PROCEEDINGS OF SPIE

Optical Design and Engineering VII

Laurent Mazuray
Rolf Wartmann
Andrew P. Wood
Editors

14–17 May 2018
Frankfurt, Germany

Sponsored by
SPIE

Cosponsored by
OPTATEC (Germany)

Published by
SPIE

Volume 10690

Proceedings of SPIE 0277-786X, V. 10690

Optical Design and Engineering VII, edited by Laurent Mazuray, Rolf Wartmann,
Andrew P. Wood, Proc. of SPIE Vol. 10690, 1069001 · © 2018 SPIE
CCC code: 0277-786X/18/$18 · doi: 10.1117/12.2503816

The papers 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. Additional papers and presentation recordings may be available online in the SPIE Digital Library at SPIEDigitalLibrary.org.

The papers 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 these proceedings:
Author(s), "Title of Paper," in *Optical Design and Engineering VII*, edited by Laurent Mazuray, Rolf Wartmann, Andrew P. Wood, Proceedings of SPIE Vol. 10690 (SPIE, Bellingham, WA, 2018) Seven-digit Article CID Number.

ISSN: 0277-786X
ISSN: 1996-756X (electronic)

ISBN: 9781510619173
ISBN: 9781510619180 (electronic)

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

Printed in the United States of America.

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

SPIE. DIGITAL LIBRARY
SPIEDigitalLibrary.org

Paper Numbering: *Proceedings of SPIE* follow an e-First publication model. A unique citation identifier (CID) number is assigned to each article at the time of 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 and print versions of the publication. SPIE uses a seven-digit CID article numbering system structured as follows:

- The first five 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.

Contents

DESIGN SOLUTIONS I

DESIGN SOLUTIONS II

DESIGN SOLUTIONS III

SPACE APPLICATIONS I

POSTER SESSION

Authors

Numbers in the index correspond to the last two digits of the seven-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first five 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.

Conference Committee

Symposium Chair

Wilhelm Ulrich, Carl Zeiss AG (Germany)

Symposium Co-chairs

Juan Carlos Miñano, Universidad Politécnica de Madrid (Spain)
David M. Williamson, Nikon Research Corporation of America (United States)

Honorary Symposium Chair

Tina E. Kidger, Kidger Optics Associates (United Kingdom)

Conference Chairs

Laurent Mazuray, Airbus Defence and Space (France)
Rolf Wartmann, Carl Zeiss Microscopy (Germany)
Andrew P. Wood, Qioptiq Ltd. (United Kingdom)

Conference Programme Committee

Catherine Antier, Thales Optronique S.A.S. (France)
Tobias Bauer, Leica Microsystems GmbH (Germany)
Francoise Cau, Sagem (France)
Andres F. Cifuentes, ASE Optics Europe (Spain)
Andrew J. Court, TNO (Netherlands)
Guillaume Dovillaire, Imagine Optic SA (France)
Michael Duparré, Friedrich-Schiller-Universität Jena (Germany)
Alain Durieux, Sodern (France)
Regis Grasser, CILAS (France)
Herbert Gross, Friedrich-Schiller-Universität Jena (Germany)
Ullrich Krüger, JENOPTIK Optical Systems GmbH (Germany)
Demetrio Labate, Leonardo (Italy)
Paolo Laporta, Politecnico di Milano (Italy)
Thierry Lépine, Institut d' Optique (France) and Laboratoire Hubert Curien (France)
Kevin F. Middleton, STFC Rutherford Appleton Laboratory (United Kingdom)
Takao Nakagawa, Japan Aerospace Exploration Agency (Japan)
Iain A. Neil, ScotOptix (Switzerland)
Thomas Nobis, Carl Zeiss AG (Germany)
Jérôme Primot, ONERA (France)
Jeffrey M. Raynor, STMicroelectronics (R&D) Ltd. (United Kingdom)
Jannick P. Rolland, University of Rochester (United States)
Elisabetta Rugi, RUAG Holding AG (Switzerland)

Simon Thibault, Université Laval (Canada)
Min Wang, INO (Canada)
Richard N. Youngworth, Riyo-LLC (United States)
María J. Yzuel, Universitat Autònoma de Barcelona (Spain)

Session Chairs

1 Design Methods I
Rolf Wartmann, Carl Zeiss Microscopy GmbH (Germany)

2 Design Methods II
Alessio Taiti, Leonardo (Italy)

3 Design Methods III
Rolf Wartmann, Carl Zeiss Microscopy GmbH (Germany)

4 Design Methods IV
Andrew P. Wood, Excelitas Qioptiq (United Kingdom)

5 Design Solutions I
Andrew P. Wood, Excelitas Qioptiq (United Kingdom)

6 Design Solutions II
Laurent Mazuray, Airbus Defence and Space (France)

7 Design Solutions III
Richard N. Youngworth, Riyo LLC (United States)

8 Design Solutions IV
Rolf Wartmann, Carl Zeiss Microscopy GmbH (Germany)

9 Freeforms I
Thierry Lépine, Laboratoire Hubert Curien (France)

10 Freeforms II
Herbert Gross, Friedrich-Schiller-Universität Jena (Germany)

11 Freeforms III
Laurent Mazuray, Airbus Defence and Space (France)

12 Space Applications I
Laurent Mazuray, Airbus Defence and Space (France)

13 Space Applications II
Laurent Mazuray, Airbus Defence and Space (France)