

# **Intelligent Systems**

Papers Presented at the AIAA SciTech Forum and Exposition  
2023

National Harbor, Maryland, USA and Online  
23-27 January 2023

Volume 1 of 3

ISBN: 978-1-7138-7589-5

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

The contents of this work are copyrighted and additional reproduction in whole or in part are expressly prohibited without the prior written permission of the Publisher or copyright holder. The resale of the entire proceeding as received from CURRAN is permitted.

For reprint permission, please contact AIAA's Business Manager, Technical Papers. Contact by phone at 703-264-7500; fax at 703-264-7551 or by mail at 34922 Uwytkug'Xcmg{'Ftkxg.'Uwyg'422, Reston, VA 20191, USA.

# TABLE OF CONTENTS

## VOLUME 1

### **INTELLIGENT SYSTEMS IN GUIDANCE NAVIGATION AND CONTROL I**

Drone-Based Automated Exterior Inspection of an Aircraft Using Reinforcement Learning Technique .....	1
<i>Yufeng Sun, Ou Ma</i>	
Planning Visual Inspection Tours for a 3D Dubins Airplane Model in an Urban Environment .....	12
<i>Collin Hague, Andrew Willis, Dipankar Maity, Artur Wolek</i>	
Artificial Neural Network Cooperative Localization for Autonomous Systems .....	30
<i>Robert J. Geng, Travis W. Moleski, Jay Wilhelm</i>	
Multi-Sensor Fusion for Decentralized GPS-Denied Robotic Swarm Cooperative Navigation.....	41
<i>Vincent Hill, Jordan Larson</i>	
Body-Fixed Laser Range-Finder Based Multirotor Recovery .....	47
<i>Stanislav Shougaev, Moshe Idan</i>	

### **LEARNING, REASONING, AND DATA DRIVEN SYSTEMS I**

An Iterative Scheme to Learn System Dynamics of Space Objects from Partial State Information .....	63
<i>Sriram Narayanan, Indranil Nayak, Mrinal Kumar</i>	
Peeking into the Black-Box: Prediction Intervals Give Insight into Data-Driven Quadrotor Model Reliability .....	76
<i>Jasper J. Van Beers, Coen C. De Visser</i>	
Vision-Based Perception with Safety Awareness for UAS Autonomous Landing .....	97
<i>Zhenhao Zhao, Jonathan Lee, Zongyao Li, Chung H. Park, Peng Wei</i>	
Landing Trajectory Prediction for UAS Based on Generative Adversarial Network .....	110
<i>Jun Xiang, Junfei Xie, Jun Chen, Drake Essick, Luiz Gonzalez Bautista</i>	
Deep Reinforcement Learning Controller for Autonomous Tracking of Evasive Ground Target .....	120
<i>David Van Wijk, Kameron J. Eves, John Valasek</i>	

### **INTELLIGENT FAULT TOLERANT CONTROL I**

Data-Driven Health Management System for Multi-Spacecraft Formation Flying.....	132
<i>Tatiana Gutierrez, Nolan Coulter, Hever Moncayo, Yashwanth Kumar Nakka, Changrak Choi, Amir Rahmani, Akshita Gupta</i>	
Adaptive Control of a Flexible Wing for Flutter Suppression and Disturbance Rejection.....	159
<i>Patrick S. Downs, Richard J. Prazenica</i>	
A Modular Approach to Verification of Learning Components in Cyber-Physical Systems .....	182
<i>Lijing Zhai, Aris Kanellopoulos, Filippos Fotiadis, Kyriakos G. Vamvoudakis, Jérôme Hugues</i>	

Towards an Architecting Framework for the Design of Self-Healing Resilient Systems, Enabled by Reinforcement Learning-Based Reconfiguration .....	190
<i>Michael G. Balchanos, Matthew R. Rines, Olivia J. Pinon-Fischer, Dimitri N. Mavris</i>	

## **INTELLIGENT SYSTEMS IN GUIDANCE NAVIGATION AND CONTROL II**

Energy-Minimization Path Planning and Control of Unmanned Aerial Systems for Advanced Air Mobility .....	206
<i>Trevor Karpinski, Alexander Blakesley, Jakub Krol, Bani Anvari, George E. Gorospe, Liang Sun</i>	
On-Board Implementation Using Julia Precompiler for Rendezvous Path Planning .....	220
<i>Colin Taylor, Satyanarayana G. Manyam, David Casbeer</i>	
Fixed-Wing Glider Guidance for Plume Localization and Tracking Missions.....	227
<i>Derrick W. Yeo, Elena Shrestha, Jason M. Cho</i>	
Quantitative Conflict Detection in an Airspace of Heterogeneous Unmanned Aerial Vehicles Subject to Wind Uncertainties .....	240
<i>Rajnish Bhusal, Aakarshan Khanal, Kamesh Subbarao, Animesh Chakravarthy, Wendy Okolo</i>	

## **INTELLIGENT SYSTEMS IN GUIDANCE NAVIGATION AND CONTROL III**

Improving the Maneuver Automaton with Maneuver Interruption .....	257
<i>Kevin Choi, Zachary C. Goddard, Samuel J. Deal, Kyle Williams, Anirban Mazumdar</i>	
Precision Maritime Localization and Landing with Real-Time Kinematic GNSS .....	269
<i>Alexander D. Jordan, Matthew Rydalch, Tim McLain, Michael Williamson</i>	
Maximum Uncertainty Distribution in a Traffic of Small Unmanned Aerial Vehicles for Collision-Free Airspace Operation .....	280
<i>Rajnish Bhusal, Aakarshan Khanal, Kamesh Subbarao, Animesh Chakravarthy, Wendy Okolo</i>	
Model Uncertainty-Aware Adaptive Controller Design with Online Parameter Identification .....	295
<i>Akin Catak, Ahmet T. Cetin, Emre Koyuncu</i>	

## **LEARNING, REASONING, AND DATA DRIVEN SYSTEMS II**

Airport Runway Configuration Management with Offline Model-Free Reinforcement Learning .....	304
<i>Milad Memarzadeh, Tejas G. Puranik, Krishna M. Kalyanam, Wes Ryan</i>	
Value of Potential Field in Reward Specification for Robotic Control Via Deep Reinforcement Learning .....	318
<i>Mingkang Wu, Feng Tao, Yongcan Cao</i>	
Drone Navigation in Unreal Engine Using Generative Adversarial Imitation Learning .....	326
<i>Suraj Bandela, Yongcan Cao</i>	
Tethered Multicopter Guidance in GPS-Denied Environments Through Reinforcement Learning .....	336
<i>Amer Al-Radaideh, Robert A. Selje, Daniel Coraspe, Efe Camci, Rajdeep Dutta, Liang Sun, Senthilnath Jayavelu, Xiaoli Li</i>	

## **INTELLIGENT FAULT TOLERANT CONTROL II**

Experimental Results on Composing Cooperative Behaviors in Networked Mobile Robots in the Presence of Unknown Control Effectiveness .....	350
<i>Eren Sarioglu, Atahan Kurttisi, Kadriye Merve Dogan</i>	
An Efficient Algorithm to Determine Polynomial Trajectories and Adaptive Control of a Quadcopter .....	360
<i>Atahan Kurttisi, Sirani Perera, Kadriye Merve Dogan</i>	
Intelligent Rover Slip Detection and Characterization .....	375
<i>Morgan J. May, Philip A. Ferguson</i>	

## **GN&C ARCHITECTURES FOR AUTONOMOUS SYSTEMS I**

Data-Driven Retrospective Cost Adaptive Control of a Quadrotor UAV .....	386
<i>Brian Y. Lai, Syed Aseem Ul Islam, Scott Nivison, Dennis S. Bernstein</i>	
The Open-Blimp: An Open-Source Blimp Platform for Lighter-Than-Air Research.....	401
<i>Tony X. Lin, Tristan K. Schuler, Daniel M. Lofaro, Donald Sofge, Fumin Zhang</i>	
Run-Time Assurance Via Real-Time Generation of Backup Trajectories and Transverse Dynamics Regulation Laws .....	407
<i>Ibrahim A. Alomar, Fatema Alhani, Abdulaziz A. Alfaadehl, Eric M. Feron, Hesham Shageer, Mohamad T. Shahab</i>	

## **GN&C ARCHITECTURES FOR AUTONOMOUS SYSTEMS II**

A ROS Package for UAV Run Time Assurance with In-The-Loop Reachability .....	419
<i>Christian Llanes, Samuel Coogan</i>	
Safe Optimal Control with Synthesized Waypoints as Guidance .....	431
<i>Lin Song, Neng Wan, Naira Hovakimyan</i>	
Gust Load Alleviation Control and Gust Estimation for a High Aspect Ratio Wing Wind Tunnel Model .....	443
<i>Christopher J. Forte, Nhan T. Nguyen, Juntao Xiong</i>	

## **DISTRIBUTED SENSING FOR AUTONOMOUS AIR MOBILITY I**

Concepts for Distributed Sensing and Collaborative Airspace Autonomy in Advanced Urban Air Mobility .....	466
<i>Corey A. Ippolito, Kelley E. Hashemi, Evan Kawamura, George E. Gorospe, Wendy Holforty, Keerthana Kannan, Vahram Stepanyan, Thomas Lombaerts, Nelson Brown, Alexander M. Jaffe, Chester Dolph</i>	
A Simulation Architecture for Air Traffic Over Urban Environments Supporting Autonomy Research in Advanced Air Mobility .....	486
<i>Keerthana Kannan, Joshua E. Baculi, Thomas Lombaerts, Evan Kawamura, George E. Gorospe, Wendy Holforty, Corey A. Ippolito, Vahram Stepanyan, Chester Dolph, Nelson Brown</i>	

Distributed Ground Sensor Fusion Based Object Tracking for Autonomous Advanced Air Mobility Operations .....	504
<i>Thomas Lombaerts, Keerthana Kannan, Evan Kawamura, Chester Dolph, Vahram Stepanyan, George E. Gorospe, Corey A. Ippolito</i>	
Perception Testing in Fog for Autonomous Flight.....	532
<i>George E. Gorospe, Elihu Deneke</i>	
Classifying Aircraft Using Velocity Data with Support Vector Machines and Likelihood Ratio Tests .....	546
<i>Logan Dihel, Chester Dolph, Henry T. Holbrook, Sandip Roy</i>	

### **GN&C ARCHITECTURES FOR AUTONOMOUS SYSTEMS III**

Adaptive Finite Time Intercept Guidance.....	560
<i>Anthony J. Calise</i>	
L <sub>1</sub> Adaptive Control of Constrained Systems Using Barrier States.....	578
<i>Christoph E. Aoun, Pan Zhao, Hassan Almubarak, Naira Hovakimyan, Evangelos A. Theodorou</i>	
Assessment of Metrics that Measure the Effectiveness of Control Allocation and Their Use in Linear Closed-Loop Analysis .....	590
<i>Umut Zalluhoglu, Raghu Venkataraman, Marco Ceze, Hugh Carson, Miki Szmuk, Christopher McFarland, David Friedman</i>	
Multi-Intersection Planning with Durational Speed Scheduling for Drone Corridors.....	607
<i>Samiksha R. Nagrare, Ashwini Ratnoo, Debasish Ghose</i>	

### **ADAPTIVE AND INTELLIGENT CONTROL SYSTEMS I**

Verification of Adversarially Robust Reinforcement Learning Mechanisms in Aerospace Systems .....	621
<i>Taehwan Seo, Prachi P. Sahoo, Kyriakos G. Vamvoudakis</i>	
Non-Linear Intelligent Control Design for Unconventional Unmanned Aerial Vehicle.....	635
<i>Adnan F. Din, Imran Mir, Faiza Gul, Suleman Mir</i>	
Model-Free Maneuvering Control of Fixed-Wing UAVs Based on Deep Reinforcement Learning.....	649
<i>Wenya Wei, Zhou Fang, Yiwen Zhu</i>	
Genetic Fuzzy Methodology for Decentralized Multi-UAV Cooperation with Physical Constraints .....	662
<i>Anoop Sathyan, Ou Ma</i>	

### **LEARNING, REASONING, AND DATA DRIVEN SYSTEMS III**

Development of Intelligent Control Strategy for an Unconventional UAV: A Novel Approach .....	669
<i>Adnan F. Din, Imran Mir, Faiza Gul, Suhail Akhtar, Suleman Mir</i>	

## **VOLUME 2**

Drone Navigation Using Octrees and Object Recognition for Intelligent Inspections .....	692
<i>Alejandro Martinez Acosta</i>	

Object Detection for Ground-Based Non-Cooperative Surveillance in Urban Air Mobility Utilizing Lidar-Camera Fusion .....	706
<i>Cheng Huang, Ivan Petrunin, Antonios Tsourdos</i>	
Reinforcement Learning Based Self-Play and State Stacking Techniques for Noisy Air Combat Environment .....	717
<i>Ahmet S. Tasbas, Safa O. Sahin, Nazim Kemal Üre</i>	
Architecture for Edge Computing in Space.....	727
<i>Jon M. Neff, Eric Yuan, Amy O'Brien, Henry Helvajian</i>	

## **AUTONOMY I**

Data-Driven, Physics-Guided Learning of Dynamic System Models .....	735
<i>Zhenhua Jiang, Joseph Saurine</i>	
Obstacle Avoidance for UAV Formation Using Binary Tree Structure .....	748
<i>Gautam Kumar, Ashwini Ratnoo</i>	
On-Board Artificial Intelligence for Failure Detection and Safe Trajectory Generation.....	762
<i>Eduardo Morillo, Hever Moncayo</i>	
A TEG-Excited Switched Reluctance Generator for Self-Powered Sensing in Next Generation Aircraft .....	784
<i>Bahareh Zaghari, Aleksas Stuiikys, Alexander Weddell, Neil Grabham, Neil White, Terry Harvey, Ling Wang</i>	

## **AUTONOMY II**

A Methodology to Develop Survivability Maps for Autonomous Aerial Vehicles.....	794
<i>Fanruiqi Zeng, John-Paul Clarke, Husni R. Idris</i>	
Learning Stochastic Processes Using Gaussian Processes: An Application to Flight Delay Prediction .....	809
<i>Aakarshan Khanal, Rajnish Bhusal, Kamesh Subbarao, Animesh Chakravarthy, Wendy Okolo</i>	
Motion Primitive Path Planning Under Uncertainty for High-Speed Vehicles.....	822
<i>Geordan M. Gutow, Jonathan D. Rogers, Kyle Williams</i>	

## **GN&C ARCHITECTURES FOR AUTONOMOUS SYSTEMS IV**

Feedback Oscillatory Control of Roll Instability During Stall Using the LIBRA Mechanism.....	836
<i>Mahmoud A. Abdelgalil, Haithem E. Taha</i>	
Enabling Proliferated Space Sensor Awareness Constellations Through Topological Observability .....	848
<i>Chris W. Hays, Troy Henderson, Sean Phillips, Alexander A. Soderlund</i>	
Adaptive Algorithm for Multirotor Attitude Control in the Presence of Actuation Delay and Unknown Actuator Efficiency .....	871
<i>Atahan Kurttisi, Kadriye Merve Dogan, Ahmet T. Koru</i>	
Geomagnetic Aided Navigation Using Rao Blackwellized Particle Filter .....	883
<i>Andrei Cuenca, Hever Moncayo</i>	

Model-Based Systems Engineering (MBSE) in the Evaluation of Handling Qualities .....	894
<i>Caleigh Rowan, Kadriye Merve Dogan</i>	

### **MULTI-AGENT COORDINATION AND CONTROL I**

Distributed Limited Resource Allocation and Energy-Expenditure Learning for Advanced Air Mobility .....	908
<i>Arezoo Samiei, Robert A. Selje, Liang Sun</i>	

Virtual Target Approach for Emulating Advanced Guidance Laws on Conventional Interceptors .....	918
<i>Gleb Merkulov, Martin Weiss, Tal Shima</i>	

Multi-Agent Task Assignment and Sequencing Using Monte Carlo Tree Search and Process Algebra .....	933
<i>Steven J. Rasmussen, David Casbeer, Abhay Singh Bhadoriya, Swaroop Darbha, Satyanarayana G. Manyam</i>	

Leader Detection in Swarms Using a Relative Velocity Framework.....	946
<i>Animesh Chakravarthy, Debasish Ghose</i>	

### **AUTONOMY III**

Strategic Deconfliction of Small Unmanned Aircraft Using Operational Volume Blocks at Crossing Waypoints .....	957
<i>Priyank Pradeep, Alexey A. Munishkin, Krishna M. Kalyanam, Heinz Erzberger</i>	

Aquila Optimizer with Parallel Computation Application for Efficient Environment Exploration.....	970
<i>Faiza Gul, Imran Mir, Suleman Mir</i>	

Locomotion of Multiple Vehicles in Multi-Lane Sky Corridors: Some Experimental Results .....	987
<i>Samiksha R. Nagrare, Onkar Chopra, Ashwini Ratnoo, Debasish Ghose</i>	

A Game Theoretic Approach to Distributed Planning of Multi-Agent Systems Under Temporal Logic Specifications .....	999
<i>Levi Vande Kamp, Abbasali Koochakzadeh, Yasin Yazicioglu, Derya Aksaray</i>	

Reasoning Service Exemplars for NASA's Data and Reasoning Fabric .....	1010
<i>Stefan Schuet, Joshua E. Baculi, Vaishali Hosagrahara, Vahram Stepanyan, Katelyn Jarvis, Kalmanje S. Krishnakumar</i>	

### **INTELLIGENT FAULT TOLERANT CONTROL III**

Abnormal Condition Identification Using Antigen Presenting Cell Approach for a Partitioned Immune System .....	1022
<i>Ryan McLaughlin, Mario Perhinschi</i>	

Immunity-Based Sensor and Actuator Abnormal Condition Identification on a UAV Using a Partitioned Immune System .....	1030
<i>Ryan McLaughlin, Mario Perhinschi</i>	

Framework for Abnormal Condition Evaluation Using a Partitioned Immune System .....	1043
<i>Ryan McLaughlin, Mario Perhinschi</i>	



Immunity-Based Sensor and Actuator Abnormal Condition Evaluation on a UAV Using the Partition of the Universe Approach .....	1055
<i>Ryan McLaughlin, Mario Perhinschi</i>	

Integrated Immunity-Based Methodology for UAV Monitoring and Control .....	1066
<i>Ryan McLaughlin, Mario Perhinschi, Mohanad Alnuaimi</i>	

### **GN&C ARCHITECTURES FOR AUTONOMOUS SYSTEMS V**

Using Automotive Radar to Enable Detection and Tracking of Small UAVs.....	1082
<i>Adam A. Johnson, Aleena Kurumunda</i>	

Modeling, Trajectory Planning, and Control of the Bathy-drone: A Drone Towing a Boat Equipped with Sonar for Bathymetry Mapping.....	1098
<i>Andres Pulido, Antonio Diaz, Andrew Ortega, Peter Ifju, Jane Shin</i>	

Distributed Adaptive Control of Multiagent System with State and Control Dependent Coupled Dynamics in the Presence of Unknown Control Effectiveness Matrix.....	1112
<i>Islam A. Aly, Sebastian Comeaux, Kadriye Merve Dogan</i>	

Scalability Concept for Model Reference Adaptive Control of Gain Scheduled Dynamical Systems .....	1126
<i>Jesse Jaramillo, Kevin Wilcher, Tansel Yucelen, Mehrdad Pakmehr</i>	

Machine Learning Based Architecture for Generation of Synthetic Flight Test Data .....	1138
<i>Nathaniel Sisson, Hever Moncayo</i>	

### **INTELLIGENT FAULT TOLERANT CONTROL IV**

A Novel Air Traffic Management and Control Methodology Using Fault-Tolerant Autoencoder and P2P Blockchain Application on the UAS-S4 Ehécatl.....	1154
<i>Seyed Hashemi, Seyed Ali Hashemi, Ruxandra M. Botez, Georges Ghazi</i>	

Modeling the Longitudinal Dynamics of the Cessna Citation X Using Neural Network Methodology .....	1164
<i>Elias E. Zohreh Nejad, Georges Ghazi, Ruxandra M. Botez</i>	

Attack-Tolerant Trajectory Prediction Using Generative Adversarial Network Secured by Blockchain Application to the UAS-S4 Ehécatl.....	1176
<i>Seyed Hashemi, Seyed Ali Hashemi, Ruxandra M. Botez, Georges Ghazi</i>	

Model-Free Boundedly-Optimal Damage Recovery in Sublinear Time Iterations .....	1184
<i>Shanelle G. Clarke, Inseok Hwang</i>	

### **DISTRIBUTED SENSING FOR AUTONOMOUS AIR MOBILITY II**

Distributed Target Tracking with Optimal Data Migration.....	1195
<i>Vahram Stepanyan, Keerthana Kannan, Evan Kawamura, Thomas Lombaerts, Corey A. Ippolito</i>	

Simulated Vision-Based Approach and Landing System for Advanced Air Mobility .....	1211
<i>Evan Kawamura, Chester Dolph, Keerthana Kannan, Thomas Lombaerts, Corey A. Ippolito</i>	

VSLAM and Vision-Based Approach and Landing for Advanced Air Mobility .....	1234
<i>Evan Kawamura, Chester Dolph, Keerthana Kannan, Nelson Brown, Thomas Lombaerts, Corey A. Ippolito</i>	

Determination of Optimal Informant Trajectories by Applying Range-Based Guidance Law for Target Interception.....	1259
<i>Melody N. Mayle, Rajnikant Sharma</i>	

## **ADAPTIVE AND INTELLIGENT CONTROL SYSTEMS II**

Reinforcement Learning-Based Nonlinear Disturbance Observer for UAV with Parametric Uncertainty and Unmodeled Dynamics.....	1274
<i>Dongwoo Lee, Hyunjoo Ahn, Jaeho Lee, Hyochoong Bang</i>	

On Resilience-Based Optimization of Close-Proximity Multi-Satellite Coordination Via an Artificial Honeybee Colony Algorithm .....	1287
<i>Alec C. Nichols, Sean Phillips, Alexander A. Soderlund</i>	

Potential of Hybrid Neural Network Local Path Planner for Small UAV in Urban Environments .....	1305
<i>Andreas Thoma, Luc Stiemer, Carsten Braun, Alex Fisher, Alessandro G. Gardi</i>	

## **GN&C ARCHITECTURES FOR AUTONOMOUS SYSTEMS VI**

Investigating Noise Rejection with Gradient-Based Update Laws in Discrete-Time Adaptive Control.....	1318
<i>Peter Fisher, Anuradha Annaswamy</i>	

On Adaptive Control of Robotic Manipulators with Actuator Deficiencies .....	1332
<i>Islam A. Aly, Sebastian Comeaux, Kadriye Merve Dogan, Enver Tatlicioglu, Erkan Zergeroglu</i>	

Hierarchical Reinforcement Learning and Gain Scheduling-Based Control of a Hypersonic Vehicle.....	1344
<i>Wanjiku Makumi, Max L. Greene, Zachary Bell, Brendan Bialy, Rushikesh Kamalapurkar, Warren Dixon</i>	

Vision-Based Distributed Pose Estimation Using a Spacecraft Constellation.....	1355
<i>Saptarshi Bandyopadhyay, Vinod P. Gehlot, William Seto, Amir Rahmani, Spencer Kraisler, Shahriar Talebi, Aditya Deole, Niyousha Rahimi, Mehran Mesbahi, Jonathan Becktor</i>	

## **VOLUME 3**

Adaptive Stabilization of Multi-Rotor Systems with Actuator Limits and Transient Mass Distribution.....	1369
<i>John K. Zelina, Islam A. Aly, Kadriye Merve Dogan, Richard J. Prazenica</i>	

## **HUMAN-MACHINE TEAMING**

Foundational Human-Autonomy Teaming Research and Development in Scalable Remotely Operated Advanced Air Mobility Operations: Research Model and Initial Work .....	1382
<i>Eric T. Chancey, Michael S. Politowicz, Bill K. Buck, Kathryn Ballard, James Unverricht, Vincent E. Houston, Meghan Chandarana, Lisa Le Vie</i>	

MPATH (Measuring Performance for Autonomy Teaming with Humans) Ground Control Station: Design Approach and Initial Usability Results.....	1391
<i>Michael S. Politowicz, Eric T. Chancey, Bill K. Buck, James Unverricht, Bryan J. Petty</i>	
A Remote Vehicle Operations Center's Role in Collecting Human Factors Data .....	1405
<i>Bill K. Buck, Eric T. Chancey, Michael S. Politowicz, James Unverricht, Steven Geuther</i>	
Intelligent Change Detection System (ICDS): A Machine Learning Approach to Combat Change Blindness in Remote Operation Environments.....	1416
<i>Vincent E. Houston, Michael S. Politowicz, Noah E. Jennings</i>	
Where is the Human-In-The-Loop? Human Factors Analysis of Extended Visual Line of Sight Unmanned Aerial System Operations Within a Remote Operations Environment.....	1423
<i>James Unverricht, Eric T. Chancey, Michael S. Politowicz, Bill K. Buck, Steven Geuther, Kathryn Ballard</i>	

### **ADAPTIVE AND INTELLIGENT CONTROL SYSTEMS III**

Explainable Artificial Intelligence Techniques for the Analysis of Reinforcement Learning in Non- Linear Flight Regimes .....	1437
<i>Gabriel De Haro Pizarroso, Erik-Jan Van Kampen</i>	
Adaptive Fault-Tolerant Control of Octo-Rotor UAV Under Motor Faults in Adverse Wind Conditions .....	1458
<i>Ibrahim Ahmed, Marcos Quinones-Grueiro, Gautam Biswas</i>	
Sim-To-Real Transfer of a Deep Reinforcement Learning Approach for Active Stall Protection.....	1468
<i>Franziska Hein, Stefan Notter, Walter Fichter</i>	
Machine Actuating Commands for Autonomy of an Unmanned Combat Air Vehicle .....	1480
<i>Chimpalthradi R. Ashokkumar</i>	

### **INTELLIGENT SYSTEMS STUDENT PAPER COMPETITION I**

Situational Anomaly Detection Using Multi-Agent Trajectory Prediction for Terminal Airspace Operations .....	1497
<i>Hyunsang Park, Inseok Hwang</i>	
Online Probabilistic Collision Detection for Urban Air Mobility Under Data-Driven Uncertainty .....	1510
<i>Pengcheng Wu, Jun Chen</i>	
Data-Driven Controller and Multi-Gradient Search Algorithm for Morphing Configurations.....	1521
<i>Jose M. Magalhaes, Gustavo Luiz Olichevis Halila, Kyriakos G. Vamvoudakis</i>	

### **CONTINGENCY MANAGEMENT FOR AUTONOMOUS FLIGHT**

An L <sub>1</sub> Adaptive Control Augmentation for a Lift-Plus-Cruise Vehicle .....	1539
<i>Andrew Patterson, Kasey A. Ackerman, Jacob Cook, Michael J. Acheson, Irene M. Gregory</i>	
Modified Cascading Generalized Inverse Control Allocation .....	1549
<i>Michael J. Acheson, Irene M. Gregory</i>	

Comparison of Acoustic Models and Trajectory Generation Methods for an Acoustically-Aware Aircraft .....	1574
<i>Kasey A. Ackerman, Irene M. Gregory</i>	

Combined Bernstein Polynomial Optimal Reciprocal Collision Avoidance Differential Dynamic Programming for Trajectory Replanning and Collision Avoidance for UAM Vehicles.....	1591
<i>Matthew D. Houghton, Michael J. Acheson, Andrew P. Patterson, Alex Oshin, Irene M. Gregory</i>	

## **MULTI-AGENT COORDINATION AND CONTROL II**

Q-Learning Based Search of a Ground Target in a Grid with Partial Information .....	1613
<i>Srikanth Elkoori Ghantala Karnam, Rajnikant Sharma</i>	

Multi-Agent Assisted Shortest Path Planning Using Monte Carlo Tree Search .....	1626
<i>Abhay Singh Bhadoriya, Swaroop Darbha, Sivakumar Rathinam, David Casbeer, Steven J. Rasmussen, Satyanarayana G. Manyam</i>	

## **AUTONOMY V**

Estimating System State from the Actions of a Reinforcement Learning Agent.....	1636
<i>Andres Enriquez Fernandez, John J. Bird</i>	

Sequential Cooperative Reinforcement Learning of Mothership Routing Problem.....	1651
<i>Jaeho Lee, Junwoo Park, Dongwoo Lee, Hyochoong Bang</i>	

Real-Time Planning of Optimal Route for Conflict-Free UAS Operation Using Deep Reinforcement Learning .....	1663
<i>Jaejun Jang, Nicholas C. Song, Junki Shim, Gwonyeol Lee, Jae-Young Choi, Rachit Prasad, Seongim Choi</i>	

Data-Driven Target Tracking Methods of UAS/UAM in Dynamic Environment .....	1679
<i>Rachit Prasad, Gwonyeol Lee, Jae-Young Choi, Junki Shim, Nicholas C. Song, Seongim Choi</i>	

Dynamic Network-Based Probabilistic Route Planner and Validation.....	1692
<i>Rachit Prasad, Junki Shim, Jae-Young Choi, Jaejun Jang, Gwonyeol Lee, Nicholas C. Song, Seongim Choi</i>	

## **AUTONOMY IV**

A Deep Reinforcement Learning Approach to Solve the Vehicle Routing Problem with Resource Constraints.....	1706
<i>Dong Ho Lee, Jaemyung Ahn</i>	

Robust Waypoint Guidance of a Hexacopter on Mars Using Meta-Reinforcement Learning.....	1718
<i>Lorenzo Federici, Roberto Furfaro, Alessandro Zavoli, Guido De Matteis</i>	

Systems Theoretic Process Analysis of a Run Time Assured Neural Network Control System.....	1735
<i>Kerianne L. Hobbs, Benjamin Heiner, Lillian Busse, Kyle Dunlap, Jonathan Rowanhill, Ashlie B. Hocking, Aditya Zutshi</i>	

State-Estimation-Aware Planning for Autonomous Systems with Temporal Logic Specifications.....	1755
<i>Ali Tefvik Büyükköçak, Yingjie Hu, Azizollah Taheri, Derya Aksaray, Demoz Gebre-Egziabher</i>	

GPS-Denied State Estimation for Blue/NDAA Unmanned Multi-Rotor Vehicles .....	1767
<i>Grant Phillips, Justin M. Bradley, Prashant Ganesh</i>	

## **AUTONOMY VII**

Motion-Primitive Based Deep Reinforcement Learning for High Speed Aerospace Vehicle Missions .....	1778
<i>Winston C. Levin, Sean M. Nolan, Ali K. Raz, Kris Ezra, Julie J. Parish, Kyle Williams</i>	
Development of Active Decoy Guidance Policy by Utilising Multi-Agent Reinforcement Learning.....	1790
<i>Enver Bildik, Burak Yuksek, Antonios Tsourdos, Gokhan Inalhan</i>	
Impact and Influence of Cyber-Physical Systems Research on Autonomous Aerospace Systems.....	1803
<i>Justin M. Bradley, Cody H. Fleming, Kristin Y. Rozier, Amy Pritchett</i>	
Energy-Aware Motion Planning Using Experimental Flight Data from a Tailsitter UAV .....	1826
<i>Peter Ryseck, Elena Shrestha, Derrick W. Yeo, Inderjit Chopra</i>	
Effects of Intercept Point Placement on Clothoid Path Recovery Time After Collision Avoidance.....	1838
<i>Travis W. Moleski, Theodore Tuttle, Jay Wilhelm</i>	

## **AUTONOMY VI**

Self-Supervised Obstacle Detection During Autonomous UAS Taxi Operations .....	1854
<i>Muhammad Yousuf Shaikh, Ivan Petrunin, Argyrios Zolotas</i>	
A Closed Loop Perception Subsystem for Small Unmanned Aerial Systems .....	1869
<i>Veera Venkata Ram Murali K. Muvva, Kruttidipta Samal, Justin M. Bradley, Marilyn Wolf</i>	
Integration of Reinforcement Learning and Unreal Engine for Enemy Containment Via Autonomous Swarms.....	1880
<i>David Peterson, Beyonce Andrades, Kevin Lizarazu-Ampuero, Jai Deshmukh, Thomas Stapor, Will Destaffan, Don Engel, Justin Krometis, Justin A. Kauffman</i>	
Multi-Agent Control of Chaser Satellites Using Games with Lexicographic Preferences .....	1895
<i>Kristina Miller, Sean Phillips, Alexander A. Soderlund</i>	
Impact of Hydrogen Powered Drones on Advanced Air Mobility.....	1908
<i>Daniel Coraspe, Samuel Diaz-Acosta, Emilio Serrano, Zoey Banash, Liang Sun</i>	

## **INTELLIGENT SYSTEMS STUDENT PAPER COMPETITION II**

Safe Path Planning of UAV Based on Reinforcement Learning in Probabilistic Environments .....	1918
<i>James Gault, Jun Xiang, Jun Chen</i>	
Twin-Delayed Deep Deterministic Policy Gradient for Altitude Control of a Flying-Wing Aircraft with an Uncertain Aerodynamic Model.....	1927
<i>Willem Völker, Yifei Li, Erik-Jan Van Kampen</i>	

### **DISTRIBUTED SENSING FOR AUTONOMOUS AIR MOBILITY III**

Comparison of Visual and LiDAR SLAM Algorithms Using NASA Flight Test Data .....	1946
<i>Keerthana Kannan, Anjan Chakrabarty, Joshua E. Baculi, Evan Kawamura, Wendy Holforty, Corey A. Ippolito</i>	
A Structurally-Adaptive Framework for Distributed Airborne Sensing Over Real-Time Collaborative Information Sharing Networks.....	1969
<i>Corey A. Ippolito</i>	
Feasibility Study of Distributed Decision-Making on the Edge for Urban Air Mobility .....	1987
<i>Aditya N. Das</i>	

### **GN&C ARCHITECTURES FOR AUTONOMOUS SYSTEMS VII**

Dynamic Inversion with Adaptive Augmentation for a High-Speed Guided Projectile .....	1996
<i>Tristan Griffith, John K. Zelina, Benjamin C. Gruenwald, Joshua Bryson</i>	
Modeling of GPS Degradation Conditions for Risk Assessment of UAS Operations in Urban Environments.....	2014
<i>Andrei Cuenca, Tatiana Gutierrez, Eduardo Morillo, Brock Steinfeldt, Hever Moncayo</i>	
Experimental Validation of a Distributed Norm-Free and Adaptive Event-Triggered Control Approach on an Aerial Multiagent System.....	2027
<i>Deniz Kurtoglu, Jesse Jaramillo, Stefan Ristevski, Andrya Pimentel, Tansel Yucelen, Jonathan A. Muse</i>	
Candidate Performance Metrics for Generalized Control for Autonomous Flight .....	2038
<i>Irene M. Gregory, Michael J. Acheson, Andrew P. Patterson, Matthew D. Houghton, Alex Oshin, Kasey A. Ackerman, Jacob Cook</i>	

### **Author Index**