

PROCEEDINGS OF SPIE

Second Conference of Young Scientists of the Chinese Society of Optical Engineering

**Liangcai Cao
Qiming Zhang
Pengcheng Hu
Liwei Liu**
Editors

**25–27 April 2025
Ningbo, China**

Organized by
Yongjiang Laboratory (China)
Ningbo University (China)

Sponsored by
Chinese Society of Optical Engineering (China)

Published by
SPIE

Volume 13799

Part One of Two Parts

Proceedings of SPIE 0277-786X, V. 13799

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 SPIDigitalLibrary.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 *Second Conference of Young Scientists of the Chinese Society of Optical Engineering*, edited by Liangcai Cao, Qiming Zhang, Pengcheng Hu, Liwei Liu, Proc. of SPIE 13799, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510694781

ISBN: 9781510694798 (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.

**SPIE. DIGITAL
LIBRARY**

SPIDigitalLibrary.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

xi *Conference Committee*

Part One

SECOND YOUNG SCIENTISTS CONFERENCE OF THE CHINESE SOCIETY OF OPTICAL ENGINEERING

- 13799 02 **Phase unwrapping in large depth-of-field scenes** [13799-1]
- 13799 03 **Strong coupling of monolayer molybdenum disulfide with silicon nanogrooves** [13799-4]
- 13799 04 **In situ synthesis of Te/Si heterojunction photodetectors enabling ultra-broadband UV-vis-IR photoelectric conversion** [13799-5]
- 13799 05 **Optimization of a SiCl₄-Ar inductively coupled plasma etching process for InP-based waveguide devices** [13799-6]
- 13799 06 **Identification of rice varieties based on spectral-image fusion using hyperspectral imaging technology** [13799-7]
- 13799 07 **The binocular multiline structured light roller-pressed component three-dimensional online measurement and digital calibration method** [13799-8]
- 13799 08 **HIBi-RTDETR: an efficient real-time infrared traffic object detector for edge devices** [13799-11]
- 13799 09 **A windowless low-temperature surface profile measurement method for tiled detectors** [13799-13]
- 13799 0A **Research on a precision temperature-controlled JT cooler for high operating temperature infrared detectors** [13799-16]
- 13799 0B **Impact of six-degree-of-freedom tremor perturbations in remote sensing platforms on image quality: modeling, simulation, and restoration** [13799-17]
- 13799 0C **Optimization of registration accuracy of distorted super-wide field-of-view infrared images based on global selection preserving matching with chunking** [13799-18]
- 13799 0D **Enhancing textural detail in infrared simulation image: a time-segment temperature field modulation method** [13799-19]
- 13799 0E **A fast radiative transfer model for optical remote sensing image simulation with multilayer clouds** [13799-20]

- 13799 OF **Research on optical system of remote sensing payload with high stray light suppression capability for deep space exploration [13799-21]**
- 13799 OG **Research and application of testing methods for performance parameters of Geiger-mode and linear avalanche photodiode focal plane detectors [13799-23]**
- 13799 OH **Stabilization control technology of airborne optoelectronic targeting system based on adaptive algorithm [13799-24]**
- 13799 OI **Research on cross-modal reconstruction technique of visible and infrared images based on deep learning [13799-25]**
- 13799 OJ **Modeling and analysis of continuous detection system for space debris in ultra-low-orbit [13799-26]**
- 13799 OK **Analysis of the impact of line-of-sight calibration residuals on target positioning performance in astronomical optical detection systems [13799-29]**
- 13799 OL **Data-driven infrared small target prediction for drone swarm in complex environment [13799-30]**
- 13799 OM **Analysis of radiation characteristics based on engine parameters [13799-31]**
- 13799 ON **Non-uniformity correction of infrared focal plane array detectors based on Hermite interpolation [13799-32]**
- 13799 OO **Detection of infrared moving small targets from dynamic background based on improved ViBe algorithm [13799-33]**
- 13799 OP **Electromagnetic scattering modeling of space solid particle clouds for engineering applications [13799-38]**
- 13799 OQ **Structural design and simulation analysis for plasma edge diffusion control in diamond polishing [13799-39]**
- 13799 OR **Research on mathematical modeling of aerodynamic effects of infrared optical hoods [13799-40]**
- 13799 OS **Design of readout circuit based on SPAD array and laser ranging experiments [13799-41]**
- 13799 OT **CCWHE: multimodel ensemble method for modulation recognition based on weight learning [13799-42]**
- 13799 OU **A FPGA implementation scheme for JPEG-LS lossless compression based on frame difference method [13799-45]**
- 13799 OV **Comparative analysis of GIQE 4 and GIQE 5 for remote sensing image quality assessment [13799-46]**
- 13799 OW **Rapid detection of enzyme activities in tomato leaves using visible-near infrared hyperspectral imaging integrated with image segmentation [13799-48]**

- 13799 0X **Edge-YOLO: vehicle-mounted infrared object detection method via edge enhancement** [13799-50]
- 13799 0Y **A method for measuring the contrast of outdoor targets on a drone platform** [13799-52]
- 13799 0Z **Design of infrared FPA digital ROIC architecture with frame integration** [13799-54]
- 13799 10 **Study of a portable and highly sensitive glucose Raman detector based on light-guiding metal capillaries** [13799-55]
- 13799 12 **High aspect ratio and steepness TiO₂ metasurface fabrication via stepwise mixed-gas ICP etching** [13799-57]
- 13799 13 **High-order nonlinear error compensation method based on error construction** [13799-58]
- 13799 14 **Mirror design based on topology optimized high stiffness lattice** [13799-59]
- 13799 15 **Continuous monitoring of typhoon-induced gravity waves via multisource optical satellites** [13799-60]
- 13799 16 **Design of tunable terahertz metalenses with single and multifocus capabilities** [13799-61]
- 13799 17 **Optical dispersion effect-based short-time Fourier transform signal recognition method** [13799-64]
- 13799 18 **Laser acoustic cross-medium communication demodulation method based on sliding RMS filter** [13799-67]
- 13799 19 **A novel single-layer DoFP polarization imaging system incorporating metasurface-based spectral routing** [13799-69]
- 13799 1A **Behavior detection based on infrared video: review and prospect** [13799-71]
- 13799 1B **Abnormal behavior detection method based on multimodal feature fusion with attention mechanism** [13799-72]
- 13799 1C **Time-gating improving the near-infrared single-photon imaging** [13799-74]
- 13799 1D **Visible to mid-infrared supercontinuum generated by 1.97 μ m pulse-pumped GeO₂-core fiber** [13799-76]
- 13799 1E **Numerical simulation study on thermal trailing wake of targets at sea** [13799-77]
- 13799 1F **Dynamic weighted fusion network for infrared small target detection** [13799-78]

- 13799 1G **Design and analysis of wide-frequency-band germanium-based terahertz subwavelength grating polarizer** [13799-79]
- 13799 1H **Arrayed VCSEL capacitor discharge pulse driver design and simulation** [13799-80]
- 13799 1I **Establishment and simulation analysis of aircraft infrared radiation model** [13799-83]
- 13799 1J **A high signal-to-noise ratio descattering method on rainy via small data** [13799-84]
- 13799 1K **Distributed optical fiber temperature measurement system based on point-type FBG calibration** [13799-85]
- 13799 1L **Advances in variable F-number infrared detector technology at Kunming Institute of Physics** [13799-86]
- 13799 1M **Ion beam polishing on the surface performance of fused silica optical materials** [13799-87]
- 13799 1N **Multimodal feature fusion and classification recognition of infrared small targets** [13799-88]
- 13799 1O **Review of noise reduction algorithms for low illumination images** [13799-89]
- 13799 1P **Thermal dissipation analysis of Stirling cryocoolers using phase change materials and heat sinks** [13799-95]
- 13799 1Q **Current status and future prospects of fuzzy control** [13799-96]
- 13799 1R **Design of MWIR and LWIR infrared common-path optical system based on freeform surface** [13799-97]
- 13799 1S **Deep learning target detection network guided by physical mechanism** [13799-99]
- 13799 1T **A multimodal remote sensing image fusion method for object detection based on tensor decomposition** [13799-100]
- 13799 1U **Research on mission planning algorithm framework for large-scale heterogeneous sensing constellation** [13799-101]
- 13799 1V **Intent recognition of airborne targets based on temporal trajectories** [13799-103]
- 13799 1W **Spatial distribution characteristics of low-altitude medium-energy protons based on FY-3E satellite** [13799-104]
- 13799 1X **SARRSD: large-scale microwave radar remote sensing mapping-type and recognition-type object detection dataset** [13799-105]
- 13799 1Z **Cloud-edge collaborative processing method for remote sensing image target detection application** [13799-109]

Part Two

- 13799 20 **Research on packaging technology of infrared detectors integrated with cryogenic optical systems** [13799-110]
- 13799 21 **Research progress on integrated cryogenic optical system and cooled infrared detector assembly** [13799-111]
- 13799 22 **Semisupervised target detection network based on transformer and contrast learning** [13799-112]
- 13799 23 **Design of a fold-back common aperture optical system for laser infrared composite detection system** [13799-113]
- 13799 24 **Antishock and vibration servo control based on ADRC** [13799-116]
- 13799 25 **An infrared wide-area imaging simulation method** [13799-118]
- 13799 26 **Infrared imaging recognition performance analysis using a signal-level sea surface bright band model** [13799-119]
- 13799 27 **A review on the recently developed promising BaGa₄Se₇ crystals** [13799-120]
- 13799 28 **Distributed direct position determination based on local cost function** [13799-121]
- 13799 29 **Progressive and scalable space-based intelligent information system architecture based on edge cloud** [13799-123]
- 13799 2A **Review of visual SLAM technology in complex illumination environments** [13799-124]
- 13799 2B **Research on access and handover technologies for 5G low earth orbit satellite communication systems** [13799-128]
- 13799 2C **Large-scale infrared 3D reconstruction based on SfM optimization and 3D Gaussian splatting** [13799-130]
- 13799 2D **A nanosecond optical parameter oscillator at 2.6μm with near diffraction limit beam** [13799-131]
- 13799 2E **Research on infrared image gas leakage detection method based on spatiotemporal multifeature fusion** [13799-133]
- 13799 2F **Muscle injury detection based on ultrasound/photoacoustic dual-mode shear wave elastography** [13799-134]

- 13799 2G **Current research advances in high-overload-resistant multimode strapdown optoelectronic systems** [13799-135]
- 13799 2H **Wavelength-selective absorption metasurface for infrared stealth** [13799-136]
- 13799 2I **Design and implementation of a cross-domain content caching and distribution architecture for mega-constellation satellite internet** [13799-139]
- 13799 2J **A high-precision onboard radiometric calibration method based on cooperative light sources** [13799-143]
- 13799 2K **Multiagent reinforcement learning-based dynamic controller placement algorithm for satellite network** [13799-146]
- 13799 2L **Research on signal-level evaluation methods for the operating range of infrared imaging systems** [13799-148]
- 13799 2M **Experimental comparison and analysis of the performance of different image matching methods for different low-texture images** [13799-149]
- 13799 2N **Design of a digital readout integrated circuit for small-pitch short-wave infrared focal plane arrays** [13799-150]
- 13799 2O **Laser-induced damage threshold of GaN nanostructures under high-power laser irradiation** [13799-151]
- 13799 2P **Research on satellite multi-connectivity-based transmission enhancement** [13799-152]
- 13799 2Q **Research on mid-wave infrared band-stop filter based on metal metasurface** [13799-153]
- 13799 2R **Infrared weak-texture gas image segmentation via physics-informed learning** [13799-154]
- 13799 2S **Dynamic network resource scheduling method for LEO communication constellation based on degree of node confidence** [13799-155]
- 13799 2T **Intelligent planning framework for space-ground collaborative observation tasks based on reinforcement learning** [13799-156]
- 13799 2U **Influence mechanism of stitching mirror error on imaging quality of large aperture infrared diffractive telescope based on Fourier optics** [13799-157]
- 13799 2V **Real-time high-resolution terahertz imaging for concealed object detection** [13799-160]
- 13799 2W **Prospects for the application of multimodal foundation models in remote sensing agents** [13799-161]
- 13799 2X **Study on collaborative inversion of surface soil moisture in farmland based on multisource remote sensing data** [13799-162]

- 13799 2Y **Target-oriented adaptive brightness algorithm for EBAPS imaging systems** [13799-163]
- 13799 2Z **Classification of ginseng year based on visible-near infrared hyperspectral images combined with image segmentation** [13799-164]
- 13799 30 **Research on inductively coupled plasma etching characteristics of large-area TiO₂ gratings based on nanoimprinting** [13799-166]
- 13799 31 **Key technologies and development trends of ultra-high-speed atmospheric laser communication** [13799-168]
- 13799 32 **Research on post-disaster building damage detection method based on multitemporal remote sensing images** [13799-169]
- 13799 33 **Safe backup strategy for on-orbit satellites in large-scale LEO constellation** [13799-170]
- 13799 34 **Energy-efficient routing algorithm based on intersatellite traffic-awareness in hybrid RF/FSO satellite communication networks** [13799-172]
- 13799 35 **Dynamic beam hopping based on cooperative MAPPO for LEO satellite communication systems** [13799-174]
- 13799 36 **A review of information service agents based on remote sensing multimodal foundation models** [13799-175]
- 13799 37 **Design and implementation of delay tolerant network architecture for the mega-constellation satellite network** [13799-182]
- 13799 38 **Design of an intelligent interference prediction model for high-speed frequency hopping satellite communication systems** [13799-183]
- 13799 39 **High dynamic range and accurate 3D imaging based on adaptive laser line extraction** [13799-184]
- 13799 3A **Progress on type-II superlattice-based long-wavelength infrared photodetectors** [13799-186]
- 13799 3B **Spatial-information recurrent field transform network for sequence infrared small target detection** [13799-192]
- 13799 3C **Extraction and position fusion of abdominal aortic lipid plaques in rabbits based on photoacoustic-ultrasound dual-modality** [13799-195]
- 13799 3D **Grüneisen parameter-based photoacoustic system for quantitative blood flow velocity measurement** [13799-196]
- 13799 3E **Data-driven luminous flux compensation method for ring-array photoacoustic imaging system** [13799-200]
- 13799 3F **Three-dimensional super-resolution photoacoustic microscopy method and system based on point spread function** [13799-202]

- 13799 3G **Compression artifact removal in photoacoustic tomography based on transformer with enhanced self-attention** [13799-206]
- 13799 3H **A dual-modality endoscopic imaging and localized thermal therapy system integrating photoacoustic amplitude-based thermometry** [13799-207]
- 13799 3I **Research on precise positioning method of low-altitude targets based on DOA estimation** [13799-211]
- 13799 3J **Design and implementation of FPGA bias-temperature compensation circuit used in APD** [13799-214]
- 13799 3K **Wavefront coding-based athermalized infrared pixel super-resolution imaging technology** [13799-215]
- 13799 3L **Photoacoustic–ultrasound multimodal method for monitoring tissue thermal damage during photothermal therapy** [13799-216]
- 13799 3M **Digital twin-based assembly technology for cryogenic infrared optical systems** [13799-220]
- 13799 3N **ANOVA-driven recursive quad-tree segmentation for precision thermal defect localization in photoelectric focal plane arrays** [13799-221]
- 13799 3O **Strain analysis of fiber in layer-stranded OPGW cable based on high spatial resolution BOTDA** [13799-222]
- 13799 3P **Temperature and strain measurement using artificial neural networks** [13799-223]
- 13799 3Q **Development status of spaceborne infrared sensors** [13799-224]