PROCEEDINGS OF SPIE

SPIDigitalLibrary.org/conference-proceedings-of-spie

Front Matter: Volume 11746

, "Front Matter: Volume 11746," Proc. SPIE 11746, Artificial Intelligence and Machine Learning for Multi-Domain Operations Applications III, 1174601 (5 May 2021); doi: 10.1117/12.2598645

Event: SPIE Defense + Commercial Sensing, 2021, Online Only

PROCEEDINGS OF SPIE

Artificial Intelligence and Machine Learning for Multi-Domain Operations Applications III

Tien Pham
Latasha Solomon
Editors

12–16 April 2021
Online Only, United States

Sponsored and Published by
SPIE

Volume 11746

Proceedings of SPIE 0277-786X, V. 11746

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

Artificial Intelligence and Machine Learning for Multi-Domain Operations Applications III, edited by
Tien Pham, Latasha Solomon, Proc. of SPIE Vol. 11746, 1174601 · © 2021 SPIE
CCC code: 0277-786X/21/\$21 · doi: 10.1117/12.2598645

Proc. of SPIE Vol. 11746 1174601-1

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 [SPIDigitalLibrary.org](https://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 *Artificial Intelligence and Machine Learning for Multi-Domain Operations Applications III*, edited by Tien Pham, Latasha Solomon, Proc. of SPIE 11746, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

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

ISBN: 9781510643291
ISBN: 9781510643307 (electronic)

Published by
SPIE
P.O. Box 10, Bellingham, Washington 98227-0010 USA
Telephone +1 360 676 3290 (Pacific Time)
[SPIE.org](https://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
[SPIDigitalLibrary.org](https://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

MULTI-DOMAIN OPERATIONS: CONCEPTS AND FUTURE TRENDS

- 11746 06 **Artificial intelligence and machine learning: a perspective on integrated systems opportunities and challenges for multi-domain operations** [11746-2]
- 11746 07 **Improving the performance of AI models in tactical environments using a hybrid cloud architecture (Invited Paper)** [11746-3]
- 11746 08 **Context-sensitive, distributed, multi-domain adaptive option generation** [11746-4]
- 11746 09 **Secure and trustworthy machine learning/artificial intelligence for multi-domain operations (Invited Paper)** [11746-99]

LEARNING AND REASONING WITH SMALL DATA SAMPLES, DIRTY DATA, HIGH CLUTTER, AND DECEPTION

- 11746 0B **Decision making with uncertainty using the LRM method: MATLAB versus Java** [11746-5]
- 11746 0E **Neural network-based band selection on hyperspectral imagery** [11746-8]
- 11746 0F **Creating a semantic hierarchy of SUN database object labels using WordNet** [11746-9]

AI-ENABLED SITUATION AWARENESS AND CONTEXT AWARE DECISION MAKING

- 11746 0H **Unsupervised learning for target tracking and background subtraction in satellite imagery** [11746-10]
- 11746 0I **A modular system for behaviour analytics from airborne full-motion video** [11746-11]
- 11746 0J **Empirical game-theoretic methods to minimize regret against specific opponents** [11746-12]
- 11746 0K **Unsupervised multi-view object proposal ranking** [11746-13]
- 11746 0L **Optimizing the efficiency of collective decision making in groups** [11746-14]

NOVEL AI/ML FRAMEWORK AND ARCHITECTURES

- 11746 0O **The journey to collaborative AI at the tactical edge (CATE) [11746-17]**
- 11746 0Q **What's data got to do with it? [11746-19]**

ADVERSARIAL MACHINE LEARNING AND SECURITY

- 11746 0T **Emergent reinforcement learning behaviors through novel testing conditions [11746-22]**
- 11746 0V **Machine learning raw network traffic detection [11746-24]**
- 11746 0W **Deep learning approach for attack detection in controller area networks [11746-25]**
- 11746 0X **Investigation of a differential cryptanalysis inspired approach for Trojan AI detection [11746-26]**
- 11746 0Y **Towards Botnet hazard analysis with generative adversarial networks for threat detection [11746-27]**
- 11746 0Z **TextCycleGAN: cyclical-generative adversarial networks for image captioning [11746-28]**
- 11746 10 **Using options to improve robustness of imitation learning against adversarial attacks [11746-29]**
- 11746 11 **On the benefits of robust models in modulation recognition [11746-30]**
- 11746 12 **Cooperative monitoring for detecting adversarial communication [11746-31]**

HUMAN AGENT TEAMING

- 11746 13 **Robust uncertainty representation in human-AI collaboration [11746-32]**
- 11746 14 **Human data collection for machine learning and artificial intelligence aid development for multi-domain operations [11746-33]**
- 11746 15 **Battlespace: using AI to understand friendly vs. hostile decision dynamics in MDO [11746-34]**
- 11746 16 **Analyzing a human-in-the-loop's decisions for the detection of data poisoning [11746-35]**

NOVEL AI/ML MODELS, ALGORITHMS AND APPLICATIONS

- 11746 17 **Deep learning restoration of signals with additive and convolution noise** [11746-36]
- 11746 18 **Multi-agent reinforcement learning for convex optimization** [11746-37]
- 11746 19 **Statistical sparsity-based learning for ultra-wideband radar signal reconstruction** [11746-38]

AUTONOMOUS MANEUVER IN COMPLEX ENVIRONMENT

- 11746 1B **A Bayesian spatio-temporal aircraft route predictive algorithm with applications to military operations** [11746-40]
- 11746 1C **Machine learning for longwave infrared image enhancement to improve maneuverability hazard detection** [11746-41]
- 11746 1D **Risk-aware autonomous navigation** [11746-42]
- 11746 1F **Effects of perturbed depth sensors in autonomous ground vehicles** [11746-44]
- 11746 1H **Low latency adversarial threat avoidance, navigation in 3D point cloud environment via multi-agent reinforcement learning in a correspondence 2D floorplan** [11746-46]
- 11746 1I **Evaluation of multimodal semantic segmentation using RGB-D data** [11746-47]

EXPLAINABLE AND AI-ENABLED ANALYTICS

- 11746 1J **Decisions, graphs, and artificial reasoning for uncertainty of information** [11746-48]
- 11746 1L **Generating explanations for answer set programming applications** [11746-50]
- 11746 1M **Augmenting saliency maps with uncertainty** [11746-51]

FEDERATED/DISTRIBUTED AI/ML

- 11746 1O **Embedding dynamic knowledge graphs based on observational ontologies in semantic vector spaces** [11746-52]
- 11746 1Q **Energy efficient 'in memory' computing to enable decentralised service workflow composition in support of multi-domain operations** [11746-54]

COALITION AND JOINT OPERATIONS

- 11746 1T Learning-aided SDC control in mobile ad hoc networks [11746-57]
- 11746 1W Reinforcement and transfer learning for distributed analytics in fragmented software defined coalitions [11746-60]
- 11746 1X Coalition situational understanding via explainable neuro-symbolic reasoning and learning [11746-61]
- 11746 1Y From social networks to negative ties: refining analysis for conflict and adversarial interaction [11746-62]
- 11746 20 3D simulation and scenario for AI research in multi-domain and coalition operations [11746-64]

MODELING AND SIMULATION

- 11746 22 Autonomous network cyber offence strategy through deep reinforcement learning [11746-66]
- 11746 23 Computational modeling approaches to characterize risk and achieve safe, effective, and trusted designs in the development of artificial intelligence and autonomous closed-loop medical systems [11746-67]
- 11746 24 Generating genetic engineering linked indicator datasets for machine learning classifier training in biosecurity [11746-68]
- 11746 25 Experimentation for optimization of heterogeneous drone swarm configurations: terrain and distribution [11746-69]
- 11746 26 Scalability in modeling and simulation systems for multi-agent, AI, and machine learning applications [11746-70]

ARTIFICIAL INTELLIGENCE/MACHINE LEARNING AND UNMANNED SYSTEMS: JOINT SESSION WITH 11746 AND 11758

- 11746 28 Using AI-ML to develop energy and exergy flow characterizations for multi-domain operations [11746-72]
- 11746 29 Differential morphological profile neural network for maneuverability hazard detection in unmanned aerial system imagery [11746-73]
- 11746 2A Validation of object detection in UAV-based images using synthetic data [11746-74]
- 11746 2B Performance evaluation of multimodal deep learning: object identification using UAV dataset [11746-75]

POSTER SESSION

- 11746 2C **Robust machine learning algorithms for image segmentation in biphasic ceramics** [11746-76]
- 11746 2E **Incremental learning-based jammer classification** [11746-78]
- 11746 2H **Towards an explainable AI adjunct to deep network obstacle detection for multisensor vehicle maneuverability assessment** [11746-81]
- 11746 2J **Explainable AI for medical imaging: explaining pneumothorax diagnoses with Bayesian teaching** [11746-83]
- 11746 2K **Survey of recent multi-agent reinforcement learning algorithms utilizing centralized training** [11746-84]
- 11746 2L **Remote sensing: leveraging cloud IoT and AI/ML services** [11746-85]
- 11746 2N **Machine learning for source classification utilizing infrasound data** [11746-87]
- 11746 2O **A two-level strategy based on evolutionary algorithm to solve the inter-domain path computation under node-defined domain uniqueness constraint** [11746-88]
- 11746 2Q **Recent advances in adversarial machine learning: status, challenges and perspectives** [11746-90]
- 11746 2R **Identifying novel vessel classes with OOD methods** [11746-91]
- 11746 2S **Deep learning at the edge: automatic modulation classification on real world signals** [11746-92]
- 11746 2T **SAGE supporting operations research inspired algorithms** [11746-93]
- 11746 2U **Soldier-led Adaptation of Autonomous Agents (SLA3)** [11746-94]
- 11746 2V **Accumulating confidence for deep neural network object detections and semantic segmentations in sequential UAS imagery through spatiotemporal feature correspondences generated from SfM techniques** [11746-95]
- 11746 2W **Rigorous evaluation of vector-associated model performance (REVAMP)** [11746-96]
- 11746 2X **Semantic lifting of integrated messages (SLIM)** [11746-97]