PROCEEDINGS OF SPIE

Optical Technologies for Telecommunications 2024

Anton V. Bourdine Oleg G. Morozov Albert Kh. Sultanov Editors

6–8 November 2024 Samara, Russian Federation

Organized by

Povolzhskiy State University of Telecommunications and Informatics (Russian Federation) Kazan National Research Technical University named after A. N. Tupolev – KAI (Russian Federation) Ufa University of Science and Technology (Russian Federation)

Published by SPIE

Volume 13738

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 2024*, edited by Anton V. Bourdine, Oleg G. Morozov, Albert K. Sultanov, Proc. of SPIE 13738, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510694323

ISBN: 9781510694330 (electronic)

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA Telephone +1 360 676 3290 (Pacific Time) SPIE.org

Copyright © 2025 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.



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

ix Conference Committee

OPTICAL COMMUNICATION TECHNOLOGIES AND SYSTEMS

	OF HEAR COMMUNICATION RECTINOLOGIES AND STSTEMS
13738 02	Study of the efficiency of optical ILCF-signal generation and conversion system based on a classical RoF segment using two lasers (Invited Paper) [13738-5]
13738 03	Optical technologies for radio line adaptability in industry (Invited Paper) [13738-11]
13738 04	Sixth-generation fixed network F6G [13738-1]
13738 05	Software package for estimating the characteristics of wireless communication channel with quantum-key distribution in atmosphere [13738-7]
13738 06	Development of a method for reducing the PAPR for orthogonal access methods based on the use of shaping filters in hybrid fiber-satellite communication networks [13738-9]
13738 07	Estimating QoS parameters in an SDN node when processing correlated flows [13738-47]
	PASSIVE AND ACTIVE OPTICAL COMPONENTS FOR FIBER OPTIC NETWORKS AND INFORMATION MEASURING SYSTEMS
13738 08	Combination of fiber optical interferometric structures as a universal approach to sensor development (Invited Paper) [13738-21]
13738 09	Superstructured addressed fiber Bragg structures for differentiation and integration of UWB signal envelopes in microwave photonic systems (Invited Paper) [13738-78]
13738 0A	Absolute phase modulation with holographic encoding [13738-2]
13738 OB	Using fiber optic systems in monitoring of construction structures: a review [13738-10]
13738 OC	Application of radiophotonics devices in multifrequency microwave radiometric systems for remote sensing of the atmosphere [13738-16]
13738 0D	Estimation of fluctuation sensitivity of millimeter-wave radiophoton radiometers [13738-17]
13738 OE	Miniature temperature sensor based on Fabry-Perot interferometer for biological and medical research [13738-27]

13738 OF	Simulation of a distributed fiber optic sensor as a delay line in an optoelectronic oscillator feedback loop [13738-33]
13738 0G	Analysis of the efficiency of distributed fiber optic acoustic sensors in monitoring systems [13738-35]
13738 OH	Influence of external factors on power transmission in few-mode optical fiber transmission lines [13738-36]
13738 01	Exploring the potentiality application of silica 5-mode optical fiber with perturbed refractive index profile in distributed acoustic sensing [13738-37]
13738 OJ	Fabry-Perot interferometer-based fibre optic pressure sensor mathematical modelling and sensitivity analysis [13738-42]
13738 OK	Harmonic linearization method for determining the spectrum of an optoelectronic oscillator [13738-44]
13738 OL	Research of spectral responses for MM-T6CMOF-MM fiber optic structure under varying microstructured optical fiber lengths [13738-59]
13738 OM	Comparison of guided mode dispersion parameters in two different type microstructured optical fibers: asymmetric with displaced core and quasi-ring configuration [13738-60]
13738 ON	Simulation of laser-excited optical pulse propagation over graded-index multimode optical fiber with distorted asymmetrical structure [13738-61]
13738 00	On the self-consistency of boundary value problems of the theory of radiation [13738-64]
13738 OP	Calculation of a single-mode fiber optic attenuator [13738-65]
13738 0Q	Features of plasmon-polariton waves in guiding structures at optical frequencies [13738-66]
13738 OR	Surface plasmon-polariton waves in a silver nanofilm at optical frequencies [13738-67]
13738 OS	Thin films of chitosan with the addition of silver iodide for flexible photodetectors [13738-70]
13738 OT	Thin films based on polyaniline derivatives for near-UV detection [13738-72]
13738 OU	Research of the methodology of evaluation of the linear range of components of microwave photonic paths using microwave photonic vector analyzers [13738-74]
13738 0V	Addressed fiber Bragg structure in the parallel configuration [13738-79]
13738 0W	Fiber optic electric field intensity sensor based on a Fabry-Perot interferometer with LiNbO ₃ crystal and addressed fiber Bragg structure for temperature compensation [13738-80]

13738 0X	Modernization of the calorimetric method for temperature monitoring of material processing in microwave chamber based on parallel type of addressed fiber Bragg structure [13738-81]
13738 OY	Practical experience in joining of silica microstructured and telecommunication optical fibers by using field arc fusion splicer kits [13738-83]
13738 OZ	Results of far-field red laser beam profile measurements after propagation over spun silica 7-hollow-GeO ₂ -doped-ring core microstructured optical fibers [13738-84]
	ONE-DIMENSIONAL AND MULTIDIMENSIONAL OPTICAL SIGNAL DATA PROCESSING
13738 10	Identification of vector light fields with inhomogeneous linear polarization by an orbital angular momentum of polarization (Invited Paper) [13738-25]
13738 11	Optical vortices polarization recognition by diffractive axicons and arrays of cylinders with different periods [13738-18]
13738 12	Analysis of phase-sensitive reflectometer output data processing methods for speech detection [13738-19]
13738 13	Practical application of ensemble methods for the analysis and classification of x-ray images $[13738-20]$
13738 14	Diffractive optical elements for laser beam shaping and control in optical systems [13738-22]
13738 15	Modeling of nonparaxial propagation of beams generated by vortex diffractive optical elements [13738-38]
13738 16	Problems of images superposition multidimensional television signal in measurement machine vision systems [13738-48]
13738 17	Interactive processing of ferrule images to automatically estimate pollution degree [13738-49]
13738 18	Finding optimal masks for simulation of tight focusing of laser beams with inhomogeneous polarization [13738-50]
13738 19	New vortex laser beams: Bessel-Bessel-Gauss beams [13738-52]
13738 1A	Investigation of the influence of turbulent media on the propagation of squared Laguerre-Gaussian beams [13738-53]
13738 1B	Features of Zernike function properties affecting aberration recognition capabilities [13738-54]
13738 1C	Influence of wave aberrations on the diffraction pattern of a binary axicon [13738-55]

13738 1D	The topological charge of the superposition of optical vortices in a turbulent medium [13738-57]
13738 1E	The spirality of beams defined on the Poincare sphere [13738-58]
13738 1F	Control of the OAM density for a beam generated by a generalized spiral phase plate with a nonmonotonic angular phase dependence [13738-62]
	MAINTENANCE, MONITORING, AND RESTORATION OF FIBER OPTIC NETWORKS
13738 1G	Experimental study of response characteristics of optical fibers in underground cable to external vibro-acoustic influences (Invited Paper) [13738-30]
13738 1H	Fiber optic link lifetime forecast using mivar AI technologies [13738-6]
13738 11	Experimental methods for studying the thunderstorm influence on the operation of fiber optic communication systems [13738-8]
13738 1J	Study of deformation of optical device modules for transmitting parameters at low negative temperatures [13738-28]
13738 1K	Study of optical cable deformation depending on temperature and bending radius [13738-29]
13738 1L	Study of the strength of optical fibers after removal of the primary protective coating by various methods $[13738\hbox{-}32]$
	ADVANCED TECHNOLOGIES OF OPTICAL COMMUNICATIONS
13738 1M	Application of diffractive optical elements in adaptive telecommunication systems (Invited Paper) [13738-23]
13738 1N	The utilization of photonic neural networks in the domain of quantum sensing (Invited Paper) [13738-43]
13738 10	Orbital angular momentum of structurally stable laser beams [13738-26]
13738 1P	Simulation and performance analysis of quantum key distribution system with regard to variations of optical path attenuation [13738-31]
13738 1Q	Using holographic coding to improve global positioning accuracy [13738-69]

PROBLEMS OF SPECIALIST TRAINING IN THE FIELD OF OPTICAL COMMUNICATIONS

13738 1R	Key aspects of training specialists in the field of quantum communications [13738-15]
13738 15	Microwave photonic spectral characteristics analyzers for wideband amplitude Mach-Zehnder modulators and photodetectors [13738-63]
13738 1T	The development of transprofessional skills in handling social orders in the process of professional training of specialists in infocommunication technologies and communication systems [13738-75]
13738 1U	Digital competencies in the training of specialists in the field of infocommunication technologies and communication systems [13738-76]