

PROCEEDINGS OF SPIE

Target and Background Signatures IV

**Karin U. Stein
Ric Schleijpen**
Editors

**10–11 September 2018
Berlin, Germany**

Sponsored by
SPIE

Cooperating Organisations
European Optical Society
Cranfield University (United Kingdom)

Published by
SPIE

Volume 10794

Proceedings of SPIE 0277-786X, V. 10794

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

Target and Background Signatures IV, edited by Karin U. Stein, Ric Schleijpen,
Proc. of SPIE Vol. 10794, 1079401 · © 2018 SPIE · CCC code:
0277-786X/18/\$18 · doi: 10.1117/12.2517772

Proc. of SPIE Vol. 10794 1079401-1

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 *Target and Background Signatures IV*, edited by Karin U. Stein, Ric Schleijpen, Proceedings of SPIE Vol. 10794 (SPIE, Bellingham, WA, 2018) Seven-digit Article CID Number.

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

ISBN: 9781510621718
ISBN: 9781510621725 (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 © 2018, 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/18/\$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

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

| | |
|-----|-----------------------------|
| vii | <i>Authors</i> |
| ix | <i>Conference Committee</i> |

SESSION 1 CHARACTERISTICS OF VEGETATION

| | |
|----------|--|
| 10794 03 | Detectability in the SWIR spectral range [10794-2] |
| 10794 04 | Collecting information for spectral boundaries determination [10794-3] |
| 10794 05 | NATO hyperspectral measurement of natural background [10794-4] |
| 10794 06 | Copernicus Sentinel opportunities using field spectroscopy to support deep man-made infrastructures in Cyprus [10794-5] |

SESSION 2 ENVIRONMENTAL EFFECTS ON SIGNATURES

| | |
|----------|---|
| 10794 07 | Visualizing simulated temperatures of a complex object calculated with FTOM using open source software (BLENDER) [10794-6] |
| 10794 08 | Evolution of the statistical fluctuations in the measured temperature differences between painted metal plates of a CUBI infrared calibration target [10794-7] |
| 10794 0A | Sensitivity of input parameters to modelling of atmospheric transmission of long-wave infrared radiation at sea under warm and humid conditions [10794-9] |
| 10794 0B | A field-based method for evaluating thermal properties of static and mobile camouflage [10794-10] |

SESSION 3 OBSERVER EFFECTS AND TRIALS

| | |
|----------|---|
| 10794 0C | Methods for measuring time to detect in human observer trials (Invited Paper) [10794-11] |
| 10794 0E | Evaluation of validity of observer test for testing of camouflage patterns [10794-13] |
| 10794 0F | Glass detection and recognition based on the fusion of ultrasonic sensor and RGB-D sensor for the visually impaired [10794-14] |

10794 OG **Novel infrared object detection and tracking algorithm based on visual attention** [10794-15]

SESSION 4 TARGET DETECTION TECHNIQUES

10794 OH **Camouflage evaluation by bio-inspired local conspicuity quantification (Invited Paper)**
[10794-16]

10794 OJ **Evaluation of side-scan sonar performance for the detection of naval mines** [10794-18]

10794 OK **Feature extraction using high-range resolution profiles for estimating the number of targets**
[10794-19]

10794 OL **Nanosat-based detection and tracking of launch vehicles** [10794-20]

SESSION 5 MACHINE LEARNING

10794 OM **Supporting artificial intelligence with artificial images (Invited Paper)** [10794-21]

10794 ON **Detection technology of foreign matter on the ocean for MDA with hyperspectral imaging**
[10794-22]

SESSION 6 SCENES AND DETECTION PERFORMANCE

10794 OP **Improved EO/IR target and background scene simulation with MuSES using a rapid fluid flow solver (Invited Paper)** [10794-25]

10794 OQ **Semi synthetic naval scene generation with engagement simulation for infrared-guided missile threat analysis** [10794-26]

10794 OR **The IR modeling and simulation of the orbit target with celestial background** [10794-28]

10794 OS **Scene text detection and recognition system for visually impaired people in real world (Best Student Paper)** [10794-29]

10794 OT **Sea-land segmentation in SAR images based on multifeature fused boundary clustering**
[10794-30]

SESSION 7 HARDWARE AND MATERIALS

10794 OU **Optical polarization and the dependence of angle of incidence for different surfaces: comparison between different wavelengths from UV to IR (Invited Paper)** [10794-31]

- 10794 0V **Multispectral gonireflectometer facility for directional reflectance measurements and its use on materials and paints** [10794-32]
- 10794 0W **Adaptive camouflage panel in the visible spectral range** [10794-33]

POSTER SESSION

- 10794 0X **Water spray infrared extinction calculation and experimental validation** [10794-36]
- 10794 0Y **Autoencoder versus pre-trained CNN networks: deep-features applied to accelerate computationally expensive object detection in real-time video streams** [10794-35]
- 10794 0Z **New developments in thermal targets** [10794-34]

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.

| | |
|-------------------------------|------------------------------------|
| Abayowa, Bernard, 0Y | Lin, Shufei, 0S |
| Aurdal, Lars, 0M | Liu, Lei, 0G |
| Aved, Alexander, 0Y | Løkken, Kristin Hammarstrøm, 0M |
| Bai, Jian, 0F | López Martínez, Marcos, 0V |
| Baláz, Teodor, 0E | Madden, Christopher S., 0C |
| Bárta, V., 04, 05 | Madsen, Eirik Blix, 0A |
| Bartos, Berndt, 07, 0W | Melillos, George, 06 |
| Bi, Yanqiang, 0R | Merken, P., 08 |
| Bilton, Nicola, 0A | Na, Kyoungil, 0K |
| Björkert, Stefan, 0U | Nakaya, Daiki, 0N |
| Brattli, Alvin, 0M | Ni, Jiazheng, 0X |
| Cao, Zhisong, 0R | Packard, Corey D., 0P |
| Carlo, Jeffrey T., 0Y | Palm, Hans Christian, 0M |
| Chen, Hao, 0S | Pawlikowski, Jakub, 0W |
| Chen, Xu, 0G | Polak, Grzegorz, 0Z |
| Chen, Zhongwei, 0X | Pszczel, Mark, 0A |
| Cheng, Ruiqi, 0F, 0S | Pushkarov, Oleksandr, 0A |
| Choi, Gak-Gyu, 0K | Racek, František, 05, 0E |
| Culpepper, Joanne B., 0C | Rynes, Peter L., 0P |
| Eriksson, Johan, 0U | Satori, Shin, 0N |
| Fei, Lei, 0S | Scherer-Negenborn, Norbert, 0L, 0Q |
| Glimsdal, Eirik, 0M | Schmied, A., 0Q |
| Gulde, Max, 0L | Schwarz, Alexander, 0W |
| Hadjimitsis, Diofantos G., 06 | Schwegmann, A., 0H |
| Hallberg, Tomas, 0U | Schweitzer, Caroline, 0L |
| Hanuš, J., 04 | Selj, Gorm K., 0B |
| Hartmann, Tim, 0V | Shang, Yonghong, 0R |
| Heinrich, Daniela H., 0B | Shiwa, Mitsuharu, 0N |
| Hepokoski, Mark A., 0P | Simmonds, Luke, 0C |
| Hlostá, Pawel, 0Z | Stein, Karin, 07, 0L |
| Horch, Clemens, 0L | Swiderski, Waldemar, 0Z |
| Howlett, Todd B., 0Y | Tao, Dongxing, 0R |
| Huang, Zhiming, 0F | Themistocleous, Kyriacos, 06 |
| Huebner, Claudia S., 0J | Thomassen, Jan, 0A |
| Ito, Takaaki, 0N | Tyminski, Dariusz, 0Z |
| Ito, Tomonori, 0N | van Rheenen, Arthur D., 0A |
| Iyer, Vasanth, 0Y | Vandewal, M., 08 |
| Jobánek, Adam, 0E | Wang, Jing, 0R |
| Kariis, Hans, 0U | Wang, Kaiwei, 0F, 0S |
| Karnitz, Duncan L., 0P | Wendelstein, Norbert, 0L |
| Klausen, Runhild Aae, 0M | Wheaton, Vivienne C., 0C |
| Klein, Mark D., 0P | Winkelmann, M., 03 |
| Krejčí, Jaroslav, 05, 0E | Wu, Kejiang, 0T |
| Kunzer, Michael, 0W | Xia, Qi, 0G |
| Lee, Jung-Won, 0K | Xu, Xiaojian, 0T |
| Less, David M., 0P | Yang, Kailun, 0F, 0S |
| Levanen, Derrick S., 0P | Yuan, Yuan, 0R |
| Lewis, G. D., 08 | Zechmeister, Martin, 0W |
| Lin, Boying, 0R | Zhang, Li, 0X |

Conference Committee

Symposium Chair

Ric Schleijpen, TNO Defense, Security and Safety (Netherlands)

Symposium Co-chair

Karin U. Stein, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany)

Conference Chairs

Karin U. Stein, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany)

Ric Schleijpen, TNO Defence, Security and Safety (Netherlands)

Conference Programme Committee

Joanne B. Culpepper, Defence Science and Technology Group (Australia)

Willem H. Gunter, Institute for Maritime Technology (South Africa)

Daniela H. Heinrich, Norwegian Defence Research Establishment (Norway)

Katrin Idla, Tallinn University of Technology (Estonia)

Hans M. Kariis, Swedish Defence Research Agency (Sweden)

Alexander Schwarz, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany)

Peter Wellig, Armasuisse (Switzerland)

Session Chairs

- 1 Characteristics of Vegetation

Karin U. Stein, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany)

- 2 Environmental Effects on Signatures

Alexander Schwarz, Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (Germany)

- 3 Observer Effects and Trials

Peter Wellig, Armasuisse (Switzerland)

- 4 Target Detection Techniques

Katrin Idla, Tallinn University of Technology (Estonia)

- 5 Machine Learning
Ric Schleijpen, TNO Defense, Security and Safety (Netherlands)
- 6 Scenes and Detection Performance
Joanne B. Culpepper, Defence Science and Technology Group
(Australia)
- 7 Hardware and Materials
Hans M. Kariis, FOI-Swedish Defence Research Agency (Sweden)