PROCEEDINGS OF SPIE

International Conference on Algorithms, Image Processing, and Deep Learning (AIPDL 2026)

Xiangjie Kong
Editor

22–24 May 2026
Kuala Lumpur, Malaysia

Organized by
University of Macau (Macau, China)
Universiti Teknologi Malaysia (Malaysia)

Supported by
Zhejiang University of Technology (China)
University of Malaya (Malaysia)
University of Illinois Springfield (United States)

Published by
SPIE

Volume 14504

Part One of Two Parts

Proceedings of SPIE 0277-786X, V. 14504

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 *International Conference on Algorithms, Image Processing, and Deep Learning (AIPDL 2026)*, edited by Xiangjie Kong, Proc. of SPIE 14504, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

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

ISBN: 9798907921238
ISBN: 9798907921245 (electronic)

Published by
SPIE
P.O. Box 10, Bellingham, Washington 98227-0010 USA
Telephone +1 360 676 3290 (Pacific Time)
SPIE.org
Copyright © 2026 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

xiii *Conference Committee*

Part One

ALGORITHM

14504 02 **Construction of college career education model relying on reversible logic synthesis algorithm** [14504-1]

14504 03 **Algorithmic design of blockchain-based identity authentication transactions in multiagent autonomous interaction scenarios** [14504-4]

14504 04 **A novel high-efficiency search algorithm for low-carbon building material formulations and process parameters based on Bayesian optimization** [14504-7]

14504 05 **A multisource decision intelligent algorithm framework and system based on particle swarm optimization and dual-channel XGBoost** [14504-14]

14504 06 **Quality evaluation of college education considering multiobjective particle swarm optimization algorithm** [14504-23]

14504 07 **Application of computer algorithms in fault prediction of urban rail transit vehicles** [14504-28]

14504 08 **Big data algorithms in predicting the performance of fine chemical additives** [14504-36]

14504 09 **Development of an intelligent diagnostic system for special equipment operation images in unmanned scenarios** [14504-45]

14504 0A **The identification and risk warning methods of polysilicon material flow based on big data and intelligent algorithms under the dual carbon goals** [14504-51]

14504 0B **An intelligent talent analytics system with a unified computational framework integrating K-Means and Random Forest** [14504-65]

14504 0C **A unified algorithmic framework for vehicle routing optimization based on QUBO and spatio-temporal coupling decomposition** [14504-68]

14504 0D **Optimization of non-invasive detection timing and anomaly determination based on multi-factor regression and clustering algorithms** [14504-90]

14504 0E **Noise localization algorithm for cross-border English corpora based on sequence labeling and anomaly scoring** [14504-95]

14504 0F **Intelligent algorithm and model for flour quality evaluation** [14504-102]

14504 0G **Hierarchical inversion algorithm for spectral signals based on differential feature initial value construction and adaptive LM optimization** [14504-104]

14504 0H **Prediction and analysis of application software operation based on improved LightGBM** [14504-109]

14504 0I **A method for identifying vegetable pests and diseases in smart farms using the YOLOv8 and Ultralytics frameworks** [14504-110]

14504 0J **DCTB-SA: a CBAM-enhanced multimodule fusion algorithm for text sentiment analysis** [14504-118]

14504 0K **Multiobjective optimization of hybrid Earth-Moon transportation on Pareto-ITOPSIS-IDFA algorithm** [14504-119]

14504 0L **Mamba-driven channel estimation for high-mobility massive MIMO systems** [14504-121]

14504 0M **Optimal grouping and decision timing for censored data using the Turnbull algorithm and nonlinear programming** [14504-124]

14504 0N **CMA-YOLO: a context-aware multiscale attention model for steel surface defect detection** [14504-130]

14504 0O **MO-IACO and hybrid WOA-PSO-based phased scaling and cost optimization for cloud data centers** [14504-131]

14504 0P **A dynamic model of solar shadow length based on astronomical principles and the Spencer algorithm** [14504-138]

14504 0Q **Parameter optimization of self-cleaning fan spray rings using response surface methodology and multiobjective optimization algorithm** [14504-139]

14504 0R **Analysis of key contributing factors to forest fires using XGBoost and the SHAP framework** [14504-145]

14504 0S **A study on lightweight YOLOv10 based on mixed-precision post-training dynamic quantization for edge deployment** [14504-148]

14504 0T **Dy-YOLO: an improved YOLOv8n model for small object detection in VisDrone aerial images** [14504-156]

14504 0U **Multialgorithm fusion trajectory positioning and enhancement methods for multi-target tracking in offshore airspace** [14504-157]

14504 0V **Algorithmic contribution and value decomposability in multinode computing systems: a sensitivity-based approach** [14504-5]

14504 0W **Research on infrared small target detection algorithm based on SC-YOLOv8** [14504-12]

14504 0X **A privacy risk assessment framework for algorithmic recommendation based on logistic regression and gradient boosting** [14504-21]

14504 0Y **Hierarchical greedy algorithm for emergency material dispatch under extreme weather** [14504-22]

14504 0Z **Shortest path adjustment for urban rail transit operations based on the dynamic Dijkstra algorithm** [14504-54]

14504 10 **Artificial intelligence algorithms in identifying formulation patterns for traditional Chinese herbal feed additives** [14504-56]

14504 11 **Big data-driven complex temporal behavior prediction and intelligent recommendation algorithms** [14504-57]

14504 12 **Application research of multiple regression and time series modeling in short-term congestion prediction of urban traffic big data** [14504-58]

14504 13 **Numerical simulation of diverse well patterns for CO_2 geological sequestration and enhanced coalbed methane recovery in coal seams** [14504-59]

14504 14 **Multi-modal semantic fusion algorithm for cultural scene understanding** [14504-60]

14504 15 **Optimization of big data task scheduling algorithms in high-throughput scenarios** [14504-62]

14504 16 **Innovation paths and methods of university courses based on digital empowerment and K-means algorithm** [14504-64]

14504 17 **BERT semantic representation and model optimization for intelligent classification of social work texts** [14504-69]

14504 18 **Military training simulation and intelligent algorithm optimization training plan** [14504-71]

14504 19 **Real-time optimization of multimodal spatiotemporal fusion algorithm for maritime safety early warning** [14504-72]

14504 1A **Multi-source heterogeneous evaluation based on sequential Monte Carlo inference and consistency-aware dynamic aggregation algorithm** [14504-73]

14504 1B **A method for latent variables in multi-round scoring systems based on temporal Bayesian inversion** [14504-75]

14504 1C **YOLO11-Seg-SCRS for underwater crack instance segmentation with degradation-aware preprocessing** [14504-77]

14504 1D **Optimization of crop planting strategies under uncertain environments based on genetic algorithm and NSGA-II** [14504-81]

14504 1E **Underwater crack detection with YOLO11s-VFN: a lightweight neck redesign for improved localization** [14504-82]

14504 1F **Research on the matching of motors and transmission devices based on the AHP-logarithmic weighting evaluation mode** [14504-84]

14504 1G **Helmet small target detection in dense crowds based on YOLOv8m+MSGF-T improved model** [14504-86]

14504 1H **A study on an accurate ASMI prediction algorithm for the Chinese population based on multidimensional feature dimension reduction strategies and elastic net regression** [14504-93]

14504 1I **An intelligent algorithmic framework for partially observable systems: dynamic state-space Bayesian inversion and hierarchical match quality modeling** [14504-97]

14504 1J **An intelligent algorithm framework for multi-source scoring elimination based on inverse optimization and risk-controlled decision** [14504-98]

14504 1K **Continuous-time dynamic modeling of smartphone battery SOC based on WLS-LM algorithm** [14504-103]

14504 1L **Detection and decomposition decision optimization based on simulated annealing algorithm** [14504-117]

14504 1M **Multi-sensor UAV stereoscopic obstacle avoidance path planning based on an improved HHO-RF algorithm** [14504-136]

DEEP LEARNING

14504 1N **AI empowerment and immersive interaction: reconstruction and practice of virtual simulation training teaching model for construction engineering** [14504-9]

14504 1O **Integrated solution framework of improved Hungarian-simulated annealing for NP-hard combinatorial optimization** [14504-13]

14504 1P **Comprehensive performance evaluation of object detection models for PCB defect detection based on subjective-objective fusion weighting** [14504-20]

14504 1Q **Intelligent monitoring and early warning system for vegetation encroachment on power transmission lines based on UAV images and deep learning** [14504-24]

14504 1R **Application of intelligent speech recognition system in computer-assisted Japanese language learning platform** [14504-26]

14504 1S **Deep learning-based anomaly detection of river flow in GPS spatio-temporal data** [14504-27]

14504 1T **Application of random forest and neural network fusion in rice growth prediction and intelligent precision agriculture decision-making** [14504-39]

14504 1U **Library book recommendation methods based on explainable artificial intelligence** [14504-40]

14504 1V **Lightweight defect detection algorithms for industrial quality inspection with few samples and their implementation on OpenCV DNN** [14504-41]

14504 1W **Research and applications of key technologies for fault diagnosis and handling in complex systems based on multimodal fusion** [14504-42]

14504 1X **Optimization algorithm for training acceleration and convergence of deep learning model for large-scale data** [14504-43]

14504 1Y **A psychological health support system for vocational college students that integrates artificial intelligence and multimodal emotional analysis** [14504-49]

14504 1Z **An improved Hidden Markov Model for music learning sequence analytics in MOOC environments** [14504-52]

14504 20 **Multiagent reinforcement learning for personalized product recommendation with large language model enhancement** [14504-76]

14504 21 **Sparsity-adaptive hybrid prediction framework (SAHPF): a stratified routing approach for heterogeneous time-series forecasting in competitive environments** [14504-80]

14504 22 **Multimodel fusion and decision optimization framework for high-dimensional detection data** [14504-88]

14504 23 **Bayesian inverse reconstruction of latent variables under truncated ordinal constraints: a general framework and case study on hybrid voting systems** [14504-89]

14504 24 **DUFT-BO: dyna-utility freeze-thaw Bayesian optimization with learned cost sensitivity** [14504-91]

14504 25 **The reinforcement learning task scheduling algorithm for the scenario of public event hierarchical handling** [14504-94]

14504 26 **A comparative study of RL-finetuned and base models in data science tasks** [14504-100]

Part Two

14504 27 **Research on quantification and classification optimization of news text emotional features based on fusion of TextCNN and large language model** [14504-101]

14504 28 **The dynamic evaluation of smoke screen interference and optimization of deployment strategies in air-to-ground combat scenarios** [14504-105]

14504 29 **Constrained multiobjective optimization for NIPT sampling timing stratified by maternal BMI** [14504-106]

14504 2A **Reconstruction of latent fan vote distributions in dance competitions via Bayesian MCMC inference** [14504-107]

14504 2B **The reconstruction of latent preferences in game shows using dynamic Bayesian networks based on the Matthew effect and sequential Monte Carlo sampling** [14504-113]

14504 2C **Uncertainty-aware latent preference estimation and dynamic weight allocation in hybrid expert–crowd scoring systems** [14504-116]

14504 2D **Dynamic modeling of fetal Y-chromosome concentration in NIPT based on a mechanism-guided mixed-effects model** [14504-125]

14504 2E **State recognition of high-dimension data based on stack-integrated learning** [14504-128]

14504 2F **Automatic code smell detection and refactoring suggestion generation based on large language models** [14504-132]

14504 2G **Multivariate time-series forecasting for input–output systems: explainable feature construction and two-stage residual ensemble learning** [14504-140]

14504 2H **Cross-language information retrieval for deep learning technical documentation: a transformer-based bilingual alignment method** [14504-141]

14504 2I **Fed-RPBayesVol: a reproducible privacy-preserving federated random-projection and Bayesian-ensemble framework for synthetic high-dimensional volatility forecasting** [14504-142]

14504 2J **Resolution selection for melanoma classification under low-capacity models** [14504-143]

14504 2K **MSAE-Net: a robust hybrid residual framework for small-sample high-dimensional time series forecasting** [14504-146]

14504 2L **Bidirectional relation-enhanced RED-GNN for inductive knowledge graph reasoning** [14504-147]

14504 2M **Blockchain-based data storage and dynamic consensus optimization for drone swarms** [14504-149]

14504 2N **Rule-based lightweight collaboration with fixed decision styles for multiagent systems** [14504-153]

14504 2O **Design and verification of a structured pruning scheme for diffusion models targeting FPGA deployment** [14504-155]

14504 2P **A game-constrained deep RL framework for multiagent cooperation: embedding Nash equilibrium into TD3** [14504-6]

14504 2Q **Research on numerical methods for periodic solutions of delay differential equations based on monotone iteration technique** [14504-8]

14504 2R **Computational complexity analysis of artificial intelligence-driven green supply chain collaborative optimization model** [14504-10]

14504 2S **An intelligent computational framework for infrared interference thickness inversion based on differential evolution and multi-domain feature fusion** [14504-17]

14504 2T **Controlled closed-loop handling for CI build failures: StopLedger based on schema constraints and security gating** [14504-19]

14504 2U **The optimization of workload management for vocational college students using big data and LSTM deep learning models** [14504-25]

14504 2V **Construction method of an architectural artificial intelligence question-answering system oriented to engineering standards** [14504-31]

14504 2W **Optimization of deep learning algorithms in automotive fault diagnosis systems** [14504-33]

14504 2X **A study on the application of temporal convolutional networks in interactive simulation-based temporal risk analysis** [14504-35]

14504 2Y **Research on personalized service optimization of large language models in intelligent elderly care environments** [14504-44]

14504 2Z **Machine learning for predicting secondary school students' math exam outcomes** [14504-48]

14504 30 **GPU-accelerated distributed computing architecture for intelligent decision systems** [14504-50]

14504 31 **PheLM-PAC: a BERT-based phenomenological adequacy classifier for evaluating embodied language understanding in large language models** [14504-53]

14504 32 **Object detection algorithm in complex environments based on multimodal sensor fusion and deep learning** [14504-55]

14504 33 **Intelligent decision-making and optimization algorithms based on deep reinforcement learning** [14504-61]

14504 34 **Chinese traditional painting style transfer via LoRA-adapted stable diffusion with adaptive denoising strength scheduling** [14504-63]

14504 35 **Algorithmic applications of multi-agent reinforcement learning in logistics collaborative distribution** [14504-66]

14504 36 **Ship trajectory prediction based on attention mechanism and bidirectional selective state space model** [14504-67]

14504 37 **Dynamic evaluation model of teaching quality in private colleges and universities based on multi-source data-driven and deep learning** [14504-70]

14504 38 **Graph neural network-based urban traffic flow prediction and signal optimization for smart city governance** [14504-78]

14504 39 **Emotion-aware adaptive dialogue system for enhanced human-AI interaction using multimodal transformer networks** [14504-83]

14504 3A **Multimodal sentiment-aware interface adaptation for intelligent human-computer interaction systems** [14504-85]

14504 3B **Flood risk feature evaluation integrating spatial repair techniques and ensemble learning** [14504-87]

14504 3C **Application of a line-of-sight-based occlusion scheduling strategy for relay and cooperative shielding via particle swarm optimization** [14504-92]

14504 3D **TP-EG: a hybrid machine learning framework for Olympic medal prediction and competitive effect analysis** [14504-99]

14504 3E **Unified underwater image enhancement in complex degradation scenarios** [14504-112]

14504 3F **PCA-FNN: classification and prediction of new energy vehicle prices** [14504-115]

14504 3G **Multi-objective optimization of climate-adaptive passive shading using hybrid PSO and NSGA-II** [14504-120]

14504 3H **Optimization of green synthesis process for pharmaceutical intermediate under the enabling role of artificial intelligence** [14504-133]

14504 3I **Reinforcement learning-driven digital intervention for mitigating social anxiety: system design, algorithmic modeling, and empirical evaluation** [14504-134]

14504 3J **Personalized NIPT timing optimization based on survival analysis and BMI stratification** [14504-135]

14504 3K **A study on data processing optimization in smart manufacturing based on Spark SQL** [14504-150]

14504 3L **An improved unsupervised deep feature extraction algorithm based on contrastive learning** [14504-151]

IMAGE PROCESSING

14504 3M **Intelligent medical image recognition algorithm for the diagnosis of acute trauma** [14504-2]

14504 3N **Knowledge graph design and multifunctional module implementation of intelligent medical equipment** [14504-3]

14504 3O **A constraint-driven latent variable inference framework with Dirichlet prior and rejection sampling for dynamic weight fusion systems** [14504-15]

14504 3P **An entropy-weighted and Monte Carlo sampling-based multiobjective optimization framework for intelligent decision-making in multifactor coupled systems** [14504-16]

14504 3Q **Digital image segmentation and 3D reconstruction algorithm for crumb rubber modified asphalt mixture based on improved transformer** [14504-37]

14504 3R **Application of automated 3D modeling technology in the restoration of Chinese traditional cultural heritage** [14504-38]

14504 3S **Morphological characteristics identification and quality control system of cut tobacco based on computer vision and big data** [14504-46]

14504 3T **A multimodal 3D object detection framework based on hybrid radar point generation and dual synchronization fusion** [14504-96]

14504 3U **Multidimensional underwater image classification and scene-adaptive degradation modeling based on convergence tendencies** [14504-108]

14504 3V **Image recognition of Amur tiger based on ResNet50 and transfer learning** [14504-111]

14504 3W **Pro-SSOD: a robust and label-efficient progressive framework for industrial waste recognition** [14504-122]

14504 3X **A two-stage anti-fraud framework for advertising click fraud detection via PLM-XGBoost cross-paradigm fusion** [14504-123]

14504 3Y **BLIP image-text retrieval model based on fine-grained alignment and dynamic calibration** [14504-126]

14504 3Z **Optimal timing of non-invasive testing based on cubic regression model and BMI grouping** [14504-127]

14504 40 **Selective prediction in medical image classification with provable selective risk control** [14504-129]

14504 41 **Optimizing 3D semantic segmentation models for point clouds** [14504-144]

14504 42 **Unsupervised AI-generated image detection method based on CLIP feature clustering and pseudo-label learning** [14504-154]

14504 43 **Computer vision-assisted reconstruction of as-built BIM models from site imagery** [14504-11]

14504 44 **An intelligent computational framework for 3D turbulence prediction and path optimization based on genetic algorithm and ARMA model** [14504-18]

14504 45 **A transformer-based deep super-resolution method for histopathological images** [14504-29]

14504 46 **3D parametric modeling and volume iterative optimization algorithm for slag yard under complex terrain constraints** [14504-30]

14504 47 **Graph convolutional network with multiscale fusion for ore body spatial distribution prediction using geospatial big data** [14504-32]

14504 48 **A study on the intelligent generation and dissemination strategies of regional cultural short videos based on AIGC** [14504-34]

14504 49 **Data-driven sports skill assessment and movement optimization algorithms for smart wearable devices** [14504-47]

14504 4A **Design and implementation of a lightweight 2D visual gesture recognition algorithm integrating convex defects and circularity** [14504-74]

14504 4B **Image recognition-based long-distance non-contact automatic visual acuity detection algorithm** [14504-79]

14504 4C **SDR-Net: enhancing degraded image restoration via self-supervised degradation extraction and multi-scale contrastive learning** [14504-114]

14504 4D **Knowledge graph extraction and wind power operation and maintenance Q and A system based on large language models** [14504-137]

14504 4E **A study of vision transformer's reconstruction capacity for encrypted images: exploring performance limits and model refinement** [14504-152]