## **PROCEEDINGS OF SPIE**

# Conference on Spectral Technology and Applications (CSTA 2024)

Zhe Wang Hongbin Ding Editors

9–11 May 2024 Dalian, China

Sponsored by Chinese Society for Optical Engineering (China)

Organized by Dalian University of Technology (China)

Published by SPIE

Volume 13283

Part One of Two Parts

Proceedings of SPIE 0277-786X, V. 13283

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

Conference on Spectral Technology and Applications (CSTA 2024), edited by Zhe Wang, Hongbin Ding, Proc. of SPIE Vol. 13283, 1328301 © 2024 SPIE · 0277-786X · doi: 10.1117/12.3057323

Proc. of SPIE Vol. 13283 1328301-1

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 Conference on Spectral Technology and Applications (CSTA 2024), edited by Zhe Wang, Hongbin Ding, Proc. of SPIE 13283, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

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

ISBN: 9781510683082 ISBN: 9781510683099 (electronic)

Published by **SPIE** P.O. Box 10, Bellingham, Washington 98227-0010 USA Telephone +1 360 676 3290 (Pacific Time) SPIE.org Copyright © 2024 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

xv Conference Committee

#### Part One

	CONFERENCE ON SPECTRAL TECHNOLOGY AND APPLICATIONS (CSTA 2024)
13283 02	Infrared small target detection based on clustering and tracking [13283-2]
13283 03	Optical stripe center line compensation method based on Gaussian filter [13283-3]
13283 04	Design of PDH frequency tracking system based on system identification and a novel PID control scheme [13283-4]
13283 05	Effect of integration time on the performance parameters of InGaAs detectors [13283-5]
13283 06	Multicomponent jet flow field and radiation analysis based on DSMC method [13283-6]
13283 07	Joint transmitter and receiver spatial modulation for reconfigurable intelligent surface enabled VLC [13283-8]
13283 08	Automated sampling path planning model for complex surface of cylinder gear based on laser scanning techniques [13283-10]
13283 09	Dim and small target detection algorithm based on multi-velocity hypothesis and energy accumulation [13283-11]
13283 0A	Multithreading method for rapid tool wear detection based on integrating image classification and object detection [13283-12]
13283 OB	Research on infrared unmanned aerial vehicle tracking method combining deep learning and kernel correlation filtering [13283-13]
13283 OC	Study on the propagation performance of OAM-hopping in atmospheric turbulence channel [13283-14]
13283 OD	Development of a low-cost active 3D triangulation laser scanner of intelligent mobile robot for transferring button weight [13283-15]
13283 OE	Automated 3-degree-of-freedom pose path planning for a button weight robot motion [13283-16]
13283 OF	Single-celled metasurface full-color holography by independent phase control at RGB wavelengths [13283-18]

- 13283 0G Experimental investigation on high-enthalpy sphere flow field using absorption spectroscopy [13283-19]
- 13283 0H Long wavelength InAs/GaSb type-II superlattice digital focal plane detector passivated by atomic layer deposited Al<sub>2</sub>O<sub>3</sub> [13283-20]
- 13283 01 Infrared target generation based on conditional diffusion inpainting [13283-22]
- 13283 0J Error performance analysis for deep space laser communication system with SPAD [13283-25]
- 13283 0K Acousto-optical effect signal denoising algorithm based on ICEEMDAN-grey correlation degree [13283-28]
- 13283 OL Research on test cases design of satellite on-board platform software through dynamic fault tree model [13283-29]
- 13283 0M The damage effects and analysis of nanosecond pulse laser irradiation on triple junction GsAs solar cells [13283-30]
- 13283 0N Dark current characterisation of HgCdTe infrared detectors [13283-32]
- 13283 00 Research on surface plasma characteristics of CaF<sub>2</sub> and MgF<sub>2</sub> windows induced by laser [13283-33]
- 13283 OP Geometric distortion of optical scene generation device based on blackbody microcavity array [13283-34]
- 13283 OR Research on the adversarial effect of directed energy near-infrared laser on infrared imaging systems [13283-36]
- 13283 05 Research on the damage effect of high-energy laser irradiation transmission medium for laser countermeasures [13283-37]
- 13283 0T A contrast of linear array imaging system between swing-mode scanning and rolling-mode scanning [13283-38]
- 13283 00 FPGA-based multichannel optical fiber and OpenMV communication voltage unit controller [13283-41]
- 13283 0W Synthetic aperture radar based on digital beamforming [13283-45]
- 13283 0X A beam propagation simulation method based on power spectral density method and Zernike tilt [13283-48]
- 13283 0Y Vehicle airport runway FOD assisted intelligent identification system [13283-50]
- 13283 0Z Polarization-space-time context covariance matrix for PolSAR ship detection [13283-51]

13283 10	Experimental analysis of polarized BRDF of coating material surface [13283-54]
13283 11	Investigation of polarization-direction-dependent SBS threshold in monolithic high-power PM fiber amplifiers [13283-55]
13283 12	A numerical investigation of laser Doppler acoustic field reconstruction with ultrasonic attenuation [13283-56]
13283 13	Optimizing signal scheduling in OTN: a deadline-driven priority strategy [13283-59]
13283 14	Research on plant health state detection based on two-channel multispectral LiDAR [13283-60]
13283 15	Dual alignment interactive network for infrared small target detection [13283-61]
13283 16	Research on key technologies for target 3D modeling based on precision control [13283-63]
13283 17	The integrity monitoring of GNSS on Android smartphones in urban scenario [13283-64]
13283 18	Research on high-temperature protection technology for uncooled IR imager [13283-65]
13283 19	Multiboot of K7 FPGA based on MicroBlaze soft core [13283-67]
13283 1A	DFE-SLAM: a visual slam augmented by feature extraction in dynamic environments [13283-69]
13283 1B	Infrared non-destructive testing based on the leading edge of the hood [13283-72]
13283 1C	A remote updating method of infrared thermal image program based on K7 FPGA [13283-73]
13283 1D	Point cloud segmentation method of satellites based on improved DGCNN [13283-74]
13283 1E	Diffractive interferogram-based phase control method of spatial light modulators [13283-76]
13283 1F	Preferred thermal aerosol fire extinguishing agent additives based on high-speed infrared imagers [13283-80]
13283 1G	Research on compound-eye array wide-field image synthesis technique based on GPU accelerated [13283-85]
13283 1H	The design of a zoom optical system in short-wave infrared [13283-90]
13283 11	Experimental and research on underwater image transmission based on semiconductor laser [13283-91]

v

- 13283 1J Research on height tracking for automatic pipeline welding based on structured light [13283-92]
- 13283 1K Research on flow field measurement technology based on optical field imaging [13283-93]
- 13283 1L Summarize and analysis of large-field imaging technology and target recognition technology based on large-field imaging detection [13283-95]
- 13283 1M Characterization method for micron-scale sealing coating wear of long-life infrared detector cryocooler assembly [13283-96]
- 13283 1N Dependence of cluster size on throat diameter of conical nozzle in supersonic gas jet [13283-98]
- 13283 10 Complex interference suppression based on high-resolution time-frequency image U-net method [13283-99]
- 13283 1P A centroiding algorithm for high precision cross strip anode readout of photon imaging detector [13283-102]
- 13283 1Q A motion error compensation method for phase-shifting profilometry based on principal component analysis [13283-107]
- 13283 1R Ligand-modified FAPbI3 perovskite quantum dots for efficient near-infrared light-emitting diodes [13283-110]
- 13283 15 NR-MAE: noise reduction masked autoencoder for boosting SSL on SAR target recognition [13283-112]
- 13283 11 Bidirectional ultrafast fiber laser mode-locked with ethylene glycol [13283-114]
- 13283 10 Light temperature reconstruction of synthetic aperture of Y-array antenna based on deep learning [13283-115]
- 13283 1V The invention relates to a non-thermal medium-long wave dual-band infrared imaging system design [13283-116]
- 13283 1W Single pixel distance value extraction algorithm for GM-APD under low SBR conditionsbased deep learning [13283-117]
- 13283 1X Doppler division and range division MIMO radar with velocity and range ambiguity resolving capabilities [13283-118]
- 13283 1Y Design of fog transmission lens with large continuous zoom range [13283-122]
- 13283 17 Reconfigurable intelligent surfaces aided parallel RF and FSO communications using adaptive combing [13283-123]
- 13283 20 A 3-channel broadband Fabry-Perot quantum cascade laser combined system based on external cavity spectral beam combining [13283-124]

- 13283 21 Orbital-angular-momentum-based object detection using uniform circular-frequency diverse array [13283-125]
- 13283 22 Optimization methods for end-point accuracy of seven-axis articulated 3D scanning measurement arm [13283-126]
- 13283 23 Analysis of cross-eye jamming effect on antenna structure influence [13283-127]
- 13283 24 Space-time suppression of self-interference and inter-symbol interference for target detection in ISAC systems [13283-128]
- 13283 25 Splitting rules of the channeled modulation polarization imaging technology for different polarization detection requirements [13283-129]
- 13283 27 DNDADI: density-weighted normal angle deviation and depth information local descriptors for 3D rigid data feature matching [13283-131]
- 13283 28 Efficient multispectral infrared dim target detection framework based on slice registration [13283-132]
- 13283 29 Quantitative evaluation and optimization of infrared detection imaging [13283-133]
- 13283 2A Satellite terminal collaborative processing method for sensing images based on neural networks [13283-134]
- 13283 2B Research on a small-volume portable non-contact chlorophyll-b measurement instrument based on laser spectroscopy [13283-135]
- 13283 2C **Research on the method of infrared ship target detection in sea-sky background** [13283-137]
- 13283 2D Radar forward-looking imaging based on modulated beam with linear phase front [13283-140]
- 13283 2E Method of the accurate intensity detection for ICCD-based low light observation [13283-141]
- 13283 2F Adaptive and efficient imaging processing algorithm for sliding spotlight SAR based on chirp scaling [13283-142]
- 13283 2G Corner-based ship detection method in complex SAR scenarios [13283-143]
- 13283 21 Characterization of wafer surface morphology based on atomic force microscopy [13283-146]
- 13283 2J Simultaneous detection method of atmospheric aerosol absorption and scattering coefficients based on photoacoustic spectroscopy and integrating nephelometry [13283-147]

- 13283 2K Low-noise surface-enhanced mid-infrared laser absorption spectroscopy based on spectrum compensation [13283-149]
- 13283 2L Progress of 800G integrated coherent receiver [13283-151]
- 13283 2M Parabolic mirror-based cavity-enhanced Raman spectroscopy gas detection system [13283-152]
- 13283 2N **High-quality single-pixel imaging via untrained attention network at a low sampling ratio** [13283-154]
- 13283 20 Study on evaluation methods for warship infrared simulation images [13283-155]
- 13283 2P Application of spectroscopy technology in detecting toxic effects of environmental pollutants [13283-156]
- 13283 2Q Research on the peak power of pulses from dual-Q lasers [13283-158]

#### Part Two

13283 25	Simulation and research on high-frequency crosstalk signals in position-sensitive photodetectors [13283-162]
13283 2T	Digital readout integrated circuit for small pixel infrared focal plane arrays [13283-165]
13283 2U	Research on high-power DFB laser chips for laser photoacoustic spectroscopy [13283-166]
13283 2V	UV picosecond laser processing of fluorine-doped graphene for flexible in-plane micro- supercapacitors [13283-171]
13283 2W	Control method for drive motor of antenna servo system based on second-order speed prediction [13283-172]
13283 2X	Laser interferometric quadrature phase method for tokamak wall surface vibration measurements [13283-173]
13283 2Y	Influence of activity on extinction characteristics of non-spherical bioparticle aggregates [13283-175]
13283 2Z	Single longitudinal mode Brillouin fiber laser with fiber ring and reflective saturable absorber [13283-176]
13283 30	Optical-infrared image translation based on diffusion models [13283-179]
13283 31	Research on SAR ATR technology based on feature fusion and spiking neural network [13283-180]

- 13283 32 NLM3D infrared video denoising method based on spatio-temporal domain feature matching [13283-181]
- 13283 34 Research on emissivity of concave cavity array surface blackbody based on Monte Carlo ray tracing [13283-184]
- 13283 35 Numerical simulation of thermal characteristics of vehicle in complex environment [13283-185]
- 13283 36 Rapid screening and classification of common drugs using Raman spectroscopy based on the hybrid and cascade-SVM model [13283-186]
- 13283 37 Investigation of generated near-infrared crack defect dataset for solar cells [13283-187]
- 13283 38 High-precision radius of curvature interferometry method with axial error compensation algorithm [13283-188]
- 13283 39 Motion blur parameters estimation of uncooled infrared images [13283-190]
- 13283 3A **RGB-infrared image fusion and classification based on tensor decomposition** [13283-191]
- 13283 38 Automatic temperature control system for ultra-low temperature special optical monitoring equipment [13283-195]
- 13283 3C Evaluation of the generated visible-to-infrared images using CycleGAN and Pix2Pix based on pre-sorted AVIID-3 dataset [13283-197]
- 13283 3D Topology graph attention mechanism and its application for polarimetric ISAR satellite oriented component recognition [13283-198]
- 13283 3E Cosine response characteristic and cosine error for spectral irradiance sensors [13283-204]
- 13283 3F Research on multi-person respiration and heartbeat detection method based on adaptive VMD using mmWave radar [13283-205]
- 13283 3G ETSS-Net: a one-stage detection model for infrared small target images based on efficient transformer and scale sequence attention mechanism [13283-206]
- 13283 3H High-repetition-rate mid-infrared optical parametric oscillator based on BaGa₄Se7 crystal pumped by a 1064nm laser [13283-207]
- 13283 31 External brightness adjustment of auto-gated image intensifier in vary illumination [13283-210]
- 13283 3J Focused regulation of metalens based on multilayer graphene in terahertz bands [13283-212]
- 13283 3K DC characteristics of terahertz superconducting SIS mixers under alternating magnetic field [13283-213]

- 13283 3L Evaluation of point-source microscope localization accuracy based on measurement system analysis methods [13283-214]
- 13283 3M Spectral unmixing of complex media in photoacoustic imaging based on optimizationdriven flux correction [13283-215]
- 13283 3N Investigation and application of a Gaussian-based noise model in infrared computational imaging [13283-216]
- 13283 30 Design and testing of electric spark system for full spectrum direct reading spectrometer [13283-217]
- 13283 3P Study of long-wave infrared quantum cascade lasers combination [13283-218]
- 13283 3Q Research on laser 3D projection technology based on non-cooperative targets [13283-219]
- 13283 3R GaN-based blue Littman-type grating-coupled external-cavity semiconductor laser [13283-222]
- 13283 35 The optical design of Offner-type reflective image de-rotation system [13283-223]
- 13283 3T Design and analysis of lightweight double-sided mirrors [13283-225]
- 13283 3U Simulation experiment on classification and recognition of several typical airport runway foreign objects based on NIR hyperspectral imaging [13283-226]
- 13283 3V Research on rapid refrigeration and precise temperature control of cryogenic infrared mirror [13283-227]
- 13283 3W Analysis of copper content combined laser-induced breakdown spectroscopy with feature selection [13283-228]
- 13283 3X An evaluation on short-term salvage effectiveness of Ulva prolifera green tide based on satellite data [13283-229]
- 13283 3Y Test condition of modulation transfer function of optical lens [13283-230]
- 13283 3Z Numerical simulation study on thermal radiation transmission and suppression in hightemperature sapphire window [13283-231]
- 13283 40 Interference resource allocation method based on constrained reinforcement learning [13283-232]
- 13283 41 Single-shot phase retrieval using automatic differentiation and bilateral total variation [13283-233]
- 13283 42 Valence band barrier optimization in HgCdTe p-on-n double layer heterostructure: a Silvaco TCAD simulation [13283-235]

- 13283 43 Fast fringe image denoising for 3D reconstruction using lightweight convolutional neural network [13283-237]
- 13283 45 Fall direction detection using parallel CNN based on millimeter-wave radar multidimensional feature fusion [13283-240]
- 13283 46 Phase noise measurement of laser sources in coherent lidar system [13283-241]
- 13283 47 Research on high dynamic strain measurement methods for deployable sunshades of star sensors [13283-242]
- 13283 48 Research on high-precision temperature measurement and control technology for space mechanical cryogenic system [13283-243]
- 13283 49 Nonorthogonal code division multiplexing holography [13283-244]
- 13283 4A The absorption characteristics of particulate matter in the southern Eastern Indian Ocean [13283-245]
- 13283 4B Discussion on the relationship between satellite coverage and on-board antenna in mobile phone direct connection mode [13283-246]
- 13283 4C Study of high-repetition-rate THz parametric oscillator based on electro-optic Q-switched laser [13283-248]
- 13283 4D Optical-to-SAR image translation based on diffusion Schrödinger bridge [13283-249]
- 13283 4F Research on the coverage area of terrestrial laser diffusion communication [13283-253]
- 13283 4G Optimization algorithm for coherent parameter estimation of ground-based distributed coherent aperture radar [13283-255]
- 13283 4H A novel OFDM directional modulation waveforms synthesis approach for multiple target sensing [13283-258]
- 13283 4 A Ka-band miniaturized flexible conformal frequency selective surface radome [13283-259]
- 13283 4J Research on absolute measurement of reflectance at small angles near LiDAR reflection conditions [13283-260]
- 13283 4K Ultrashort pulses classification in an Yb-doped fiber laser based on EfficientNet model [13283-261]
- 13283 4L A noncollinear optical parametric amplifier based on an enhanced supercontinuum white light [13283-268]
- 13283 4M Impact of dispersion and saturation energy on the mode-locking states in an Yb-doped fiber laser with near-zero net dispersion [13283-269]

13283 4N	Research on binocular stereo matching based on infrared imaging [13283-270]
13283 40	Comparison of 632nm laser dazzling effect on CCD and CMOS image sensors [13283-271]
13283 4P	High-energy 3.5µm nanosecond KTA optical parametric oscillator [13283-277]
13283 4Q	A novel SAR sparse imaging algorithm based on low-rank matrix completion [13283-278]
13283 4R	Development of portable Raman rapid analyzer for water pollution and its matching control analysis software [13283-279]
13283 4S	Online lubricating oil condition monitoring by laser-induced breakdown spectroscopy with a micrometer-diameter liquid filament [13283-280]
13283 4T	Compact optical fiber laser frequency comb based on acetylene-filled photonic microcell [13283-281]
13283 40	Fast star extraction algorithm based on the local gray histogram [13283-282]
13283 4V	3D point cloud denoising method based on improved PCPNet [13283-283]
13283 4W	Nondestructive testing application of Cessna 172R aircraft skin coating based on spectral indices [13283-284]
13283 4X	Analysis of internal wave characteristics based on SWOT data [13283-286]
13283 4Y	Comparison on image quality of intra-frame high dynamic range infrared imaging with multiple integration time arrangements [13283-287]
13283 4Z	Theoretical and experimental investigations of infrared hyperspectral imaging systems based on the BIB detectors [13283-289]
13283 50	A novel integrated navigation approach with SRCKF based on LSTM signal compensation [13283-290]
13283 51	Data augmentation of linear frequency modulation radar signal and active jamming signal based on CGAN [13283-291]
13283 52	A joint sparse Bayesian learning for wideband DOA estimation [13283-292]
13283 53	Performance simulation of a long-range multi-channel LiDAR for environmental pollution monitoring [13283-294]
13283 54	Adversarial example attack of SAR image based on Grad-CAM mask extraction [13283-297]
13283 55	Echo simulation and application of multi-channel interferometric SAR based on OptiX [13283-298]

- 13283 56 Heterogeneous multiagent collaborative radar countermeasure strategy generation method based on hierarchical reinforcement learning [13283-300]
- 13283 57 Design of a low profile Eleven antenna loaded with stepped substrates [13283-301]
- 13283 58 Digital detail enhancement method for infrared images based on Gaussian filtering [13283-303]
- 13283 59 Broadband amplitude-tunable absorber based on plug-in structure [13283-304]
- 13283 5A A miniaturized high-isolation jamming system based on pulse transceiver shared antenna technology [13283-312]
- 13283 5B Research on the reliability of phased array radar power supply system based on modular parallel redundancy technology [13283-313]
- 13283 5C Research on manufacturing technology of beryllium and beryllium-aluminum alloy reflector [13283-315]
- 13283 5D Vital signs monitoring based on millimeter-wave radar using permutation entropy optimized VMD [13283-316]
- 13283 5E An automated test system used for front-end of phased array [13283-317]
- 13283 5F Cascaded feature fusion of SAR polarization for deep learning-based waterbody detection [13283-320]
- 13283 5H Radar-based contactless human ECG signal reconstruction [13283-327]
- 13283 51 **Research on measuring method of key parameters of multi-pixel photon counter** [13283-328]
- 13283 5J High-efficiency dual-level grating coupler with heterogeneous integration on lithium niobate [13283-331]
- 13283 5K Research on multi-axis and MTF testing methods for laser rangefinder system in vacuum environment [13283-335]
- 13283 5L Study of chip defect detection based on photoacoustic effect [13283-341]

### **Conference Committee**

Conference Chairs

Tian Zhongqun, Xiamen University (China)
Liu Wenqing, Hefei Institutes of Physical Science, Chinese Academy of Sciences (China)
Wang Jianyu, Shanghai Institute of Technical Physics, Chinese Academy of Sciences (China)

Program Committee

Ding Hongbin, Dalian University of Technology (China) Ren Bin, Xiamen University (China) Shao Xueguang, Nankai University (China) Zhang Chunfeng, Nanjing University (China) Wang Zhe, Tsinghua University (China) Ma Yufei, Harbin Institute of Technology (China)