

PROCEEDINGS OF SPIE

Technologies for Optical Countermeasures XVI

David H. Titterton
Robert J. Grasso
Mark A. Richardson
Editors

10–11 September 2019
Strasbourg, France

Sponsored and Published by
SPIE

Cooperating Organisations
European Optical Society
Cranfield University (United Kingdom)

Volume 11161

Proceedings of SPIE 0277-786X, V. 11161

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

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 SPIDigitalLibrary.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 *Technologies for Optical Countermeasures XVI*, edited by David H. Titterton, Robert J. Grasso, Mark A. Richardson, Proceedings of SPIE Vol. 11161 (SPIE, Bellingham, WA, 2019) Seven-digit Article CID Number.

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

ISBN: 9781510630253
ISBN: 9781510630260 (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

Copyright © 2019, 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 \$21.00 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/19/\$21.00.

Printed in the United States of America by Curran Associates, Inc., under license from SPIE.

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

**SPIE. DIGITAL
LIBRARY**

SPIDigitalLibrary.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

v *Authors*
vii *Conference Committee*

KEYNOTE SESSION

11161 02 **Quantum cascade lasers: 25 years after the first demonstration (Keynote Paper)** [11161-1]

LASERS AND SOURCES

11161 04 **Investigations of incoherent beam combining using stochastic parallel gradient descent with retroreflector target** [11161-3]

11161 05 **Fundamental mode emission in tapered quantum cascade lasers for high brightness** [11161-4]

ATMOSPHERIC EFFECT

11161 07 **Characterization and compensation of atmospheric effects on laser beams (Invited Paper)** [11161-6]

LASER EFFECTS

11161 08 **Mitigation of laser dazzle effects on a mid-wave infrared thermal imager by reducing the integration time of the focal plane array** [11161-7]

11161 09 **Use of complementary wavelength bands for laser dazzle protection (Invited Paper)** [11161-8]

11161 0A **Further investigation on laser-induced damage thresholds of camera sensors and micro-optomechanical systems** [11161-9]

11161 0B **Wave-optics modeling of a heat-seeking missile attacked using a DIRCM laser in turbulent atmosphere (Invited Paper)** [11161-10]

11161 0C **NATO SET-249 joint measurement campaign on laser dazzle effects in airborne scenarios (Invited Paper)** [11161-11]

THREAT DETECTION AND IMAGING

- 11161 0G **Laser detection utilizing coherence (Invited Paper) [11161-15]**
- 11161 0H **Developments in low-cost laser detection: wide field of view implementation and direction determination [11161-16]**
- 11161 0I **Remote detection and size estimation of optical apertures (Invited Paper) [11161-17]**
- 11161 0J **Optics detection using an avalanche photo diode array and the scanning-slit-method [11161-18]**

THREATS, THREAT DETECTION, AND DISCRIMINATION

- 11161 0K **Mueller matrix characterization of samples for potential use in clutter rejection and discrimination algorithms (Invited Paper) [11161-19]**
- 11161 0L **Novel low-cost camera-based pulsed and modulated continuous wave laser detection [11161-20]**

POSTERS-TUESDAY

- 11161 0M **A new design method for a refractive beam shaping optical system operating in mid-infrared band [11161-14]**
- 11161 0N **Research on optimization of water spray coverage of built-in infrared stealth water curtain single nozzle [11161-21]**