons Learned, and this may well become a future rolling score-card, albeit with a somewhat intentional time-delay to encourage the real-time readers to delve into the details and find the devil that's hiding in wait for them.

The Chair would like to provide a special thank you to all the Speakers, as well as the advice of his Committee Members. All the talks were truly exceptional!

For those speakers who wish to be "judged" (and where no 2nd place finishers are noted), we sometimes give a Technical or a Management award. The Technical Award is usually some optical system—perhaps evocative of one used in the Speaker's talk, emblazoned on a T-shirt (perhaps with light going right to left which we all know is impossible. If it's a Management award, it may be a Dilbert doll with its head removed and inserted in an appropriate rear/posterior orifice, mounted on a podium with the author's name captured on an attached bronze nameplate. Award ceremonies, if any, are held in an appropriate following year. This year, so many talks were judged to be 10's on a 10 point scale that there were both Technical and Managerial ties. The Chair will sort this out with the help of the presenters and the Members of his Lessons Learned Committee, and report-out the results at the next Lesson's Learned Session, whenever that may be, though it's possible that at some point further information will also be released in SPIE's Members News. (Don't worry if you were a Speaker, you won't be surprised. We'll close the loop with all involved ahead of time.)

After the Conference cut-off date, and thus after Conference Rooms had been assigned and the overall timing of all the SPIE Sessions had been established, 18 speakers inquired about presenting in 2014. Of course it was too late to accommodate these requests, but because of this apparent (TBD) pent-up demand/desire to continue in the regular sharing of this type of information, we have released an out-of-cycle Call for Papers for 2015. The response to this Call will determine if we hold our next Lessons Learned Session in 2015 or revert back to the alternate-year schedule that we have used to date.

Thanks also to the Audience for engaging questions/discussion, and the SPIE Staff for their help.

Mark Kahan