

Entry, Descent and Landing GN&C Technology I

Papers Presented at the AIAA SciTech Forum and Exposition
2024

Orlando, Florida, USA
8 – 12 January 2024

Volume 1 of 5

ISBN: 979-8-3313-0430-0

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.'Uwky'422, Reston, VA 20191, USA.

TABLE OF CONTENTS

VOLUME 1

ENTRY, DESCENT AND LANDING GN&C TECHNOLOGY I – OVERVIEWS

Hybrid Flush and Synthetic Air Data Filter for Entry Vehicle Atmospheric State Estimation	1
<i>Chris D. Karlgaard</i>	
Descent & Landing Trajectory and Guidance Algorithms with Divert Capabilities for Moon Landing.....	16
<i>Francesco Capolupo, Antonio Rinalducci</i>	
Design of ReFEx Guidance: Periodic On-Board Trajectory Updates.....	36
<i>Jose Luis R. Redondo Gutierrez, David Seelbinder, Stephan Theil</i>	

GN&C ARCHITECTURES FOR AUTONOMOUS SYSTEMS I

Standoff Target Tracking Using Look-Angle Shaping	54
<i>Dhiraj K. Jha, Ashwini Ratnoo</i>	
Conflict Resolution in Aerial Corridors Using a Droneage Intersection Model	64
<i>Samiksha R. Nagrare, Debasish Ghose</i>	
Data-Guided Regulator for Adaptive Nonlinear Control.....	77
<i>Niyousha Rahimi, Mehran Mesbahi</i>	
Passive Non-Cooperative Intruder State Estimation and Optimal-Feedback Avoidance System for UAVs	102
<i>Aniruddha S. Perumalla, Thanakorn Khamvilai, Rachel M. Axten, Eric Johnson, Anusna Chakraborty, Joseph Yadegar</i>	
Minimum Time Trajectory Optimization for a 6-DoF Quadrotor UAV Using Successive Convexification	126
<i>Hutesh Sandhu, Prateek P. Pradhan, Ketan Rajawat, Mangal Kothari</i>	
Wildland Fire Rate of Spread Estimation Using an Autonomous Unmanned Aerial System: A Case Study.....	144
<i>Bryce T. Ford, Joon Tai Kim, Ziyu Dong, Roger Williams, Mrinal Kumar</i>	

SPACECRAFT AND LAUNCH GUIDANCE NAVIGATION AND CONTROL I

Bounded and Linear Quadratic Optimal Low-Thrust Collision Avoidance in Circular Orbits.....	168
<i>Tom Itzhaki, Vitaly Shaferman</i>	
Optimal Low-Thrust Docking with a Constrained Approach Direction Using Two Intermediate Points.....	193
<i>Or Nahum, Vitaly Shaferman</i>	
Fast Desensitized Optimal Control for Rocket Powered Descent and Landing	218
<i>Tommaso Robbiani, Marco Sagliano, Francesco Topputo, Hans Seywald</i>	

Command Governors Based on Bilevel Optimization for Constrained Spacecraft Orbital Transfer.....	236
<i>Ilya Kolmanovsky, Torbjørn Cunis, Emanuele Garone</i>	
Characterization of Axisymmetric Rigid Bodies from Lightcurves Via L1 Norm Minimization.....	252
<i>Carson P. Hunsberger, Puneet Singla, Roshan T. Eapen</i>	

ENTRY, DESCENT AND LANDING GN&C TECHNOLOGY II – TERRAIN MAPPING AND MAP-RELATIVE NAVIGATION

Verification and Validation of Lunar Terrain Relative Navigation Maps for Precision Landing.....	267
<i>Kori Hough, M. Ebrahim Mohammadi, Tyler Stephans, Rebekah Jenkins, Andrew D. Horchler</i>	
Hardware-In-The Loop Testing of Crater Navigation System for Lunar Landing	281
<i>Svenja Woicke, Hans Krüger</i>	
Development of a Low-SWaP, Modular, and Standalone Visual Relative Navigation System	292
<i>Hector A. Li Sanchez, M. Ebrahim Mohammadi, Kori Hough, Ringnyu Bunji Antoinette, Michael Bloom, James R. Walton, Andrew D. Horchler, Chris Owens</i>	
The Enhanced Lander Vision System for Mars Sample Retrieval Lander Entry Descent and Landing”, Not Mars Sample Return Lander.....	303
<i>Nikolas Trawny, Andrew E. Johnson, Erik S. Bailey, Gabrielle Massone, Mark Reid, Timothy P. Setterfield, Yang Cheng, Glenn Sellar, Jose Soto</i>	
Enhanced Lander Vision System (ELViS) Algorithms for Pinpoint Landing of the Mars Sample Retrieval Lander	318
<i>Timothy P. Setterfield, Dylan Conway, Po-Ting Chen, Daniel Clouse, Nikolas Trawny, Andrew E. Johnson, Shehryar Khattak, Kamak Ebadi, Gabrielle Massone, Yang Cheng, Jeremy Nash</i>	

GN&C ARCHITECTURES FOR AUTONOMOUS SYSTEMS II

Autonomous Parafoil System Precision Landing Via Closed-Loop Guidance and Control Considering Six-Degree-Of-Freedom Model.....	337
<i>Zhenyu Wei, Yan Gao, Zhijiang Shao</i>	
Complementing Human Perception in Remote Site Exploration Using Augmented Reality - A Proof of Concept	358
<i>Francesca Vergara, Andrea D. Ryals, Antonio Arenella, Lorenzo Pollini</i>	
H_∞ Robust Control of a Quadrotor Biplane Tailsitter UAV	372
<i>Tanay Kumar, Mangal Kothari, Raktim Bhattacharya</i>	
Robust Nonlinear Control for Exact-Time Stability of a Quadrotor UAV Under Uncertainties.....	389
<i>Saurabh Kumar, Shashi Ranjan Kumar, Abhinav Sinha</i>	
A Decentralized Optimal Control Law for Multi-Circular Circumnavigation Around a Stationary Target.....	403
<i>Prateek Priyaranjan Pradhan, Arijit Sen, Mangal Kothari, Ketan Rajawat</i>	
Circumventing Unstable Zero Dynamics in Input-Output Linearization of Longitudinal Flight Dynamics.....	417
<i>Jhon M. Portella Delgado, Ankit Goel</i>	

SPACECRAFT AND LAUNCH GUIDANCE NAVIGATION AND CONTROL II

Autonomous Navigation for Binary Asteroid Landing.....	428
<i>Peter A. Elffers, Edoardo Caroselli, Erik-Jan Van Kampen, Erwin Mooij</i>	
Exact-Time Convergent Spacecraft Rendezvous Using Sliding Mode Control	452
<i>Nikhil Anand, Shashi Ranjan Kumar</i>	
Lunar Landing with Feasible Divert Using Controllable Sets.....	466
<i>Neeraj Srinivas, Abraham P. Vinod, Stefano Di Cairano, Avishai Weiss</i>	
Lyapunov-Based Two-Axis Magnetic Attitude Control of a Rigid Spacecraft.....	481
<i>Curtis Merrill, Derek A. Paley</i>	
Robust Optimal Controller for Martian Re-Entry in the Presence of Uncertainty.....	490
<i>Laura Garcia Insa, Manuel Sanjurjo Rivo, Daniel González Arribas</i>	
Multi-Objective Robust Trajectory Design for Powered Descent and Landing	512
<i>Grace E. Calkins, Zachary R. Putnam, David Woffinden</i>	

ENTRY, DESCENT AND LANDING GN&C TECHNOLOGY III – PL&HA SENSORS & TESTING

Full-Scale Hazard Detection and Avoidance and Optical Relative Navigation Integration Demonstration	532
<i>Ludwik A. Sobiesiak, Maxime Minville, Cédric Godin, David Dozois, Jean-François Hamel</i>	
Multi-Functional Flash Lidar for Precision Safe Landing in Challenging Terrains.....	542
<i>Farzin Amzajerdian, Paul Brewster, Alexander Bulyshev, Aram Gragossian, Jacob M. Hepler, Glenn D. Hines, Daniel K. Litton, Frederick G. Wilson, Sean Laughter</i>	
Moon Fast and Accurate Lidar Localization in Combination with Structured Light.....	551
<i>Zachary E. Gaines, Maxium Wilder-Smith, Joseph Luna, Julian Garcia, Matthew Alexander Mariano, Parker Tompkins, Kiana Yao, Tarek Elsharhaway</i>	
Simulated Flight Test Results from the A-LiST LiDAR System Over a Simulated Lunar Landing Field.....	567
<i>Peter Jorgensen, Brian Cantler, Sheik R. Ali, Amin Nasr, Omar Ads, Robert H. Bishop</i>	

MODELING AND SIMULATION FOR AUTONOMOUS GUIDANCE, NAVIGATION AND CONTROL I

System Identification and Modeling of a Multirotor UAV: A Comparative Study	579
<i>Khashayar Niki Maleki, Soroush Karimi, Sara Mohammadi, Kaveh Ashenayi</i>	
Data-Driven Modeling for Multirotor Autonomous Control	603
<i>Tatsuya Shiotsuka, Mai Bando, Shinji Hokamoto</i>	
Non-Linear Control of a Quadrotor with Actuator Delay.....	619
<i>Muhammed R. Kartal, Dmitry Ignatyev, Argyrios Zolotas</i>	
Airborne Recovery of the X-61A Gremlin Unmanned Aircraft	631
<i>Ryan Carter, Timothy M. Keeter, Paul Calhoun</i>	

SPACECRAFT AND LAUNCH GUIDANCE NAVIGATION AND CONTROL III

Dual-Spin Attitude Stabilization of Magneto-Coulombic Satellite Using Linear Time-Variant Model Predictive Control	645
<i>Kumardip Basak, Dipak K. Giri</i>	
Hardware-In-The-Loop Tests of a Multi-Sensor Pose Estimation Module for Small Satellite Inspection	669
<i>Claudio Vela, Giuseppe Napolano, Alessia Nocerino, Roberto Opromolla, Michele Grassi</i>	
Control for an Omnidirectional Multi-Rotor UAV for Space Applications	686
<i>Riley M. McCarthy, Tristan Thomas, Claus Danielson, Sean Phillips, Rafael Fierro</i>	

VOLUME 2

Neuro-Adaptive Model Reference Tracking Controller for Cislunar Missions	698
<i>Yrithu Thulaseedharan Pillay, Matthew Chace, James Steck, John Watkins, Atri Dutta</i>	
Optimal Linear Quadratic Powered Descent with an Optimally Selected Intermediate Point	723
<i>Or Nataf, Vitaly Shaferman</i>	

AUTONOMY AND ARTIFICIAL INTELLIGENCE FOR AEROSPACE VEHICLE GNC I

An Experimental System for Strategic Flight Path Management in Advanced Air Mobility	747
<i>David A. Karr, James L. Sturdy, Bryan A. Barrows, Mark G. Ballin</i>	
Kinodynamic FMT* with Dimensionality Reduction Heuristics and Neural Network Controllers	765
<i>Dongliang Zheng, Panagiotis Tsiotras</i>	
Range Extension Using Reinforcement Learning for High Altitude Aircraft	777
<i>Bethany L. Allik, James M. Maley</i>	
Trajectory Tracking While Stabilizing an Inverted Pendulum on a Quadcopter Using Adaptive Model-Predictive Control	787
<i>Han Yang, Mohamed Khalid M Jaffar, Michael W. Otte</i>	

ENTRY, DESCENT AND LANDING GN&C TECHNOLOGY IV – AEROCAPTURE FOR ICE GIANTS I

Uranus Flagship-Class Orbiter and Probe Using Aerocapture	801
<i>Soumyo Dutta, Eli Shellabarger, James B. Scoggins, Andrew Gomez-Delrio, Rafael Lugo, Rohan Deshmukh, Benjamin Tackett, Joseph Williams, Breanna Johnson, Daniel Matz, Joshua Geiser, Jonathan Morgan, Ricardo Restrepo, Declan Mages</i>	
Mission Design and Navigation Solutions for Uranus Aerocapture	816
<i>Ricardo Restrepo, Declan Mages, Matthew Smith, Rohan Deshmukh, Soumyo Dutta, Lylia Benhacine</i>	
Performance Analysis of Aerocapture Systems for Uranus Orbiter	836
<i>Rohan Deshmukh, Soumyo Dutta, Rafael Lugo, Ricardo Restrepo, Declan Mages, Breanna Johnson, Daniel Matz, Joshua Geiser, James B. Scoggins, Eli Shellabarger, Andrew Gomez-Delrio, Joseph Williams</i>	

Analysis of a Bank Control Guidance for Aerocapture at Uranus	854
<i>Daniel Matz, Breanna J. Johnson, Joshua Geiser, Sergio Sandoval, Rohan Deshmukh, Rafael Lugo, Soumyo Dutta, Pardhasai Chadavalavada</i>	

MODELING AND SIMULATION FOR AUTONOMOUS GUIDANCE, NAVIGATION AND CONTROL II

Hardware-In-The-Loop Validation of Autonomous Interplanetary Navigation Algorithms for Interplanetary Cruises with the Optical Star Stimulator	865
<i>Eleonora Andreis, Hans Krüger, Svenja Woicke, Paolo Panicucci, Francesco Topputo</i>	
Optimal Guidance and Control System Considering Actuator Constraints for Landing on Microgravity Celestial Body	887
<i>Toshiki Fukui, Masaki Takahashi, Masatsugu Otsuki</i>	
Dynamics, Guidance, and Control of a Low-Cost Quadcopter-Based Space Vehicle Testbed.....	908
<i>William J. Elke, Ryan Caverly</i>	
Time-Varying Observer/Controller Identification Algorithm: Applications in Guidance, Navigation and Control	929
<i>Damien Gueho</i>	

NAVIGATION, ESTIMATION, SENSING AND TRACKING I

Gauss-Markov Dynamics-Based Attitude Estimation Using Star Sensor and Rate-Integrating Gyro.....	945
<i>Edoardo Caroselli, Fabio Curti, Livio Ascani</i>	
A Geometric Approach to Deep Space Navigation Using Angles-Only Measurements.....	969
<i>Aimar Negrete, Ossama Abdelkhalik</i>	
Keypoint-Based Stereophotoclinometry for Characterizing and Navigating Small Bodies: A Factor Graph Approach	977
<i>Travis Driver, Andrew Vaughan, Yang Cheng, Adnan I. Ansar, John Christian, Panagiotis Tsiotras</i>	
Artemis I Optical Navigation System Performance	1002
<i>Rebecca Inman, Greg Holt, John Christian, Kyle W. Smith, Christopher D'Souza</i>	
Finite-Time Stable Pose Estimation on SE(3) Using Onboard Optical Sensors.....	1022
<i>Abhijit U. Dongare, Reza Hamrah, Amit K. Sanyal</i>	

TOWARDS CONTINGENCY MANAGEMENT FOR AUTONOMOUS FLIGHT

Benchmark Problem for Autonomous Urban Air Mobility	1036
<i>Newton H. Campbell, Irene M. Gregory, Michael J. Acheson, Hari S. Ilangovan, Shivakumar Ranganathan</i>	
COBRA-DDP: Trajectory Generation and Collision Avoidance Augmentations for eVTOL Vehicles.....	1061
<i>Matthew D. Houghton, Michael J. Acheson, Andrew Patterson, Alex Oshin, Irene M. Gregory</i>	
Off-Nominal Event Analysis in Autonomous Flights Based on Explainable Artificial Intelligence	1072
<i>Shivakumar I. Ranganathan, Hari S. Ilangovan, Newton H. Campbell, Michael J. Acheson, Irene M. Gregory</i>	

Reference Command Optimization for the Transition Flight Mode of a Lift Plus Cruise Vehicle	1085
<i>John L. Bullock, Sheng Cheng, Andrew Patterson, Michael J. Acheson, Naira Hovakimyan, Irene M. Gregory</i>	

AUTONOMY AND ARTIFICIAL INTELLIGENCE FOR AEROSPACE VEHICLE GNC II

Physics-Informed Deep Learning Approach to Solve Optimal Control Problem.....	1096
<i>Kyung-Mi Na, Chang-Hun Lee</i>	
Density Estimation for Entry Guidance Problems Using Deep Learning	1115
<i>Jens A. Rataczak, Davide Amato, Jay W. McMahon</i>	
MPC-Based Estimation-Aware Trajectory Generation for Uncontrolled Satellite Pose Tracking.....	1138
<i>Aditya Deole, Beniamino Pozzan, Mehran Mesbahi</i>	
Deep Neural Pose Estimation for a Flapping Wing Unmanned Aerial Vehicle with Visual-Inertial Sensor Fusion	1157
<i>Tejaswi K C, Taeyoung Lee, Chang-Kwon Kang</i>	
Implementing TD3 to Train a Neural Network to Fly a Quadcopter Through an FPV Gate.....	1169
<i>Patrick J. Thomas, Kevin Schroeder, Jonathan Black</i>	

ENTRY, DESCENT AND LANDING GN&C TECHNOLOGY V – AEROCAPTURE FOR ICE GIANTS II

Aerodynamic Implications of Aerocapture Systems for Uranus Orbiters	1178
<i>Eli Shellabarger, James B. Scoggins, Andrew D. Hinkle, Soumyo Dutta, Rohan Deshmukh, Mihirkumar Patel, Sarah Agam</i>	
Aeroheating Environment of Aerocapture Systems for Uranus Orbiters.....	1193
<i>James B. Scoggins, Andrew D. Hinkle, Eli Shellabarger</i>	
Thermal Protection System Design of Aerocapture Systems for Uranus Orbiters	1211
<i>Jonathan Morgan, Joseph Williams, Ethiraj Venkataphy, Matthew Gasch, Rohan Deshmukh, Eli Shellabarger, James B. Scoggins, Andrew J. Gomez-Delrio, Benjamin Tackett, Soumyo Dutta</i>	
Design Implications for Aerocapture Systems Placing Flagship-Class Uranus Orbiters.....	1229
<i>Andrew J. Gomez-Delrio, Soumyo Dutta</i>	

INTELLIGENT SYSTEMS IN GUIDANCE NAVIGATION AND CONTROL

Evolutionary Reinforcement Learning: A Hybrid Approach for Safety-Informed Intelligent Fault-Tolerant Flight Control.....	1240
<i>Vlad Gavra, Erik-Jan Van Kampen</i>	
Visual Pursuit Guidance Strategy with Shrinking Horizon Replanning for Drones	1263
<i>Ahmet T. Cetin, Emre Koyuncu</i>	
Pure Pursuit of a Target on a Circular Trajectory	1272
<i>Alexander L. Von Moll, David Casbeer, Isaac E. Weintraub, Meir Pachter</i>	
On Deep Reinforcement Learning for Target Capture Autonomous Guidance	1285
<i>Umer Siddique, Abhinav Sinha, Yongcan Cao</i>	

A Reinforcement Learning-Based Continuation Strategy for Autonomous On-Orbit Assembly	1300
<i>Siavash Tavana, Sepideh Faghihi, Anton de Ruiter, Krishna D. Kumar</i>	

MODELING AND SIMULATION FOR AUTONOMOUS GUIDANCE, NAVIGATION AND CONTROL III

Generalized Model of a Long-Endurance Aircraft for Fuel-Optimal Guidance	1318
<i>Mark Karpenko, Vladimir Dobrokhodov, Kevin Jones, Adam Propst, Jason Mills, Dan Edwards, Richard Stroman</i>	
The Optimal Trajectories and Modified Proportional Navigation Guidance.....	1333
<i>Hiroyuki Takano, Takeshi Yamasaki, Isao Yamaguchi</i>	
Initial Pose Determination and Control for Sample Collection Manipulator System in Microgravity Celestial Body Landers.....	1343
<i>Takafumi Fujii, Masaki Takahashi, Kent Yoshikawa, Masatsugu Otsuki</i>	
Singularity-Free Whole-Body Dynamical Equations of Legged Robots for Damage Simulation	1364
<i>Sahand Farghdani, Robin Chhabra</i>	
Design of Controller with Enlarged Region of Attraction Using Union Theorem in Sum-Of-Squares Optimization for the F-8 Aircraft.....	1375
<i>Bhaskar Biswas, Dmitry Ignatyev, Argyrios Zolotas, Antonios Tsourdos</i>	

NAVIGATION, ESTIMATION, SENSING AND TRACKING II

INS Velocity Correction Using Stabilized Seeker Data.....	1385
<i>Süleyman Büyükköçak, Mehmet Akgul, Emre h. Ata</i>	

VOLUME 3

Nonlinear Multi-Sensor Observability and Estimation of Rigid Body Inertial Parameters.....	1395
<i>Ena Sundquist, Carey Whitehair, Kristi A. Morgansen</i>	
Ill-Conditioned Autocovariance Least Square Noise Covariance Identification for Colored Noise Gust Estimation	1413
<i>Kimberly A. Hinson, Kristi A. Morgansen</i>	
Decoding Dynamic State Properties from Distributed Strain Sensing on sUAS.....	1429
<i>Leopold G. Beuken, Hee-Sup Shin, Sarah Bergbreiter, James S. Humbert</i>	
Development of a Distributed Embedded Apogee Prediction and Control System with Sensor Fusion for Sounding Rockets	1444
<i>Piotr Slawecki, Piotr Slonka, Wojciech Zebrowski, Zuzanna Wesolowska</i>	

SPACE SITUATIONAL AWARENESS I

Enhancing Efficiency and Autonomy in 5G/IoT Satellite Constellation Management	1455
<i>Franco Criscola, Zachariah Hudson, Arnau Singla, Anna Calveras, Joan A. Ruiz-de-Azua, David Canales</i>	

Optimization of Lunar-Based Radar Networks Via a Multi-Disciplinary Analysis and Optimization (MDAO) Approach.....	1474
<i>Matthew L. Gilmartin, Stef Crum, Jason Hodkin, Gregory Badura, Alaric Gregoire, Yuri Shimane, Lois Visonneau, Michael J. Steffens, Selcuk Cimentalay, Francis Humphrey, Mariel Borowitz, Brian C. Gunter, John Christian, Koki Ho</i>	

Electron Beam Properties for Touchless Potential Sensing of Complex Geometry Spacecraft.....	1497
<i>Kaylee M. Champion, Hanspeter Schaub</i>	

Threat Level Estimation from Possible Break-Up Events in LEO	1512
<i>Simone Servadio, Daniel Jang, Richard Linares</i>	

UNCERTAINTY QUANTIFICATION AND ANALYSIS OF COMPLEX AEROSPACE SYSTEMS (JOINT NDA/GNC)

Uncertainty Quantification of Shear-Induced Paraffin Droplet Pinch-Off in Hybrid Rocket Motors	1531
<i>Georgios Georgalis, Darsh Nathawani, Matthew Knepley, Abani Patra</i>	

A Normal-Score Ensemble Kalman Filter for 1D Shock Waves	1548
<i>James J. Hansen, Davy Brouzet, Matthias Ihme</i>	

Comparing Two Contrail Models Under Certain and Uncertain Inputs	1562
<i>Caleb Akhtar Martinez, Jerome Jarrett</i>	

Modified Gram-Charlier Method for Analytical PDF	1579
<i>Colton Campbell, Mishal Thapa, Sameer B. Mulani, Subham Gupta</i>	

A Bi-Fidelity Strategy for Optimization Under Uncertainty with Applications to Aircraft Trajectory Optimization.....	1591
<i>Thomas Dixon, Alex Gorodetsky</i>	

ENABLING TECHNOLOGIES FOR AAM AUTONOMY

Verification of Design Specifications in L_1 Adaptive Control.....	1603
<i>Lin Song, Sheng Cheng, Sayan Mitra, Naira Hovakimyan</i>	

Optimizing UAV Network Efficiency: Integrative Strategies for Simultaneous Energy Management and Obstacle-Aware Routing.....	1615
<i>Salar Basiri, Dhananjay Tiwari, Christos Papachristos, Srinivasa Salapaka</i>	

Synergistic Perception and Control Simplex for Verifiable Safe Vertical Landing	1632
<i>Ayoosh Bansal, Yang Zhao, James Zhu, Sheng Cheng, Yuliang Gu, Hyung Jin Yoon, Hunmin Kim, Naira Hovakimyan, Lui R. Sha</i>	

Assured Collision Avoidance for Learned Controllers: A Case Study of ACAS Xu	1652
<i>Gokul Puthumanaiyam, Manav Ketan Vora, Taha Shafa, Yangge Li, Melkior Ornik, Sayan Mitra</i>	

Particle Filter Fault Diagnosis of Highly Automated Aircraft	1663
<i>Vincent Kwao, Ioannis Raptis</i>	

Autonomous Aerial Search and Revisit Behavior for Communication Limited Environments	1676
<i>Wei Cui, Animesh Shastry, Derek A. Paley, Stephen Nogar</i>	

ENTRY, DESCENT AND LANDING GN&C TECHNOLOGY VI – ENTRY GUIDANCE & ENTRY SYSTEMS

Six-Degrees-Of-Freedom Aero-Propulsive Entry Trajectory Optimization	1688
<i>Marco Sagliano, Ping Lu, Breanna Johnson, David Seelbinder, Stephan Theil</i>	
Steps Towards a Hypersonic Entry Test Platform	1710
<i>Breanna J. Johnson, Samuel M. Pedrotty, Stan Bouslog, Richard Hagen, William O'Neill, Sarah D'Souza, Gregory Larsen, Corson Cramer, Donald Morr, Stephen R. Steffes, Matthew Fritz, Paul DeTrempe, Daniela Rocca-Bejar, David Hoffman</i>	
Assessment of Control Algorithms for Mars Entry Vehicles with Flap-Based Trajectory Control	1732
<i>Daniel Engel, Zachary R. Putnam, Soumyo Dutta</i>	

NAVIGATION, ESTIMATION, SENSING AND TRACKING III

Barrier Coverage of a Belt with Varying Resolution Requirements Using UAVs.....	1756
<i>Amit Kumar, Debasish Ghose</i>	
Robust Navigation Based on an Interacting Multiple-Model Filtering Framework Using Multiple Tracking Cameras.....	1769
<i>Sasanka Kuruppu Arachchige, Kyuman Lee</i>	
Computation-Aware Bearings-Only Target Localization and Circumnavigation in 2D	1779
<i>William Warke, Kasra Yazdani, Matthew Hale</i>	
Ownship Calibration for Indoor Magnetic Navigation.....	1798
<i>Jose H. Ramos, Kristy L. Waters, Adrienne Dorr, Kyle Volle, Prashant Ganesh, Kevin Brink</i>	

SMALL SATELLITE GUIDANCE, NAVIGATION AND CONTROL

Cold Gas Thruster and Controller Development for Satellite Attitude Control.....	1809
<i>Huda Sedaki, Emre Koyuncu, Mustafa A. Karabeyoglu, Ahmet Gurer, Ahmet T. Cetin</i>	
Affordable Ranging and Clock Synchronization Device - Development and the Field Communication / Function Experiment.....	1816
<i>Junichiro Kawaguchi, Shingo Nishimoto, Saki Komachi, Hayato Kokubo, Kohei Takeda, Shinya Fujita, Yuji Sakamoto</i>	
Model-Based Control of a Novel Outrunner Reaction Wheel for CubeSats and SmallSats.....	1832
<i>Rhimas Van de Putte, Mikel Samson, Laila Kazemi, Tjorven Delabie</i>	
Stochastic Modeling of the Star Tracker Measurement Process to Assess Accuracy and Precision from Perturbation Propagation	1856
<i>Gagandeep S. Thapar, Leonardo A. Torres</i>	
Hardware-In-The-Loop Experiments of an Attitude Fusing Library for CubeSat Star Trackers.....	1880
<i>Mikel R. Samson, Laila Kazemi, Rhimas Van de Putte, Tjorven Delabie, Brecht De Vuyst</i>	
Fast Satellite Circumnavigation Via Continuous Control.....	1898
<i>Andres M. Gonzalez</i>	

CONTROL TECHNIQUES FOR AAM AUTONOMY

Uncertainty Quantification-Based Switching Control Method for Vision-Based Object Tracking in Unmanned Aerial Vehicles	1910
<i>Antonio Fernández Castaño, Caleb Patton, Hyung Jin Yoon, Petros Voulgaris</i>	
Mixed Model Predictive Control and Data-Driven Control of a Tiltrotor eVTOL Aircraft	1922
<i>Shen Qu, Tianyi He, Weihua Su</i>	
Nonlinear MPC of Tiltrotor Aircraft for Trajectory Stabilization with Rotor and Control Surface Failure.....	1932
<i>Jessica Santos Martins Nunes, Weihua Su</i>	
Multi-Thread Attracting Manifolds for Learning Without Regret	1944
<i>Richard D. Hoobler, Maruthi Akella, Christopher M. Elliott</i>	

CONTROL THEORY FOR AEROSPACE APPLICATIONS I

Bode's Integral Theorem and Flight Control	1954
<i>Eugene Lavretsky, Kevin Wise</i>	
Composite Adaptive Flight Control Based on Matrix Decomposition and Enhanced Excitation	1974
<i>Keum W. Lee, Sahjendra N. Singh</i>	
Extremum Seeking by Multi-Agent Vehicles and UAVs with No Steady State Oscillation Using a Geometric-Based Kalman Filtering.....	1997
<i>Sameer Pokhrel, Ahmed A. Elgohary, Sameh Eisa</i>	
Wasserstein Distributionally Robust Control Barrier Function Using Conditional Value-At-Risk with Differentiable Convex Programming	2013
<i>Alaa Chriat, Chuangchuang Sun</i>	
Multi-Outer Loop Adaptive Control for a VTOL Free-Wing Aircraft.....	2027
<i>Rachel M. Axten, Thanakorn Khamvilai, Eric Johnson</i>	
A New Smoothing Technique for Bang-Bang Optimal Control Problems	2043
<i>Kun Wang, Zheng Chen, Zhenyu Wei, Fangmin Lu, Jun Li</i>	

ENTRY, DESCENT AND LANDING GN&C TECHNOLOGY VII – PL&HA NAVIGATION AND POWERED-DESCENT GUIDANCE

Extent-Informed Tracking for Feature-Based Navigation	2061
<i>James D. Brouk, Kyle J. DeMars</i>	
Feature-Based Post-Entry State Determination Using Gaussian Mixtures.....	2079
<i>William N. Fife, Kyle J. DeMars</i>	

VOLUME 4

Lidar-Based Safe Site Relative Navigation	2094
<i>Kari C. Ward, Kyle W. Smith, Isaac S. Rowe, Jeanette M. Harper, Davis W. Adams, Samuel M. Pedrotty, Gavin F. Mendeck</i>	

Implementation and Testing of Convex Optimization-Based Guidance for Hazard Detection and Avoidance on a Lunar Lander	2114
<i>Joshua Shaffer, Chris Owens, Theresa Klein, Andrew D. Horchler, Samuel C. Buckner, Breanna J. Johnson, John M. Carson, Behcet Acikmese</i>	

Optimal Predictive Guidance for Autonomous Hazard Detection and Avoidance	2138
<i>Kento Tomita, Yuri Shimane, Koki Ho</i>	

CONTROL THEORY FOR AEROSPACE APPLICATIONS II

An Hp Mesh Refinement Method for Solving Nonsmooth Optimal Control Problems	2149
<i>Gabriela Abadia-Doyle, Anil Rao</i>	

Semi-Global Exponential Stability for Dual Quaternion Based Rigid-Body Tracking Control	2166
<i>Vrushabh Zinage, S. P. Arjun Ram, Maruthi Akella, Efstathios Bakolas</i>	

Inverse-Optimal, Continuous-Thrust Orbit Transfers.....	2191
<i>Ahmed Atallah, Ahmad Bani Younes, Aaron J. Rosengren</i>	

Control Synthesis for a Hypersonic Vehicle with Harmonic Excitation Inputs and Input-Output-Sampled Nonlinearities	2203
<i>Sze Kwan Cheah, Diganta Bhattacharjee, Maziar Hemati, Ryan Caverly</i>	

Gain Design for an INDI-Based Flight Control Algorithm for a Conceptual Lift-To-Cruise Vehicle	2218
<i>Denis Surmann, Stephan Myschik</i>	

ENTRY, DESCENT AND LANDING GN&C TECHNOLOGY VIII – POWERED-DESCENT GUIDANCE

Performance Analysis of a Dual Quaternion Guidance Algorithm Applicable During Lunar Approach with a Hazard Avoidance Maneuver	2233
<i>Javier A. Doll, Samuel T. Wagner, Matthew Fritz, Jiann-Woei Jang, Jeanette M. Harper, Kyle W. Smith, Behcet Acikmese, Samuel M. Pedrotty, Gavin F. Mendeck</i>	

Successive Convexification for Powered Descent Guidance with Time-Varying Mass Properties.....	2261
<i>Alex Hayes, Jing Pei</i>	

Constrained Visibility Guidance for 6-DOF Powered Descent Maneuvers with Terrain Scanning Using Sequential Convex Programming	2270
<i>Samuel C. Buckner, Joshua Shaffer, John M. Carson, Breanna J. Johnson, Ronald R. Sostaric, Behcet Acikmese</i>	

Improving Computational Efficiency for Powered Descent Guidance Via Transformer-Based Tight Constraint Prediction	2292
<i>Julia Briden, Trey Gurga, Breanna J. Johnson, Abhishek Cauligi, Richard Linares</i>	

Powered Atmospheric Landing Guidance for Reusable Rockets: The CALLISTO Studies	2311
<i>Marco Sagliano, Ansgar Heidecker, Stefano Fari, Macés Hernández Jose Alfredo, Markus Schlotterer, Svenja Woicke, David Seelbinder, Etienne Dumont</i>	

Fast Monte Carlo Analysis for 6-DoF Powered-Descent Guidance Via GPU-Accelerated Sequential Convex Programming.....	2336
<i>Govind M. Chari, Abhinav G. Kamath, Purnanand Elango, Behcet Acikmese</i>	

PATH AND TRAJECTORY TOPICS

Generic Path-Following Guidance for an Autonomous Vehicle	2352
<i>Saurabh Kumar, Abhinav Sinha, Shashi Ranjan Kumar</i>	
Predictive Path Following Control for Fixed Wing UAVs Using the qLMPC Framework in the Presence of Wind Disturbances	2364
<i>Ahmed S. Rezk, Horacio M. Calderón, Herbert Werner, Benjamin Herrmann, Frank Thielecke</i>	
Smooth Parameterized Trajectory Planning and Control for Autonomous Dynamic Soaring	2383
<i>Alexander Zwenig, Fabian Gücker, Haichao Hong, Florian Holzapfel, Meiko Steen, Peter Hecker</i>	
Avoidance Trajectory Generation for Quad-Rotors by Polygonal Bounding of Congested Obstacles	2396
<i>Yoshihide Arai, Takashi Sago, Yuki Ueyama, Masanori Harada</i>	

SPACE SITUATIONAL AWARENESS II

Preliminary Lunar Surface SSA Architecture Optimization for the Observability of Cislunar and Lunar Resident Space Objects	2407
<i>Clint Spesard, Robert A. Bettinger</i>	
An Octree-Based Spatial Index for Space-Based Space Surveillance Coverage Volume Computation	2418
<i>Ryan Ketzner, Tarek A. Elgohary</i>	
Sensor Tasking Strategies for Space-Based Observers in the Cislunar Environment	2430
<i>Roshan T. Eapen, Smriti Nandan Paul, Puneet Singla</i>	
Sensor Tasking for Low Earth Orbit Objects: Leveraging Space Sensor Data for Ground-Based Optical Observations	2450
<i>Smriti Nandan Paul, Hang Woon Lee</i>	
An Efficient Thrust-Limited Control Metric: Towards Tractable Reachability Computations in the Two-Body Problem	2468
<i>Guillermo Escribano, Manuel Sanjurjo Rivo, Jan Siminski, Alejandro Pastor, Diego Escobar</i>	

MISSILE AND TRANS-ATMOSPHERIC VEHICLE GN&C I

Optimal Target Interception with Time-Varying Acceleration Constraints	2480
<i>Or Nahum, Vitaly Shaferman</i>	
True-Proportional-Navigation Based Impact Time Guidance with Predefined Convergence Time	2511
<i>Kakoli Majumder, Shashi Ranjan Kumar</i>	
Qualitative Analysis of Variable Speed Proportional Navigation Guidance Law	2528
<i>Nobin Paul, Debasish Ghose</i>	
Optimal Guidance for an Ideal Missile	2547
<i>Curtis P. Mracek</i>	

MOTION PLANNING, SENSING, AND OPERATIONS

- Goal-Oriented Asteroid Mapping Under Uncertainties Using Sequential Convex Programming..... 2565
Antonio Rizza, Francesco Toppoto, Simone D'Amico
- Dynamic Aerial Coverage of Stationary and Moving Structures Using Lissajous Curves..... 2585
Suryadeep Nath, Debasish Ghose
- Trajectory-Constrained Standoff Target Tracking Using Barrier Lyapunov Functions 2604
Ishir Roongta, Piyush Kumar, Twinkle Tripathy
- UAV Path Planning for Cave Exploration Using Tangent Based Intersection Method 2616
Bazeela Bandy, Vineethkumar Kasula, Nakul Surwade, Samiksha R. Nagrare, Debasish Ghose

SPACE SITUATIONAL AWARENESS III

- Segregating Orbital Station Keeping Maneuvers of Non-Cooperative Space Objects Using SMOTE Based Imbalanced Learning 2628
Shivshankar S, Debasish Ghose
- Survey Mode: A Review of Machine Learning in Resident Space Object Detection and Characterization..... 2642
Konstantinos Tsaprailis, George Choumos, Vaios Lappas, Charalampos Kontoes
- Artificial Intelligence for a Safe Space: Data and Model Development Trends in Orbit Prediction and Collision Avoidance..... 2669
George Choumos, Konstantinos Tsaprailis, Vaios Lappas, Charalampos Kontoes
- Performance of Observational Spacecraft Across Orbit Families for Space Domain Awareness in the Cislunar Realm 2698
Brian P. Baker-McEvelly, Jared Rose, Surabhi Bhadauria, David Canales, Carolin Frueh, Hancheol Cho
- Development of an EKF-Based Tracking Algorithm for Unresponsive Objects in Cislunar Space and Methods for Its Use in Cislunar Surveillance Architecture Design 2719
Neel Puri, Michael J. Steffens, Dimitri N. Mavris

HIGH ALTITUDE/ENDURANCE/FLUTTER

- Design of a Collocation-Based Active Flutter Suppression Control Law for the IAWTM Wind Tunnel Model 2737
Jared A. Grauer, Josiah Waite
- N-Tank Continuous Framework for Thermal Management to Enhance Thermal Endurance 2753
David Sigthorsson, Michael W. Oppenheimer, David B. Doman
- Fuel-Optimal Guidance of an Ultra-Long Endurance Aircraft 2775
Vladimir Dobrokhodov, Mark Karpenko, Kevin Jones

VOLUME 5

Flight Testing Total Energy Control Autopilot Functionalities for High Altitude Aircraft 2794
Christian Weiser, Gertjan Looye, Daniel Ossmann

A Hybrid Optimal Path Planner for Parafoiled Systems..... 2807
Remi Pedenon-Orlanducci, Ahmad Zaydan, Sofiane Achiche, David Saussie

MISSILE AND TRANS-ATMOSPHERIC VEHICLE GN&C II

Deep Reinforcement Learning-Based Optimal Time-Constrained Intercept Guidance..... 2825
Abhinav Sinha, Devin White, Yongcan Cao

Terminal Impact Angle Control Guidance Taking Account of Field-Of-View Constraint Using a
Time-Shifting Sliding Surface 2841
Takeshi Yamasaki, Yuhei Kikukawa, Hiroyuki Takano, Isao Yamaguchi

Generalized Vectorized Trigonometric Regularization for Solving Optimal Control Problems with
Complex Solution Structures..... 2861
Yevhenii Kovryzhenko, Nicholas P. Nurre, Ehsan Taheri

MISSILE AND TRANS-ATMOSPHERIC VEHICLE GN&C III

The Development of a Drag-Modulating Closed-Loop Feedback System to Control a Rocket's
Ascent..... 2880
Ezra Bregin, Mohamed Khalid M Jaffar

Simultaneous Trajectory Optimization for Reusable Payload Fairing Recovery Via an Initialization-
Enhanced Hp-Adaptive Pseudospectral Method 2895
Zhenyu Wei, Cong Wang, Zhijiang Shao

Robust Non-Singular Terminal Three-Dimensional Autopilot Design for Endo-Atmospheric
Interceptors..... 2915
Vignesh Anand, Shashi Ranjan Kumar

High Angle of Attack Missile Control for Agile Turn Based on Reinforcement Learning..... 2928
Youngjun Lee, Jongho Park, Youdan Kim

Enhancing Target Acquisition in Long-Range Missiles Through Multi-Sensor Fusion 2941
Marc Schneider, Walter Fichter

Near-Optimal Evasion from Realistic Pursuers Employing Modern Linear Guidance Laws..... 2953
Adi Mishley, Vitaly Shaferman

URBAN/SMALL/ROTARY WING AIRCRAFT CONTROL

Energy Optimal Flight Path Planning for Unmanned Aerial Vehicles in Urban Environments Based
on a Novel Energy-Distance Map..... 2979
Hannes Rienecker, Veit Hildebrand, Harald Pfifer

Embedding Safety Requirements into Learning-Based Controllers for Urban Air Mobility
Applications..... 2996
Omanshu Thapliyal, Malarvizhi Sankaranarayananasamy, Ravigopal Vennelakanti

Model-Free Attitude Control of Quadcopter Using Disturbance Observer and Integral Reinforcement Learning	3007
<i>Hanna Lee, Youdan Kim</i>	
Nonlinear Guidance and Optimal Control Design of Gemini V2 Small UAS with Robustness Analysis	3019
<i>Megan Carlson, Spencer Carl, Scott W. Rosa, Wesley Hunt, Brayden Niessen, Muhammad Yakawu, Christopher Whitlock</i>	
Robust Variable Horizon MPC with Move Blocking for Helicopter Shipboard Landing on Moving Decks	3040
<i>Tri Ngo, Cornel Sultan</i>	

NONLINEAR DYNAMIC INVERSION CONTROL

Handling Quality-Oriented Tuning Procedure of a Dynamic Inversion Control Law Via a Robust Control Technique	3051
<i>Resit Demirkiran, Hasan Isci, Ercument Turkoglu</i>	
Incremental Nonlinear Dynamic Inversion-Based Fault-Tolerant Guidance for UAV	3085
<i>Yeji Kim, Seungkeun Kim, Jinyoung Suk</i>	
Incremental Nonlinear Dynamic Inversion Control with Flight Envelope Protection for the Flying-V	3096
<i>Jurian Stougie, Tijmen Pollack, Erik-Jan Van Kampen</i>	
Angular Acceleration Estimation with Off-CG Accelerometers for Incremental Nonlinear Dynamic Inversion Control	3119
<i>Hojo Jeong, Junho Jeong, Jinyoung Suk, Seungkeun Kim</i>	

DISTRIBUTED GUIDANCE, NAVIGATION AND CONTROL I

Optimal Formation Control for Cooperative Slung Load Transportation	3135
<i>Giovanni Di Monaco, Alessandro Zavoli, Guido De Matteis, Giulio Avanzini</i>	
Catenary Guided Cooperative Aerial Manipulation of a Cable Suspended Payload Via Multi-Rotors	3152
<i>Uluhan C. Kaya, Kamesh Subbarao</i>	
On Collaborative Navigation with Satellite Signals of Opportunity	3168
<i>James M. Maley</i>	
Optimal Finite Time Cooperative Rendezvous for Multiple Vehicles	3184
<i>Rajeev S. Voleti, Kamesh Subbarao</i>	
Optimal Control Laws Considering Controllability Properties in Linear Time/Parameter-Varying Models for Spacecraft Relative Motion in Perturbed Orbits	3198
<i>Takahiro Sasaki</i>	

REFUELING/FORMATION CONTROL/LPV

Advanced Refueling Boom System (ARBS) Automatic Air to Air Refueling Flight Control Laws	3212
<i>Victor Martinez, Alberto Sanz, Francisco Asensio, Ignacio Romo</i>	

Decision-Making Modelling Application to Air to Air Refueling Approach Phase	3221
<i>Ignacio Romo, Francisco Asensio, Victor Martinez</i>	
A Novel Use of Model Predictive Control with Extremum Seeking in Formation Flight.....	3233
<i>Ahmed A. Elgohary, Benjamin Moidel</i>	
Target Prosecution Using Manned-Unmanned Teaming of Aircraft	3247
<i>Mohit K. Malhotra, Ashwini Ratnoo, Vijay Patel</i>	
Linear Parameter Varying Control for Real-Time Modeling Methods	3259
<i>Luke J. Miller</i>	

AIRCRAFT CONTROL TOPICS

Linear Models for Lateral-Directional Aerodynamic Stability in Unsteady Flow.....	3281
<i>Eric D. Peterson</i>	
Inlet Unstart Prevention by Adaptive Regulation Using a Nonlinear Longitudinal Timescale Model	3289
<i>Kameron J. Eves, John Valasek</i>	
Dynamics Modeling of Multicopter Type UAV with the Blade Element Momentum Theory and Nonlinear Controller Design for a Wind Environment.....	3306
<i>On Park, Hyo-Sang Shin</i>	
Scale Factor Oriented Control Parameters Tuning Procedure for Dynamically Scaled Aircraft	3320
<i>Bora Akaryildiz, Resit Demirkiran, Omer Ozyilmaz, Muhammed Emin Tanis</i>	
Deep Monocular Relative 6D Pose Estimation for Ship-Based Autonomous UAV	3339
<i>Maneesha Wickramasuriya, Taeyoung Lee, Murray Snyder</i>	
A Unified MPC Strategy for a Tilt-Rotor VTOL UAV Towards Seamless Mode Transitioning	3354
<i>Qizhao Chen, Ziqi Hu, Junyi Geng, Dongwei Bai, Mohammadreza Mousaei, Sebastian Scherer</i>	

DISTRIBUTED GUIDANCE, NAVIGATION AND CONTROL II

Experimental Validation of the Reliability-Aware Multi-UAV Coverage Path Planning Problem.....	3373
<i>Mickey Li, Arthur G. Richards, Mahesh Sooriyabandara</i>	
Flexible Multiagent Coverage Path Planning for Disjoint Areas of Interest	3384
<i>Andrea Henshall, Ezra Tal, Sertac Karaman</i>	
Flight Path Planning for Minimization of Total Noise Exposure in Urban Air Mobility Operations	3396
<i>Kail J. Yuan, Damaris R. Zachos, Jack W. Langelaan, Eric Greenwood, Kenneth Brentner</i>	
Multi-Agent Passive Inspection Coverage of an Unknown Torque-Free Rigid Body Using Monte Carlo Analysis and Quaternion Measurements.....	3419
<i>Steven C. Cutlip, Joshua Aurand, Kendra Lang, Sean Phillips</i>	

CLEAN AVIATION SPECIAL SESSION: NEXT GENERATION AIRCRAFT COCKPITS, SYSTEMS AND AVIONICS

Clean Sky 2 LPA DISruptive COckpit Large Aircraft Demonstrator (a.k.a. DisCo Demonstrator)	3440
<i>Gennaro Formisano</i>	

Clean Sky 2 LPA DISruptive COckpit Large Aircraft Virtual Test Means 3458
Martial Tchatat

Integration and Evaluation of a Full MEMS Technology in Large Passenger Aircraft Architecture..... 3463
Francesco Conte

Author Index