PROCEEDINGS OF SPIE

SPIDigitalLibrary.org/conference-proceedings-of-spie

Front Matter: Volume 10418

, "Front Matter: Volume 10418," Proc. SPIE 10418, XI Conference on
Reconnaissance and Electronic Warfare Systems, 1041801 (12 May 2017);
doi: 10.1117/12.2280221

SPIE.

Event: Conference on Reconnaissance and Electronic Warfare Systems,
2016, Oltarzew, Poland

PROCEEDINGS OF SPIE

XI Conference on Reconnaissance and Electronic Warfare Systems

Jerzy Lopatka

Editor

21–23 November 2016

Ołtarzew, Poland

Organized by

Military University of Technology (Poland)

Sponsored by

General Staff of the Polish Armed Forces (Poland)

Electronics and Telecommunications Committee of the Polish Academy of Sciences (Poland)

Published by

SPIE

Volume 10418

Proceedings of SPIE 0277-786X, V. 10418

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

XI Conference on Reconnaissance and Electronic Warfare Systems, edited by Jerzy Lopatka,
Proc. of SPIE Vol. 10418, 1041801 · © 2017 SPIE · CCC code: 0277-786X/17/\$18
doi: 10.1117/12.2280221

Proc. of SPIE Vol. 10418 1041801-1

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 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 *XI Conference on Reconnaissance and Electronic Warfare Systems*, edited by Jerzy Lopatka, Proceedings of SPIE Vol. 10418 (SPIE, Bellingham, WA, 2017) Seven-digit Article CID Number.

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510612945

ISBN: 9781510612952 (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 © 2017, 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/17/\$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**

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 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	<i>Authors</i>
vii	<i>Conference Committee</i>
ix	<i>Introduction</i>

10418 02	Cognitive systems in electronic warfare [10418-28]
10418 03	System principles, mathematical models and methods to ensure high reliability of safety systems [10418-30]
10418 04	A hybrid method for protection against threats to a network infrastructure for an electronic warfare management system [10418-4]
10418 05	Dynamic spectrum management: an impact on EW systems [10418-20]
10418 06	Dynamic spectrum management as an anti-interference method [10418-12]
10418 07	Properties of centralized cooperative sensing in cognitive radio networks [10418-25]
10418 08	Cooperative spectrum sensing using USRP platforms [10418-24]
10418 09	The use of a wireless sensor network to monitor the spectrum in urban areas [10418-22]
10418 0A	Competition in the domain of wireless networks security [10418-15]
10418 0B	SDF technology in location and navigation procedures: a survey of applications [10418-21]
10418 0C	Emitter location errors in electronic recognition system [10418-13]
10418 0D	Imagery intelligence from low altitudes: chosen aspects [10418-16]
10418 0E	The evolution of transmission security functions in modern military wideband radios [10418-11]
10418 0F	Model of ballistic targets' dynamics used for trajectory tracking algorithms [10418-14]
10418 0G	Absorber for microwave investigation in the open space [10418-9]
10418 0H	Design of WLAN microstrip antenna for 5.17-5.835 GHz [10418-29]
10418 0I	Planar Uda-Yagi antenna for imaging SAR system [10418-7]

- 10418 0J **The concept of radio channel emulator for MANET tests** [10418-23]
- 10418 0K **Distribution of envelope and phase of signals in ISM 2.4-GHz band transmitted in urban environment** [10418-17]
- 10418 0L **The impact of compression of speech signal, background noise and acoustic disturbances on the effectiveness of speaker identification** [10418-18]
- 10418 0M **Analysis of the possibility of using G.729 codec for steganographic transmission** [10418-26]
- 10418 0N **Nonlinear Kalman filtering in the presence of additive noise** [10418-19]
- 10418 0O **Automatic classification of visual evoked potentials based on wavelet decomposition** [10418-10]
- 10418 0P **Chosen results of field tests of synthetic aperture radar system installed on board UAV** [10418-5]

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.

Bednarczyk, Mariusz, 0A
Bugaj, Jarosław, 0H
Bugaj, Marek, 0H
Byłak, Michał, 04
Chęciński, R., 08
Ciołek, Michał, 0M
Cyrek, Jacek, 0P
Czopik, Grzegorz, 0N
Dikta, Anna, 0C
Dobrowolski, Andrzej P., 0L, 0O
Dołowski, Jerzy, 0M
Gajewski, P., 05, 06
Głuszewski, Wojciech, 0G
Jach, J., 0E
Kamiński, K., 0L
Kaniewski, P., 06, 0E
Kaniewski, Piotr, 0P
Kaszuba-Chęcińska, A., 08
Kawalec, Adam, 0F
Kedzierski, M., 0D
Kelner, Jan M., 0B
Komorniczak, Wojciech, 0P
Kraszewski, Tomasz, 0N
Kryk, Michał, 0J
Kubacki, Roman, 0G
Kulpa, Krzysztof, 02
Kustra, M., 06, 0E
Labowski, Michał, 0P
Lesnik, Czesław, 0P
Łopatka, Jerzy, 05, 06, 07, 08, 09, 0J
Malanowski, Mateusz, 02
Malon, Krzysztof, 07, 09
Matuszewski, Jan, 0C
Matyszek, R., 06, 0E
Misiurewicz, Jacek, 02
Okoń-Fąfara, Marta, 0F
Pasternak, Mateusz, 0I
Pietrasinski, Jerzy, 0I
Piotrowski, Zbigniew, 0M
Przesmycki, Rafał, 0G
Różański, Grzegorz, 04
Rudyk, Karol, 0G
Samczyński, Piotr, 02
Serafin, Piotr, 0P
Skokowski, Paweł, 07, 09
Smólski, Bogusław, 0G
Stasiakiewicz, Paweł, 0O
Studanski, Ryszard, 0K

Suchanski, M., 05, 06
Szczepankiewicz, Michał, 02
Tomczykiewicz, Kazimierz, 0O
Wajszczyk, Bronisław, 0P
Walczykowski, P., 0D
Wiłczak, Andrzej, 0F
Wnuk, Marian, 0H
Wojtuń, Jarosław, 0M
Zaslavskyi, V., 03
Ziółkowski, Cezary, 0B
Żywek, Marcin, 02

Conference Committee

Conference Chair

Jerzy Lopatka, Military University of Technology (Poland)

Deputy Conference Chair

Piotr Kaniewski, Military University of Technology (Poland)

Secretary

Artur Bajda, Military University of Technology (Poland)

Scientific Committee

Marek Amanowicz, Military University of Technology (Poland)
Ryszard Berent, Ministry of Defense (Poland)
Zbigniew Bielecki, Military University of Technology (Poland)
Witold Czarnecki, Military University of Technology (Poland)
Andrzej Dobrowolski, Military University of Technology (Poland)
Adam Duda, Ministry of Defense (Poland)
Slawomir Dudczak, Ministry of Defense (Poland)
Andrzej Felski, Polish Naval Academy (Poland)
Piotr Gajewski, Military University of Technology (Poland)
Marek Gladysz, Ministry of Defense (Poland)
Adam Kawalec, Military University of Technology (Poland)
Ryszard J. Katulski, Gdansk University of Technology (Poland)
Krzysztof Kopczynski, Military University of Technology (Poland)
Roman Kubaki, Military University of Technology (Poland)
Krzysztof Kulpa, Warsaw University of Technology (Poland)
Robert Kurowski, Ministry of Defense (Poland)
Henryk Madura, Military University of Technology (Poland)
Grzegorz Majewski, Ministry of Defense (Poland)
Mariusz Malinowski, Warsaw University of Technology (Poland)
Zygmunt Mierczyk, Military University of Technology (Poland)
Krzysztof Mitrega, Ministry of Defense (Poland)
Mateusz Pasternak, Military University of Technology (Poland)
Zbigniew Piotrowski, Military University of Technology (Poland)
Andrzej Polak, Ministry of Defense (Poland)
Krzysztof Prostacki, Ministry of Defense (Poland)
Andrzej Rozynski, Ministry of Defense (Poland)
Bogusław Smolski, Military University of Technology (Poland)
Bronisław Stec, Military University of Technology (Poland)
Marek Suchanski, Military Communications Institute (Poland)

Waldemar Susek, Military University of Technology (Poland)
Piotr Suszynski, Ministry of Defense (Poland)
Marian Wnuk, Military University of Technology (Poland)
Stanisław Zarychta, Ministry of Defense (Poland)
Cezary Ziolkowski, Military University of Technology (Poland)
Wojciech Ziolkowski, Ministry of Defense (Poland)
Andrzej Zyluk, Technical Institute of Air Forces (Poland)

Session Chairs

Plenaries

Andrzej Dobrowolski, Military University of Technology (Poland)
Jerzy Lopatka, Military University of Technology (Poland)

Radio Reconnaissance

Piotr Gajewski, Military University of Technology (Poland)

Localization and Bearing

Cezary Ziolkowski, Military University of Technology (Poland)

Spectrum Monitoring

Marek Suchanski, Military Communications Institute (Poland)

Radar Technologies

Roman Kubacki, Military University of Technology (Poland)

Protection of Critical Infrastructure

Marek Amanowicz, Military University of Technology (Poland)

Radio Defense

Ryszard J. Katulski, Gdansk University of Technology (Poland)

Unmanned Aerial Vehicles

Mateusz Pasternak, Military University of Technology (Poland)

Signal Processing

Zbigniew Piotrowski, Military University of Technology (Poland)

Image Recognition

Marek Zygmunt, Military University of Technology (Poland)

Sensors and Propagation

Marian Wnuk, Military University of Technology (Poland)

Poster Session

Jerzy Pietrasinski, Military University of Technology (Poland)

Introduction

The modern world is more and more dependent on electronics and information. Electronic systems gather and disseminate multidimensional information about the surrounding world using detection, reconnaissance, localisation, navigation and telecommunications, whereas processing and distributing the collected data provides information superiority and effective realisation of the assumed goals.

Due to broadly understood safety concerns, it is also necessary to monitor events occurring in the radio spectrum by taking control over spectrum usage and defending against jamming. These activities (also known as electronic warfare) were until recently the exclusive domain of the armed forces but now are often used by civilian departments and government agencies.

The Conference on Reconnaissance and Electronic Warfare Systems (CREWS) provides an excellent forum for the exchange of knowledge and experience between users, manufacturers and scientists involved in the use and development of reconnaissance and electronic warfare systems. The conference is also a place for bilateral talks and networking.

The CREWS topics are priorities for the Polish Armed Forces, which emphasize the fact that this conference is organized under the auspices of the Chief of General Staff.

Jerzy Lopatka