

# **Attitude Dynamics, Determination, and Control I**

Papers Presented at the AIAA SciTech Forum and Exposition  
2024

Orlando, Florida, USA  
8 – 12 January 2024

Volume 1 of 3

ISBN: 979-8-3313-0460-7

**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

### **ATTITUDE DYNAMICS, DETERMINATION, AND CONTROL I**

Hyperspectral Lightcurve Inversion for Attitude Determination .....	1
<i>Simão G. Marto, Massimiliano Vasile, Andrew Campbell, Paul Murray, Stephen Marshall, Vasili Savitski</i>	
Attitude Estimation Using Light Curves: A Particle Swarm Approach .....	21
<i>Alexander B. Burton, Carolin Frueh, Liam Robinson</i>	
Stochastic Bayesian Model Updating to Reduce Epistemic Uncertainty in Satellite Attitude Propagation .....	32
<i>Ewan B. Smith, Si Feng Bi, Jinglang Feng, Irene Cavallari, Massimiliano Vasile</i>	
Initial Attitude Acquisition for Uncooperative Resident Space Objects Using Principal Lines .....	45
<i>Bronislovas Razgus, Michele Maestrini, Pierluigi Di Lizia</i>	

### **CISLUNAR ASTRODYNAMICS, MISSIONS, AND OPERATIONS I**

Cislunar Orbital Uncertainty Propagation Through the Application of Radial Basis Function Approximation .....	53
<i>Pugazhenth Sivasankar, Tarek Elgohary</i>	
Physics-Informed Domain Splitting for Orbit Uncertainty Propagation .....	77
<i>Brandon A. Jones</i>	
Counting Lambert's Problem Solutions in the Circular-Restricted Three-Body Problem .....	94
<i>Riley M. Fitzgerald</i>	
Tracking and Bias Estimation in Near Rectilinear Halo Orbit Using Multiple Model Adaptive Estimation .....	110
<i>Christopher Nebelecky, Logan Andrzejewski, John L. Crassidis</i>	
Multidisciplinary System Design Optimization for Lunar Transportation Missions Via Surrogate-Assisted Evolutionary Algorithms .....	124
<i>Yuki Takao, Tsubasa Ozawa, Suk Hyun Yeo, Keisuke Suenaga, Aric Y. Bandera, Hideaki Ogawa</i>	
Accuracy of a Lunar Analytic Orbit Theory .....	149
<i>Grigory Nikitin, Kyle T. Alfriend, Bharat Mahajan</i>	

### **TRAJECTORY MANEUVER DESIGN AND OPTIMIZATION I**

Exterior Earth–Moon Transfers Design Using the Theory of Functional Connections and Homotopy .....	157
<i>Claudio Toquinho Campana, Gianmario Merisio, Francesco Topputo</i>	
Leveraging a Mesh Refinement Technique for Optimal Libration Point Orbit Transfers .....	172
<i>George V. Haman III, Anil Rao</i>	

A Suboptimal Three Body Shape Based Approach to Trajectory Design.....	196
<i>Aimar Negrete, Gage W. Harris, Ossama Abdelkhalik, Ping He</i>	
Investigation of Sequential Distant Flyby Transfer Technique for Planet-Moon System Missions .....	207
<i>Daichi Ito, Yasuhiro Kawakatsu</i>	
Sun-Earth Harmonic Orbit Via Earth-Moon Resonance Orbit .....	221
<i>Jinsung Lee, Jaemyung Ahn</i>	

### **ASTEROID AND SMALL BODY MISSIONS I**

Cosmic Origins Wayfinder (COW-1): A Preliminary Approach.....	238
<i>Duha Bader, Michael Gunnarson, Jacqueline Arroyo-Donjuan, Ramon Becerra-Orozco, Hendrik Borchert, Ipsita Chauhan, Gianluca Chaux</i>	
On the Existence and Stability of Rings Around Small Bodies.....	262
<i>Sofia Lasky-Headrick, Diogo M. Sanchez</i>	
Preliminary Study of Spacecraft and Robotic Arm Dynamics During Sampling on Phobos .....	271
<i>Kent Yoshikawa, Nobutaka Tanishima, Junji Kikuchi, Yasutaka Satou, Hiroki Kato, Hirotaka Sawada</i>	
Design of Frozen Orbits Near Small Bodies Using Attitude-Dependent Solar Radiation Pressure .....	279
<i>Jinah Lee, Chandeok Park</i>	
Enabling Multiple Small Satellite Near-Earth Asteroid Flyby Missions Using Small Solid Rocket Kick Stages with Rideshare Opportunities .....	286
<i>William Benson</i>	

### **ORBIT DETERMINATION AND ESTIMATION I**

Cislunar Orbit Determination Using Multi-Receiver Doppler Ratios .....	301
<i>Kullen W. Waggoner, David Curtis</i>	
State Estimation of Chaotic Trajectories: A Higher-Dimensional, Grid-Based, Bayesian Approach to Uncertainty Propagation.....	315
<i>Benjamin L. Hanson, Aaron J. Rosengren, Thomas R. Bewley</i>	
Angles Only Initial Relative Orbit Determination for the Circular Restricted Three-Body Problem.....	335
<i>David Zuehlke, Alex Sizemore, Troy Henderson</i>	
Nonlinear Particle Flow for Constrained Bayesian Inference .....	348
<i>Kyle J. Craft, Kyle J. DeMars</i>	
Enhancing Eclipse Transient Orbit Determination Methods with Statistical Atmospheric Models .....	368
<i>Truman DeWalch, Riley M. Fitzgerald</i>	

### **SATELLITE RENDEZVOUS AND PROXIMITY OPERATIONS I**

Adaptive End-To-End Architecture for Autonomous Spacecraft Navigation and Control During Rendezvous and Proximity Operations .....	377
<i>Justin J. Kruger, Tommaso Guffanti, Tae Ha Park, Mason Murray-Cooper, Samuel Y. Low, Toby Bell, Simone D'Amico, Christopher W. Roscoe, Jason Westphal</i>	

A Coupled Guidance & Navigation Optimization to Improve Rendezvous and Proximity Operations .....	401
<i>Christopher D. Petersen</i>	
Spacecraft Rendezvous and Docking with Obstacle Avoidance Using Bounded Buffered Voronoi Cells.....	411
<i>Nolan Chafe, Steve Ulrich</i>	
Adaptive Filtering for Multi-Satellite Relative Navigation with Quantized Measurements.....	424
<i>John Iannamorelli, Simone Semeraro, Keith A. LeGrand, Carolin Frueh</i>	
A Robust Monocular Line-Based Relative Navigation Approach for Spacecraft Rendezvous and Proximity Operations.....	441
<i>Iason Georgios Velentzas, Mehregan Dor, Panagiotis Tsiotras</i>	

## **CISLUNAR ASTRODYNAMICS, MISSIONS, AND OPERATIONS II**

Artemis Lunar Surface Navigation: Old Challenges, New Potential Solutions.....	459
<i>Anima Sabale, Erika E. Miller</i>	
Automated and Visually Interactive Navigation Analysis (AVINA) Software for Next Generation Cislunar Missions .....	469
<i>Maximilian M. Schadegg, Sonia Hernandez, Jill Seubert</i>	
Preliminary Analysis of Desirable Cislunar Orbits for Positioning, Navigation and Timing (PNT) at the Lunar South Pole, Surface, and Earth-Moon Corridor .....	485
<i>Kaitlin R. Roberts, Robert A. Bettinger</i>	
Design and Evaluation of Inertial Navigation Systems for Lunar Constellations .....	507
<i>Bongjun Yang, Enkuang D. Wang, Joseph B. Loof</i>	
Cislunar Orbit Collision Probability Analysis .....	526
<i>Stef Crum, Mariel Borowitz, Brian C. Gunter, Francis Humphrey</i>	

## **SATELLITE CONSTELLATIONS, FORMATIONS, AND RELATIVE MOTION I**

Capturing an Unknown Uncooperative Target with a Swarm of Spacecraft .....	544
<i>El Ghali Asri, Zheng Hong Zhu</i>	
Mutual Information-Based Trajectory Planning for Cislunar Space Object Tracking Using Successive Convexification.....	562
<i>Trevor Wolf, David Fridovich-Keil, Brandon A. Jones</i>	
GPS-Enhanced Spaceborne Angle-Only Relative Navigation with Dual Kalman Filters .....	583
<i>Yazan Chihabi, Steve Ulrich</i>	
Overview of the ISAM Design Challenge and Competition .....	602
<i>Jacob Rome, Vinay Goyal</i>	

## **TRAJECTORY MANEUVER DESIGN AND OPTIMIZATION II**

Hidden Genes Genetic Algorithm with Low-Thrust Shaped-Based Method.....	611
<i>Sungmoon Choi, David Knapick, Madhusudan Vijayakumar, Ossama Abdelkhalik</i>	

Chance-Constraint Method for Covariance Control of Low-Thrust Interplanetary Missions .....	625
<i>Nicola Marmo, Alessandro Zavoli</i>	
An Indirect Formulation of Operational Compliant Low-Thrust Trajectories.....	639
<i>Alessandra Mannocchi, Carmine Giordano, Francesco Toppato</i>	
Application of Indirect Multi-Stage Reachable Set Determination Algorithm for Low-Thrust Spacecraft Trajectory Optimization.....	650
<i>Sean Bowerfind, Ehsan Taheri</i>	
Low-Thrust Spacecraft Trajectory Optimization with Gravity-Assist Maneuver Using Dymos.....	672
<i>Gage W. Harris, Ping He</i>	
Enhanced Finite Fourier Series for Low-Thrust Trajectory Design .....	685
<i>Ehsan Taheri</i>	

### **CISLUNAR ASTRODYNAMICS, MISSIONS, AND OPERATIONS III**

Autonomous Satellite Operational Mode Switching for Anomalies and Space Weather Effects Mitigation.....	701
<i>Faraz Abed Azad, Alicia Petersen, Christopher Petersen</i>	
Low-Thrust Cis-Lunar Transfers Exploiting Ballistic Capture Trajectories.....	714
<i>Yashdeep Chaudhary, Harry Holt, Lorenzo Anòè, Claudio Bombardelli, Roberto Armellin</i>	
End-To-End Operationally-Constrained Low-Thrust Transfers to Gateway's Near-Rectilinear Halo Orbit .....	735
<i>Nicholas P. Nurre, Ehsan Taheri</i>	
Comparison of Standard and High-Power Electric Propulsion Trajectories.....	754
<i>Patrick O'Connell, Jennifer Hudson</i>	
Near-Optimal Lunar-Orbit Control Using Solar Sails .....	771
<i>Toshihiro Chujo</i>	
Leveraging Quasi-Periodic Orbits to Design Transfers in the Circular Restricted Three-Body Problem .....	783
<i>Dhruv Jain, Kathleen Howell</i>	

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

Uranus Flagship-Class Orbiter and Probe Using Aerocapture .....	822
<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 .....	837
<i>Ricardo Restrepo, Declan Mages, Matthew Smith, Rohan Deshmukh, Soumyo Dutta, Lylia Benhacine</i>	
Performance Analysis of Aerocapture Systems for Uranus Orbiter .....	857
<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>	

## VOLUME 2

Analysis of a Bank Control Guidance for Aerocapture at Uranus .....	875
<i>Daniel Matz, Breanna J. Johnson, Joshua Geiser, Sergio Sandoval, Rohan Deshmukh, Rafael Lugo, Soumyo Dutta, Pardhasai Chadalavada</i>	

### **TRAJECTORY MANEUVER DESIGN AND OPTIMIZATION III**

A Convex Formulation for Collision Avoidance Maneuver Strategies During Low-Thrust Phases .....	886
<i>Zeno Pavanello, Laura Pirovano, Andrea De Vittori, Pierluigi Di Lizia, Roberto Armellin</i>	
A Convex Optimization Method for Multiple Encounters Collision Avoidance Maneuvers .....	905
<i>Zeno Pavanello, Laura Pirovano, Roberto Armellin, Andrea De Vittori, Pierluigi Di Lizia</i>	
Enhanced Berthing Maneuvers Through Contact-Inclusive Dynamics: A Novel Approach .....	922
<i>Simone Asci, Angadh Nanjangud</i>	
Feature Learning Based Optimal Control Method for Cislunar Trajectory Design .....	934
<i>Roha Gul, Mitchell Dominguez, Ran Dai, Kathleen Howell</i>	

### **INTERPLANETARY MISSION DESIGN**

Mercurial Array of Probing Seismographs .....	955
<i>Sofia Lasky-Headrick, Caylin Nimmo, Vincent Palmer, A. R. Thomas, Diogo M. Sanchez</i>	
Immersive Framework for Designing Trajectories Using Augmented Reality .....	973
<i>Joseph D. Anderson, Jesika A. Geliga, Kevin Y. Tang, Kamden P. Kuykendall, David Canales, Barbara S. Chaparro</i>	
Analysis of Transfer Trajectories Utilizing Sequential Saturn-Titan Aerocaptures .....	993
<i>Isaac L. Payne, Riley M. Fitzgerald</i>	
Europa Clipper Mission Design: Analysis of Probability of Impact Requirements .....	1005
<i>Stefano Campagnola, Brent Buffington, Try Lam, mark wallace, troy goodson, Andrew French, Dylan Boone, zahi tarzi, narek Shougarian</i>	
A Feasibility Study of Microsat Mission Architectures for Ring Science in the Uranian System .....	1023
<i>An-ya Olson, Amlan Sinha, Arjun Chhabra, Sarah Fry, Kristen Ahner, Ryne Beeson, Adarsh Rajguru</i>	
Evaluation of Landing Accuracy on Planetary Moons in Circular-Restricted Three Body Problem .....	1038
<i>Go Ono</i>	

### **SPACE SITUATIONAL AWARENESS I**

Enhancing Efficiency and Autonomy in 5G/IoT Satellite Constellation Management .....	1059
<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.....	1078
<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.....	1101
<i>Kaylee M. Champion, Hanspeter Schaub</i>	

Threat Level Estimation from Possible Break-Up Events in LEO .....	1116
<i>Simone Servadio, Daniel Jang, Richard Linares</i>	

### **SPECIAL SESSION: SPACE MANEUVER AND LOGISTICS I**

Technologies Needed to Support Space Servicing, Mobility, and Logistics (SML) at the United States Space Force (USSF).....	1135
<i>Elozor Plotke, Gene Rogers, Alexander Jehle, Andrew J. Hamilton</i>	

Potential United States Space Force Mission Life Extension Applications.....	1147
<i>Jocelle Rudico, James T. Nichols, Gene Rogers</i>	

Testbed Evaluation of Pose Estimation for On-Orbit Rendezvous, Proximity Operations, and Docking Using Ultra-Wideband Transceivers .....	1162
<i>John F. Swigart, Serkan Kalender, Ryan S. Williams, Jonathon D. Schut, Ashtin K. Cheng, Ricardo Gorinstein, William R. Crain</i>	

In-Space Demonstration of Model Predictive Control Approaches for Space Towing of Uncertain Loads .....	1173
<i>Isuru Basnayake, Hyeongjun Park, Jonathan Kohler, Jennifer Hudson, Marcello Romano</i>	

Robotic Fastening Solutions and Satellite Docking Solutions with Data and Fluid Transfer Capability for In-Space Servicing, Assembly, and Manufacturing (ISAM) .....	1186
<i>Harold Hess, Deeptesh Selvaraj</i>	

### **CISLUNAR ASTRODYNAMICS, MISSIONS, AND OPERATIONS IV**

HelioSwarm: Transfer Trajectory and P/2 Lunar Resonant Orbit Design for a Multi-Satellite Observatory .....	1202
<i>Paul Levinson-Muth, Maxwell Joyner, Laura Plice</i>	

Trajectory Design and Analysis of the LUMIO CubeSat .....	1222
<i>Carmine Giordano, Carmine Buonagura, Alessandro Martinelli, Gianmario Merisio, Vittorio Franzese, Francesco Toppato</i>	

Transfers from TLI to Lunar Frozen Orbits with Applications to NASA's CLPS & ARTEMIS Programs.....	1234
<i>Anthony L. Genova, Dylan Morrison-Fogel, Paul Levinson-Muth</i>	

Flight Dynamics and Navigation Performance of the BioSentinel Mission .....	1254
<i>Jose L. Alvarellas</i>	



## **SPECIAL SESSION: SPACE MANEUVER AND LOGISTICS II**

Technology Roadmap for the Development of an Orbital Smallsat Factory .....	1281
<i>Matthew B. Obenchain, Jacob Rome, Chris Hartney, Kelvin Chen, Alejandro Trujillo, Arianna Villegas, Vinay Goyal, Jon Strizzi, Deneen Taylor</i>	
Modeling and Optimization for Space Logistics Operations: Review of State of the Art .....	1302
<i>Koki Ho</i>	
Rapid Maneuverability Requirements for On-Orbit Geo Logistic Architectures .....	1317
<i>Finn O'Brien, Ethan L. Sichler</i>	
Ballistic Lunar Return Trajectories for Sustainable Cargo Return and Entry System Technology Development .....	1330
<i>Matthew M. Wittal, Benjamin W. Asher, Jeffrey D. Smith, Morad Nazari, Alan M. Cassell, Rachel L. Ticknor, Collin P. Payne, Brian P. McCarthy, Stephen T. Scheuerle, Diane C. Davis</i>	

## **TRAJECTORY MANEUVER DESIGN AND OPTIMIZATION IV**

New Insights into Infinitely Many Equal-Impulse Impulsive Trajectories Under Two-Body Dynamics.....	1345
<i>Keziban Saloglu, Ehsan Taheri</i>	
Advancing Primer Vector Theory for Averaged Two-Body Perturbed Dynamics with Eclipsing .....	1367
<i>Noah Lifset, Ryan P. Russell</i>	
Motion Primitive Approach to Spacecraft Trajectory Design in the Neptune-Triton System .....	1388
<i>Giuliana Elena Miceli, Natasha Bosanac, Jeffrey R. Stuart, Farah Alibay</i>	
Application of the Fundamental Equation of Mechanics for Initial Guess Generation in Direct Optimization.....	1409
<i>Brennan S. McCann, Morad Nazari</i>	
Adaptive Picard-Chebyshev Methods for Bang-Bang Control Dynamics .....	1421
<i>Alex Pascarella, Robyn M. Woollands</i>	

## **ATTITUDE DYNAMICS, DETERMINATION, AND CONTROL II**

Development of a Gimbal-Based CubeSat Attitude Control Emulation Platform.....	1436
<i>Benjamin T. Walleshauser, Michael C. Bazzocchi</i>	
A Novel Fast Algorithm for Maximum Torque of General Reaction-Wheel Array.....	1450
<i>Yongjun Park, Kiwook Baeck, Hyosang Yoon</i>	
Attitude Stabilization of Momentum-Biased Transformable Spacecrafts Under Solar Radiation Pressure .....	1461
<i>Yuki Kubo, Toshihiro Chujo</i>	
Momentum Management of Reaction Wheels for an Asymmetric Geostationary Satellite: With GK-2A Flight Data Analysis.....	1479
<i>Hyungjoo Yoon, Hyeongcheol Kim, Jeongin Yun, Hyosang Yoon</i>	

## **CISLUNAR ASTRODYNAMICS, MISSIONS, AND OPERATIONS V**

Design of Elliptical Lunar Frozen Orbit Considering Lunar J2 Perturbations .....	1502
<i>Yuki Matsumoto, Ryo Nakamura, Junji Kikuchi, Satoshi Ueda</i>	
Analyzing the Challenging Region in the Earth-Moon L2 Halo Family Via Hill Restricted Four- Body Problem Dynamics.....	1513
<i>Rohith Reddy Sanaga, Kathleen Howell</i>	
Structure of the NRHO-To-LLO Abort Trajectory Design Space .....	1534
<i>Manuel Indaco, Ehsan Taheri, Davide Guzzetti</i>	
Simulated Onboard Autonomous Maneuver Design for Lunar IceCube and Lunar Reconnaissance Orbiter .....	1553
<i>Matthew Poplewell, Nathan L. Parrish, Tyler Hanf</i>	
Preliminary Analysis of Disposal Reachability for Selected Lagrange Points .....	1581
<i>Sam T. Loeffler, Ryan M. Sargent, Rene D. Velazquez, Robert A. Bettinger, Carl Hartsfield</i>	
Characterizing Transition-Challenging Regions Leveraging the Elliptic Restricted Three-Body Problem: L2 Halo Orbits .....	1604
<i>Beom Park, Kathleen Howell</i>	

## **TRAJECTORY MANEUVER DESIGN AND OPTIMIZATION V**

Landing Optimization on the Special Euclidean Group SE(3) Under Control and State-Triggered Inequality Constraints.....	1626
<i>Brennan S. McCann, Morad Nazari</i>	
Constrained Hypersonic Reentry Trajectory Optimization Using a Multiple-Domain Direct Collocation Method.....	1643
<i>Cale A. Byczkowski, Anil Rao</i>	
Booster Fly-Back Analysis of Reusable Launch Systems .....	1660
<i>Irmak Cavdar, Erwin Mooij</i>	
Optimization of Aero-Gravity Assisted Maneuvers for Spaceplanes at High Atmospheric Flight on Earth .....	1685
<i>Jhonathan Murcia-Piñeros, Riccardo Bevilacqua, Emanuela Gaglio, Antonio B. Prado, Rodolpho V. de Moraes</i>	
Exoplanet Imaging Along a Time-Varying Focal Line Using Tethered Spacecraft .....	1704
<i>Karel Hernandez Bandrich, Steven Tragesser</i>	
Direct Pseudospectral Optimal Control Using Integral Chebyshev Collocation .....	1714
<i>Ian Down, Caleb Peck, Manoranjan Majji</i>	

## **VOLUME 3**

## **EARTH ORBITAL AND PLANETARY MISSION STUDIES**

Short Period Solar Polar Orbit with High Latitude Aphelion by Piggyback on Jupiter Mission Using 2 Years $\Delta$ VEGA.....	1728
<i>Shingo Nishimoto, Junichiro Kawaguchi</i>	

Mission Planning for Minimal Orbital Conjunctions .....	1749
<i>Troy D. Rockwood, Moriba K. Jah, Yang Cheng</i>	
Onboard Space Weather Monitoring of Energetic Particles .....	1762
<i>Alicia K. Petersen, Gabriella S. Araujo</i>	
Systems Engineering of a Mars Habitat Using SMAD .....	1765
<i>Anima Sabale, Jim Adams</i>	

## **MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE FOR SPACE FLIGHT I**

Machine Learning Assisted Low-Thrust Orbit-Raising: A Comparative Assessment of a Sequential Algorithm and Deep Reinforcement Learning Approach .....	1786
<i>Atri Dutta, Adrian Arustei, Matthew Chace, Pardhasai Chadalavada, James Steck, Talha Zaidi, Arslan Munir</i>	
Analyzing Data-Driven CR3BP Orbit Representations for Immersive Astrodynamics Catalogs .....	1801
<i>Eirik C. Mulder, Davide Guzzetti</i>	
A Neural-Network-Based Gaussian Nonlinear Filter .....	1815
<i>Felipe Giraldo-Grueso, Andrey A. Popov, Renato Zanetti</i>	
Machine Learning-Based Light Curves Brightness Prediction for Space Objects in the Geostationary Belt .....	1833
<i>Andrea D'Ambrosio, Andrea Scorsoglio, Adam Battle, Roberto Furfaro, Vishnu Reddy</i>	
Towards a Machine Learning-Based Approach to Predict Space Object Density Distributions .....	1846
<i>Victor Rodriguez-Fernandez, Sumiyajav Sarangerel, Peng Mun Siew, Pablo Machuca, Daniel Jang, Richard Linares</i>	

## **SPACE SITUATIONAL AWARENESS II**

Preliminary Lunar Surface SSA Architecture Optimization for the Observability of Cislunar and Lunar Resident Space Objects .....	1859
<i>Clint Spesard, Robert A. Bettinger</i>	
An Octree-Based Spatial Index for Space-Based Space Surveillance Coverage Volume Computation .....	1870
<i>Ryan Ketzner, Tarek A. Elgohary</i>	
Sensor Tasking Strategies for Space-Based Observers in the Cislunar Environment .....	1882
<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 .....	1902
<i>Smriti Nandan Paul, Hang Woon Lee</i>	
An Efficient Thrust-Limited Control Metric: Towards Tractable Reachability Computations in the Two-Body Problem .....	1920
<i>Guillermo Escribano, Manuel Sanjurjo Rivo, Jan Siminski, Alejandro Pastor, Diego Escobar</i>	

## **ORBIT DETERMINATION AND ESTIMATION II**

Cost-Effective Platform for Validating Optical Autonomous Navigation Systems and Algorithms on Earth .....	1932
<i>Paulo Kemper, Hyogeun Han, Hyosang Yoon</i>	
Orbit Determination Pipeline for Geostationary Objects Using Physics-Informed Neural Networks.....	1943
<i>Andrea Scorsoglio, Andrea D'Ambrosio, Tanner Campbell, Roberto Furfaro, Vishnu Reddy</i>	
Hybrid-Bernoulli Filter for Spacecraft Maneuver Estimation .....	1954
<i>Evan M. Hefflin, Kyle J. DeMars</i>	
A Kernel Method Approach to Orbital Debris Blast Point Determination .....	1968
<i>Jackson Kulik, Owen Oertel, Dmitry Savransky</i>	

## **SATELLITE RENDEZVOUS AND PROXIMITY OPERATIONS II**

Time Variant Particle Swarm Optimization (TVPSO) for Autonomous Extraterrestrial Rescue and Recovery.....	1975
<i>Kyle Sanders, May-Win Thein</i>	
Optimal Rendezvous Trajectories Initialized with Analytical Radial Thrust Solutions.....	1986
<i>Mihir Vedantam, Siddarth Kaki, Maruthi Akella</i>	
Optimal NMC Trajectory Design for On-Orbit, Multi-Agent Inspection Missions .....	2000
<i>Mark Mercier, David Curtis</i>	
Thruster Pointing Constrained Optimal Control for Satellite Servicing Using Indirect Optimization .....	2010
<i>Himmat Panag, Robyn M. Woollands</i>	
A Differentially-Flat, Pseudospectral, Shape-Based Solver and Embedded MPC for Berthing with Non-Cooperative Targets.....	2023
<i>Sergio Cuevas del Valle, Ester Velazquez Navarro, Pablo Solano-López, Hodei Urrutxua</i>	
Multi-Arm Post-Docking Spacecraft Dynamics Using Penalty Methods.....	2058
<i>Andrew M. Morell, João Vaz Carneiro, Leah Kiner, Hanspeter Schaub</i>	

## **TRAJECTORY MANEUVER DESIGN AND OPTIMIZATION VI**

Numerical Determination of Eclipse Times for Elliptical Spacecraft Orbits.....	2071
<i>James Austin</i>	
Optimal Orbit Populating Strategy of a Versatile Micro-Launcher Upper Stage for Multi-Small Satellites Missions.....	2095
<i>Eric Bourgeois, Arnaud Dupuis</i>	
Indirect Optimal Control Techniques for Multimode Propulsion Mission Design .....	2114
<i>Bryan C. Cline, Alex Pascarella, Robyn M. Woollands, Joshua L. Rovey</i>	
Lunar Exploration Through Co-Operative Rovers Using Smart Navigation.....	2138
<i>Bibek Adhikari, Rakesh Yadav, Jinaykumar Patel, Kamesh Subbarao</i>	

## **MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE FOR SPACE FLIGHT II**

Meta-Reinforcement Learning with Transformer Networks for Space Guidance Applications .....	2156
<i>Lorenzo Federici, Roberto Furfaro</i>	
Hardware Implementation of Learning Reference Governors for Spacecraft Rendezvous and Proximity Maneuvering with Mobile Robots .....	2177
<i>Jonathan Heidegger, Samantha Romano, Abhiram Reddy Kondur, Anouck Girard, Ilya Kolmanovsky</i>	
Assurance of Human-AI Interaction Based Systems for Spaceflight: A Discussion of Critical Aspects to Increase Mutual Trust and Reliability .....	2187
<i>Kanak Parmar, Nathan L. Parrish</i>	

## **SPACE SITUATIONAL AWARENESS III**

Segregating Orbital Station Keeping Maneuvers of Non-Cooperative Space Objects Using SMOTE Based Imbalanced Learning .....	2202
<i>Shivshankar S, Debasish Ghose</i>	
Survey Mode: A Review of Machine Learning in Resident Space Object Detection and Characterization.....	2216
<i>Konstantinos Tsaprailis, George Choumos, Vaios Lappas, Charalampos Kontoes</i>	
Artificial Intelligence for a Safe Space: Data and Model Development Trends in Orbit Prediction and Collision Avoidance .....	2243
<i>George Choumos, Konstantinos Tsaprailis, Vaios Lappas, Charalampos Kontoes</i>	
Performance of Observational Spacecraft Across Orbit Families for Space Domain Awareness in the Cislunar Realm .....	2272
<i>Brian P. Baker-McEvelly, Jared Rose, Surabhi Bhadauria, David Canales, Carolin Frueh, Hancheol Cho</i>	
Development of an EKF-Based Tracking Algorithm for Unresponsive Objects in Cislunar Space and Methods for Its Use in Cislunar Surveillance Architecture Design .....	2293
<i>Neel Puri, Michael J. Steffens, Dimitri N. Mavris</i>	

## **TRAJECTORY MANEUVER DESIGN AND OPTIMIZATION VII**

Stochastic Trajectory and Robust Controller Optimization Via Contractive Optimal Control .....	2311
<i>Akan Selim, Ahmet T. Cetin, Ibrahim Ozkol, Emre Koyuncu</i>	
Impact of Disparate Goals on Evader Performance in an Orbital Pursuer-Evader Game .....	2325
<i>Stephanie Halsey, David Curtis, Eric Prince</i>	
Optimized Measurement Timing for In-Space Thrust Inference .....	2341
<i>Oliver Jia-Richards</i>	
Stochastic Optimal Control Under Non-Gaussian Uncertainties Via Entropy Minimization and Dynamical Indicators.....	2352
<i>Akan Selim, Ahmet T. Cetin, Ibrahim Ozkol, Emre Koyuncu</i>	

Introducing the Tiger Optimization Software (TOPS): An Open-Source MATLAB Pseudospectral Solver .....	2367
<i>Sam Sowell, Ehsan Taheri</i>	

## **ASTEROID AND SMALL BODY MISSIONS II**

Strategic Revision of Target Marker Tracking by Hayabusa2 Against Camera Degradation: Challenges and In-Flight Results in 2nd Landing on Asteroid Ryugu.....	2386
<i>Naoko Ogawa, Fuyuto Terui, Yuya Mimasu, Kent Yoshikawa, Go Ono, Seiji Yasuda, Kota Matsushima, Hiroki Hihara, Junpei Sano, Yuto Takei, Takanao Saiki, Yuichi Tsuda</i>	
Asteroid Gravity Field Estimation Using a Gravity Gradiometer .....	2407
<i>Sergio Coll Ibars, Daniel Scheeres, Penina Axelrad</i>	
Gravity-Field Estimation of Asteroids.....	2425
<i>Erwin Mooij, Bart C. Root</i>	

## **ATTITUDE DYNAMICS, DETERMINATION, AND CONTROL III**

Exploring the Feasibility of Electromagnetic Attitude Control Systems for Small Satellites.....	2438
<i>Adam Sardouk, Christopher Petersen</i>	
Image-Based Synchronised Control of Spacecraft's Attitude and Space Manipulator's Motions for Capturing Uncooperative Targets .....	2455
<i>Shabadini Sampath, Jinglang Feng, Simão G. Marto, Massimiliano Vasile</i>	
Attitude Control of Dual-Spin Satellites in Low-Earth Orbit Via Predictive Control and Magnetic Actuation .....	2468
<i>Robert D. Halverson, Demoz Gebre-Egziabher, Ryan Caverly</i>	
Attitude Control of Magnetically Actuated Satellite in Circular Orbit: A Controllability Analysis .....	2483
<i>Shreshtha Agarwal, Kumardip Basak, Dipak K. Giri</i>	

## **SATELLITE CONSTELLATIONS, FORMATIONS, AND RELATIVE MOTION II**

Optimization of Inter-Constellation Data Transport Using a Satellite Ring .....	2508
<i>Troy D. Rockwood, Moriba K. Jah, Yang Cheng</i>	
Composite Nonlinear Generalized Predictive Control for Spacecraft Formation Flying Under Disturbances .....	2523
<i>Divya Rao Ashok Kumar, Steve Ulrich</i>	
Thrust-Stabilized Attitude Control for Rotating Large Thin-Film Structures Held by Formation-Flying Satellites.....	2544
<i>Tsukasa Funane, Yosuke Tanabe, Hisatoshi Kimura, Makoto Ito, Koichi Watanabe, Shinichi Nakasuka</i>	

## **SATELLITE RENDEZVOUS AND PROXIMITY OPERATIONS III**

Time Shift Governor for Spacecraft Proximity Operation in Elliptic Orbits.....	2558
<i>Taehyeun Kim, Ilya Kolmanovsky, Anouck Girard</i>	

Electro-Optical Based Relative Navigation for Close-Range Inspection and Rendezvous in the  
SpEye CubeSat-Based Mission ..... 2571  
*Roberto Opromolla, Alessia Nocerino, Giuseppe Napolano, Giancarmine Fasano, Michele  
Grassi, Vincenzo Capuano, Simone Illiano, Raffaele Votta, Marianna Rinaldi, Giuseppe  
Leccese, Silvia Natalucci*

**Author Index**