

PROCEEDINGS OF SPIE

Optical Technologies for Telecommunications 2020

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

17–20 November 2020
Samara, Russian Federation

Organized by

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

Published by
SPIE

Volume 11793

Proceedings of SPIE 0277-786X, V. 11793

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 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 2020*, edited by Vladimir A. Andreev, Anton V. Bourdine, Vladimir A. Burdin, Oleg G. Morozov, Albert C. Sultanov, Proc. of SPIE 11793, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510644243

ISBN: 9781510644250 (electronic)

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA

Telephone +1 360 676 3290 (Pacific Time)

SPIE.org

Copyright © 2021 Society of Photo-Optical Instrumentation Engineers (SPIE).

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 fees. To obtain permission to use and share articles in this volume, visit Copyright Clearance Center 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.

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**

SPIEDigitalLibrary.org

Paper Numbering: A unique citation identifier (CID) number is assigned to each article in the Proceedings of SPIE 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

OPTICAL TELECOMMUNICATION SYSTEM TECHNOLOGIES

- 11793 02 **Virtualization in optical networks** [11793-5]
- 11793 03 **3D image construct using active-pulse television system** [11793-23]
- 11793 04 **Initialization of the upstream central wavelength in 5G transport WDM-PON domain, Part I: straight initialization** [11793-53]
- 11793 05 **Initialization of the upstream central wavelength in 5G transport WDM-PON domain, Part II: reflectometric initialization** [11793-44]
- 11793 06 **Comparative analysis of fiber-optic communication lines with different underground laying technologies reliability characteristics** [11793-32]
- 11793 07 **Superposition of vortex light beams for atmospheric communication, formed by azimuthal diffractive optical elements** [11793-45]
- 11793 08 **Performance analysis of the RoF uplink channel** [11793-36]
- 11793 09 **Internet of things: safety control of wired, optical and fiber-optical network fragments** [11793-19]

PASSIVE AND ACTIVE OPTICAL COMPONENTS OF FIBER-OPTIC COMMUNICATION LINES AND INFORMATION-MEASURING SYSTEMS

- 11793 0A **Chiral fiber Bragg gratings for vortex signal generation** [11793-29]
- 11793 0B **Analysis of the threshold sensitivity of a wavefront aberration sensor based on a multi-channel diffraction optical element** [11793-2]
- 11793 0C **Compact design of a tunable high-pass filter based on one-dimensional photonic crystal waveguide** [11793-4]
- 11793 0D **Analyzing of the off-axis caustic created by the chirp-beams with autofocusing property** [11793-9]
- 11793 0E **Homography parameters estimation for superposition multidimensional television signals with automatic matching reference points** [11793-12]
- 11793 0F **The use of a tilted diffractive optical element with an increased depth of field in the problem of accounting and control of railway rolling stock** [11793-13]

- 11793 OG **Design of metamaterial structures for manufacturing piezoelements and optical structures with the necessary characteristics** [11793-25]
- 11793 OH **Mathematical model for measuring the concentration of particles in a liquid during their deposition** [11793-38]
- 11793 OI **Modeling the propagation of sets of autofocusing laser beams** [11793-15]
- 11793 OJ **Comparative modeling of optical vortex focusing by Fresnel zone plates** [11793-16]
- 11793 OK **Topological charge and orbital angular momentum of optical signals with asymmetric optical vortices** [11793-20]
- 11793 OL **Development of an ultrasonic fourteen channel flowmeter for visualization of the flow profile** [11793-26]
- 11793 OM **Method of non-destructive instrumental analysis of mode compositions and vortex signals in guiding structures** [11793-28]
- 11793 ON **Potential capabilities of optical distributed acoustic sensors to determine the location of an intruder** [11793-33]
- 11793 OO **Focusing of vector beams with fractional-order azimuthal polarization** [11793-39]
- 11793 OP **Calculation of the parameters of the modes for optical fibers with depressed cladding** [11793-41]
- 11793 OQ **The analytical formula for estimating a nonlinear coupling of optical fiber modes** [11793-42]
- 11793 OR **Field quantization in a waveguide with freeform cladding** [11793-48]
- 11793 OS **The concept of constructing liquid level control systems based on addressable fiber Bragg structures** [11793-49]
- 11793 OT **Metallens for energy backflow** [11793-51]
- 11793 OU **Development of a method for measuring the optical fiber refractive index profile** [11793-52]
- 11793 OV **Selection of refractive index profiles for couple combination of optical crypto-fibers** [11793-57]

ONE-DIMENSIONAL AND MULTI-DIMENSIONAL OPTICAL SIGNALS PROCESSING

- 11793 OW **Reconstruction algorithm an object image based on a series of its images distorted in a random environment** [11793-1]
- 11793 OX **The investigation of focusing of cylindrically polarized beams with the variable height of optical elements using high-performance computer systems** [11793-6]

- 11793 0Y **Algorithm of spatio-temporal multidimensional signal processing of triangulation optical sensor for restore shape object** [11793-10]
- 11793 0Z **Multidimensional optical video signals superposition for measurement offset, rotation angle, and scale with additive and multiplicative noise** [11793-11]
- 11793 10 **Recognition of wavefront aberrations corresponding to individual Zernike functions from the pattern of the point scattering function in the focal plane using neural networks** [11793-14]
- 11793 11 **OCT image processing system for numerical simulation of fundus temperature distribution** [11793-46]
- 11793 12 **Weight model based image compression method, part I: image analysis** [11793-17]
- 11793 13 **Weight model based image compression method, part II: image compression** [11793-30]
- 11793 14 **A new algorithm for solving the nonlinear Schrödinger equation by the split-step method to describe the evolution of a high-power ultra-short optical pulse propagating in a single-mode optical fiber** [11793-21]
- 11793 15 **Application of distributed computation of texture features to the analysis of biomedical images** [11793-47]
- 11793 16 **Symmetric vector analyzer for characterization of the spectral parameters of optical high-Q optical structures** [11793-50]

MAINTENANCE, MONITORING AND RESTORATION OF OPTICAL COMMUNICATION NETWORKS

- 11793 17 **Potential possibilities of non-destructive testing of optical fiber strength based on estimations of nonlinear acoustic emission energy** [11793-22]
- 11793 18 **Sorting of optic cable lengths on the section of fiber optic cable line according to the expected probability of failure based on fuzzy analytic hierarchy method** [11793-24]
- 11793 19 **Method for estimation of reflection on fiber optic connection based on ferrule end-face photo-image analysis** [11793-56]
- 11793 1A **Optical cable location methods** [11793-35]
- 11793 1B **Application of MIMO concept to detect nonreflecting events on cable fiber traces** [11793-34]

PROBLEMS OF SPECIALISTS TRAINING IN THE FIELD OF OPTICAL COMMUNICATIONS

11793 1C **Psychological support of social interaction in the process of optical communication specialists team building [11793-3]**

11793 1D **Competency model of an optical communication systems engineer [11793-7]**

ADVANCED OPTICAL COMMUNICATION TECHNOLOGY

11793 1E **Transmission of a high-speed 1000base-SX/LX signal through the atmosphere by vortex beams using modified DEM-310GT SFP transceivers [11793-54]**

11793 1F **Matching pixel and object image sizes during selection based on motion blur [11793-31]**

11793 1G **Usage of SDM technology in radio-over-fiber (RoF) transmission systems in high-speed scalable 6G wireless networks [11793-27]**