PROCEEDINGS OF SPIE

SPIDigitalLibrary.org/conference-proceedings-of-spie

Front Matter: Volume 9807

, "Front Matter: Volume 9807," Proc. SPIE 9807, Optical Technologies for Telecommunications 2015, 980701 (5 April 2016); doi: 10.1117/12.2234784

SPIE.

Event: XIII International Scientific and Technical Conference on Optical Technologies in Telecommunications, 2015, Ufa, Russian Federation

PROCEEDINGS OF SPIE

Optical Technologies for Telecommunications 2015

**Vladimir A. Andreev
Anton V. Bourdine
Vladimir A. Burdin
Oleg G. Morozov
Albert H. Sultanov**
Editors

**16–18 November 2015
Ufa, Russian Federation**

Organized by
Ufa State Aviation Technical University (Russian Federation)
Povolzhskiy State University of Telecommunications and Informatics (Russian Federation)
Kazan National Research Technical University (Russian Federation)

Published by
SPIE

Volume 9807

Proceedings of SPIE 0277-786X, V. 9807

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

Optical Technologies for Telecommunications 2015, edited by Vladimir A. Andreev, Anton V. Bourdine,
Vladimir A. Burdin, Oleg G. Morozov, Albert H. Sultanov, Proc. of SPIE Vol. 9807, 980701
© 2016 SPIE · CCC code: 0277-786X/16/\$18 · doi: 10.1117/12.2234784

Proc. of SPIE Vol. 9807 980701-1

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 *Optical Technologies for Telecommunications 2015*, edited by Vladimir A. Andreev, Anton V. Bourdine, Vladimir A. Burdin, Oleg G. Morozov, Albert H. Sultanov, Proceedings of SPIE Vol. 9807 (SPIE, Bellingham, WA, 2016) Six-Digit Article CID Number.

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510600485

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 © 2016, 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/16/\$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 six-digit CID article numbering system structured as follows:

- 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.

Contents

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

OPTICAL TELECOMMUNICATION TECHNOLOGIES AND SYSTEMS

9807 02	Information and telecommunication system for monitoring of hydraulic engineering structures [9807-1]
9807 03	Mathematical multiplexing and demultiplexing of flows in optical links [9807-7]
9807 04	SCRF spectral mask compliant ultra-wideband signal generation approaches for RoF systems [9807-34]
9807 05	UWB technology for safety-oriented vehicular communications (Invited Paper) [9807-41]
9807 06	Simulation of non-Gaussian optical pulse propagation over piece-wise regular fiber optic link with conventional laser-optimized multimode fiber operating in a few-mode regime [9807-47]
9807 07	Application of semiconductor optical amplifier for mobile radio communications networks based on radio-over-fiber systems [9807-50]
9807 08	IR-UWB radio-over-fiber system components development [9807-39]
9807 09	Application of the device based on chirping of optical impulses for management of software-defined networks in dynamic mode [9807-40]
9807 0A	Concept of distributed corporative wireless vehicle voice networks based on radio-over-fiber technique [9807-49]
9807 0B	Fiber optics systems mode analysis based on Dirac equation [9807-62]

PASSIVE AND ACTIVE OPTICAL COMPONENTS OF OPTICAL TELECOMMUNICATION

9807 0C	Fabrication of optical waveguides in RbTiOPO₄ single crystals by using different techniques [9807-11]
9807 0D	Design and simulation of non-resonant 1-DOF drive mode and anchored 2-DOF sense mode gyroscope for implementation using UV-LIGA process [9807-12]
9807 0E	Experimental investigation of multi-order diffractive optical elements matched with two types of Zernike functions [9807-13]

- 9807 OF **Nanocrystalline silicon thin films and grating structures for solar cells** [9807-18]
- 9807 OG **Diffraction axicon as the dispersive element for imaging hyperspectrometer** [9807-19]
- 9807 OH **Modeling of forming radially polarized beams on the basis of refractive elements with interference polarizer** [9807-20]
- 9807 OI **Nanocrystalline glass-ceramics implementation methods and refractive index modelling thereof** [9807-38]
- 9807 OJ **Fiber Bragg grating writing technique for multimode optical fibers providing stimulation of few-mode effects in measurement systems** [9807-44]
- 9807 OK **Quasi-interferometric scheme improved by fiber Bragg grating for detection of outer mechanical stress influence on distributed sensor being silica multimode optical fiber operating in a few-mode regime** [9807-46]
- 9807 OL **Experimental researches of fiber Bragg gratings operating in a few-mode regime** [9807-67]
- 9807 OM **Smart photonic carbon brush** [9807-2]
- 9807 ON **Research of dispersion distortion of signals in the ionospheric plasma and optical fiber** [9807-3]
- 9807 OO **Experimental investigation into the possibilities of using a spatial light modulator for laser-trapping light-absorbing micro-objects in air** [9807-10]
- 9807 OP **Layered lens with a linear dependence of the refractive index change** [9807-32]
- 9807 OQ **Chromatic dispersion estimation for higher-order guided modes propagating over silica large core few-mode optical fibers** [9807-45]
- 9807 OR **Converter of laser beams with circular polarization to cylindrical vector beams based on anisotropic crystals** [9807-61]
- 9807 OS **An information-measuring system for evaluating performance parameters of lighting devices** [9807-64]

ONE-DIMENSIONAL AND MULTIDIMENSIONAL OPTICAL SIGNALS DATA PROCESSING

- 9807 OT **Two-dimensional null subspace algorithm applied for blind optical images deconvolution** [9807-6]
- 9807 OU **Based on reception in general with bit-by-bit decision-making algorithm for signal processing in fiber optic telecommunication systems (Invited Paper)** [9807-17]
- 9807 OV **Calculating x-ray diffraction on crystals by means of the differential method** [9807-24]
- 9807 OW **Change detection methods for distinction task of stochastic textures based on nonparametric method** [9807-36]

- 9807 0X **Correction of chromatic aberrations at television registration of image through protective viewing systems [9807-37]**
- 9807 0Y **Methods of dispersion improvement in a fiber-fed spectrograph scheme [9807-53]**
- 9807 0Z **Performance analysis of sliding window filtering of two dimensional signals based on stream data processing systems [9807-14]**
- 9807 10 **Features of coherent preparation of medium for the control of its characteristics [9807-15]**
- 9807 11 **External amplitude-phase modulation of laser radiation for generation of microwave frequency carriers and optical poly-harmonic signals: an overview [9807-16]**
- 9807 12 **Signature analysis of microwave signal generator with a fiber optic delay line in a feedback loop [9807-42]**
- 9807 13 **Iterative procedure for camera parameters estimation using extrinsic matrix decomposition [9807-60]**
- 9807 14 **Information measurement system based on the device for evaluation of optical surface quality [9807-65]**
- 9807 15 **Optical signal processing of video surveillance for recognizing and measurement location railway infrastructure elements [9807-66]**

OPTICAL NETWORKS MAINTENANCE, CONTROL, AND RESTORATION

- 9807 16 **Method of optical cable lifetime prolongation [9807-57]**
- 9807 17 **Optical vector network analyzer based on amplitude-phase modulation [9807-21]**
- 9807 18 **Investigation of fiber curvature distributions on loose-tube optical cable delivery length [9807-52]**
- 9807 19 **Research of excess fiber length variation in loose tube and cable delivery length during fiber optic cable manufacturing [9807-56]**
- 9807 1A **Methods of optical fiber curvature measurement on loose-tube optical cable delivery length [9807-58]**
- 9807 1B **Problems of reliability of optical cables at low temperatures [9807-25]**
- 9807 1C **Modified technique for differential mode delay map measurement by scanning of input/output ends of tested multimode fiber [9807-48]**
- 9807 1D **Experimental study of low-cost fiber optic distributed temperature sensor system performance [9807-51]**
- 9807 1E **Modeling of consecutive local events in fiber-optic lines [9807-63]**

9807 1F **Frequency-coded quantum key distribution using amplitude-phase modulation** [9807-5]

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.

Abdrakhmanova, Guzel I., 04, 08, 0I
Abramov, Vladimir Y., 19
Abulkhanov, Stanislav R., 0S
Andrianova, Anna V., 04, 09, 0I
Aguiló, M., 0C
Akhmetgaleeva, Railia R., 02
Andreev, Roman V., 1B
Andreev, Vladimir A., 07, 0Q, 18, 19
Artemev, Vadim I., 0M
Artyshchenko, Stepan V., 10
Bagmanov, Valeriy Kh., 0B
Bahareva, Nadezhda F., 03
Berezovskiy, Andrey, 0T
Biryukov, Vladimir V., 12
Blank, Veronika A., 0G
Bourdine, Anton V., 06, 0A, 0J, 0K, 0L, 0Q, 1C
Bukashkin, Sergey A., 07, 0A, 18, 19
Burdin, Vladimir A., 07, 0J, 0K, 0L, 0Q, 0U,
16, 18, 1A, 1C
Butt, M. A., 0C, 0D
Buzov, Alexander L., 07, 18, 19
Buzov, Alexander V., 0A
Cherepanov, Dmitry A., 0Y
Chernov, Andrei A., 0N
Chernov, Roman A., 10
Dashkov, Michael V., 07, 0Q, 1D
Díaz, F., 0C
Diyazitdinov, Rinat R., 15
Dmitriev, Eugeny V., 18
Faskhutdinov, Lenar M., 0J, 0K, 0L, 0M
Feofilaktov, Sergey V., 0Y
Fursov, Vladimir A., 13
Gabdulkhakov, Il'daris M., 1F
Gavrilov, Pavel V., 17
Gavryushin, Sergey A., 19
Gopal, Ram, 0D
Goriachkin, Oleg, 0T
Goshin, Yegor V., 13
Grachev, Vladimir A., 12
Grakhova, Elizaveta P., 04, 08
Grigorov, Igor V., 0Q, 0U
Il'in, German I., 11
Ishmiyarov, Arsen A., 04
Ivanov, Dmitrii V., 0N
Ivanov, Vladimir A., 0N
Izotov, Pavel Y., 14
Juneja, Sucheta, 0F
Kafarova, Anastasia M., 0J, 0K, 0L
Kapustin, Sergey A., 12
Karpeev, Sergey V., 0H, 0R
Kartashevsky, Vyacheslav G., 0U
Kasimova, Dilyara I., 17
Kazanskiy, Nikolay L., 0F, 0P, 0R, 0V, 0Z
Kharitonov, Sergey I., 0S, 0V
Khasansin, Vadim R., 09
Khonina, Svetlana N., 0C, 0D, 0E, 0F, 0H,
0P, 0V
Krasnov, Andrey P., 0R
Kubanov, Victor P., 0A
Kulyas, Oleg L., 0X
Kumar, Sushil, 0F
Kuznetsov, Artem A., 0J, 0K, 0L, 0M
Lifante, G., 0C
Llorente, Roberto, 05
Lobin, Sergey G., 12
Lukyanova, Tatyana S., 12
Makarov, Igor A., 17
Meshkov, Ivan K., 04, 08, 0I
Minaeva, Alina Yu., 0J, 0K, 0L
Misbakhov, Rustam Sh., 11
Moissev, Oleg Yu., 0F
Morant, Maria, 05
Morozov, Gennady A., 0M, 11, 17, 1F
Morozov, Oleg G., 0J, 0K, 0L, 0M, 0Y, 11, 17, 1F
Murav'eva, Elena V., 02
Muslimov, Eduard R., 02, 0Y
Nikitin, Konstantin A., 0X
Nikulina, Tatiana G., 1B
Nureev, Ilnur I., 0J, 0K, 0L, 0M, 0Y, 11, 17
Ovchinnikov, Vladimir V., 0N
Paranin, Vyacheslav D., 0H, 0R
Pashin, Stanislav S., 1C
Pasternak, Yuri G., 10
Pavlycheva, Nadezhda K., 02, 0Y
Peplov, Artem A., 02
Popov, Boris V., 19
Popov, Victor B., 19
Porfirev, Alexey P., 0E, 0F, 0O
Praporshchikov, Denis E., 0A, 1C
Procopiev, Vladimir I., 07
Protsenko, Vladimir, 0Z
Pujol, M. C., 0C
Purtov, Vadim A., 17
Raevskii, Alexey S., 12
Ródenas, A., 0C
Ryabova, Mariia I., 0N
Ryabova, Natalia V., 0N
Sakhabutdinov, Airat Zh., 0M

Salikhov, Aydar I., 0I, 1E
 Sarvarova, Lutsia M., 1F
 Savelyev, Dmitry A., 0P
 Serafimovich, Pavel, 0Z
 Sevruck, Nikita L., 0J, 0K, 0L, 1C
 Shmidt, Svyatoslav P., 08
 Sibgatulina, Dina Sh., 02
 Skidanov, Roman V., 0C, 0D, 0F, 0G
 Solé, R., 0C
 Sudhakar, Selvakumar, 0F
 Sultanov, Albert Kh., 04, 08, 0B, 0I, 0W, 1E
 Tafur Monroy, Idelfonso, 08
 Tarasov, Veniamin N., 03
 Tyazhev, Anatoly I., 0A
 Ustinov, Andrey V., 0P
 Vasilets, Alexander A., 0J, 0K, 0L
 Vasin, Nikolay N., 15
 Vazhdaev, Michail A., 18
 Verma, Payal, 0C, 0D
 Vinogradov, Sergey L., 09
 Vinogradova, Irina L., 04, 08, 09, 0I, 1E
 Volkov, Kirill A., 07
 Volotovskiy, Sergey G., 0V
 Voronkov, Andrey A., 1B
 Yantilina, Liliya Z., 09, 0I
 Zagrieva, Aida R., 1F
 Zainullin, Airat R., 04
 Zastela, Mikhail Yu., 17
 Zharkov, Alexander D., 07, 1D

Conference Committee

Conference Chairs

- Vladimir A. Andreev**, Povolzhskiy State University of Telecommunications and Informatics (Russian Federation)
Vladimir A. Burdin, Povolzhskiy State University of Telecommunications and Informatics (Russian Federation)
Anton V. Bourdine, Povolzhskiy State University of Telecommunications and Informatics (Russian Federation)
Oleg G. Morozov, Kazan National Research Technical University (Russian Federation)
Albert H. Sultanov, Ufa State Aviation Technical University (Russian Federation)

Program Committee

- V. N. Akulshin**, "Bashinformsvyaz" (Russian Federation)
V. H. Bagmanov, Ufa State Aviation Technical University (Russian Federation)
A. N. Degtyarev, Ufa State Aviation Technical University (Russian Federation)
I. R. Gabitov, University of Arizona (United States)
I. A. Galikeev, SUE Center for ICT Bashkortostan Republic (Russian Federation)
A. Kh. Gilmutdinov, Kazan National Research Technical University, Kazan Aircraft Institute (Russian Federation)
M. P. Fedoruk, Novosibirsk State University (Russian Federation)
V. D. Kashavin, Agilent Technologies (Russian Federation)
A. A. Kashbiev, "Active Telecom" (Russian Federation)
N. L. Kazanskiy, Samara State Aerospace University (Russian Federation)
F. A. Kinzebaev, "Euro-Kin-Invest" (Russian Federation)
R. A. Khisamutdinov, Ufa State Aviation Technical University (Russian Federation)
N. K. Krioni, Ufa State Aviation Technical University (Russian Federation)
A. S. Kurkov, Prokhorov General Physics Institute (Russian Federation)
V. M. Levanov, Nizhny Novgorod State Medical Academy (Russian Federation)
A. V. Minov, "Osnova-telecom" (Russian Federation)
A. F. Nadeev, Kazan National Research Technical University, Kazan Aircraft Institute (Kazan, Russian Federation)
A. V. Ozhegov, Agilent Technologies (Russian Federation)

R. Llorente, Universitat Politècnica de Valencia (Spain)
V. G. Petrov, Commercial Innovation Center "Ligas"
 (Russian Federation)
D. Plettemeier, Dresden Technical University (Germany)
Mark Reor, "GWT" (Germany)
I. A. Sharifgaliev, "Energospetsnaladka" (Russian Federation)
S. V. Solovyov, "Keysight Technologies" (Russian Federation)
A. Z. Tlyavlin, Ufa State Aviation Technical University
 (Russian Federation)
S. K. Turitsyn, Aston University (United Kingdom)
I. T. Monroy, Technical University of Denmark (Denmark)
V. I. Vasiliev, Ufa State Aviation Technical University
 (Russian Federation)
S. U. Voronkov, "Technology & Communications" (Russian Federation)
T. Y. Yakubov, "Poligon" (Russian Federation)
I. U. Yamalov, Ufa State Aviation Technical University
 (Russian Federation)
Y. B. Zubarev, Russian Academy of Sciences, Moscow
 (Russian Federation)
R. R. Zhdanov, Ufa State Aviation Technical University
 (Russian Federation)
S. V. Zhernakov, Ufa State Aviation Technical University
 (Russian Federation)

Introduction

This volume contains a selection of reports presented at the 14th International Conference on Optical Technologies for Telecommunications. The conference was held 16–18 November 2015 at Ufa State Aviation Technical University, Ufa, Russian Federation.

The conference covered a large range of problems in optical technologies in telecommunications. We have no doubt that the proceedings from this conference will be helpful for both scientists and specialists working in the fields of telecommunication technologies.

Vladimir A. Andreev
Anton V. Bourdine
Vladimir A. Burdin
Oleg G. Morozov
Albert H. Sultanov