

**2019 Astrodynamics Specialist Conference  
Portland, ME August 11-15, 2019**

Aug 12, 2019 Longfellow

**Earth Orbital & Planetary Missions**

Chair: Kyle T. Alfriend, Texas A&M University

- 8:00 AAS Optimal Deorbit from Low Earth Orbit with Electric Propulsion**  
**19-** *Nathan Parrish, Advanced Space, LLC; Jeff Parker, Advanced Space, LLC;*  
**742** *Cameron Meek, OneWeb; Aurelie Heritier, OneWeb*
- 8:20 AAS Mission Opportunities to Trans-Neptunian Objects - Part VI**  
**19-** *Daniel Johnson, University of Tennessee; Zackery Crum, University of*  
**748** *Tennessee; Garrett Mitchell, The University of Tennessee; Samuel Walters,*  
*University of Tennessee; Adam Dalton, University of Tennessee; Brandon*  
*Davis, University of Tennessee; Benjamin Dolmovich, University of Tennessee;*  
*Meghan Green, University of Tennessee; Amanda Williams, University of*  
*Tennessee; Gerald Wise, University of Tennessee; James Evans Lyne,*  
*University of Tennessee*
- 8:40 AAS Optical Methods for Finding New Natural Satellites of the Solar System's**  
**19-** **Outer Planets**  
**649** *Paul McKee, Rensselaer Polytechnic Institute; William Parker, Rensselaer*  
*Polytechnic Institute; John Christian, Rensselaer Polytechnic Institute*
- 9:00 AAS Overview of the Deep Space Atomic Clock Technology Demonstration**  
**19-** **Mission**  
**796** *Todd Ely, Jet Propulsion Laboratory; Jill Seubert, NASA / Caltech JPL*
- 9:20 AAS Impulsive Least-Squares Orbit Maintenance using Gauss's Variational**  
**19-** **Equations**  
**613** *Daniele Mortari, Texas A&M University; Gang Zhang, Harbin Institute of*  
*Technology*
- 9:40 AAS OPTIMIZATION OF LOW THRUST TRANSFER ORBITS OF A**  
**19-** **SPACECRAFT CONSIDERING THE RADIATION HAZARD FROM**  
**802** **THE VAN ALLEN BELTS**  
*Rodrigo Schmitt, Institute of Astronomy, Geophysics and Atmospheric Sciences*  
*of University of Sao Paulo; Gerson Barbosa, INPE; Antonio Fernando*  
*Bertachini Prado, INPE*
- 10:00 Morning Break**

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- 10:20 AAS Extended Phase Space Realization for Attitude Dynamics of an  
19- Axisymmetric Body in Eccentric Orbit  
753** *Roshan Thomas Eapen, Texas A&M University; Kyle T. Alfriend, Texas A&M University; Manoranjan Majji, Texas A&M University, College Station*
- 10:40 AAS Solar Radiation Pressure Effects on the orbital motion at SEL2 for the  
19- James Webb Space Telescope  
657** *Ariadna Farres, University of Maryland Baltimore County; Jeremy Petersen, a.i. solutions; Karen Richon, NASA GSFC*
- 11:00 AAS Stable Low Altitude Lunar Periodic Orbits using the GRAIL Gravity Field  
19-  
903** *Sean McArdle, University of Texas at Austin; Ryan Russell, The University of Texas at Austin*
- 11:20 AAS Vehicle and Mission Design Options for Very Low Earth Orbit CubeSats  
19-  
860** *James Williams, University of Illinois at Urbana-Champaign; Michael Gray, University of Illinois at Urbana-Champaign; Zachary Putnam, University of Illinois at Urbana-Champaign*

Aug 12, 2019 Hawthorne

**Guidance, Navigation & Control I**

Chair: Anil Rao, University of Florida

- 8:00 AAS Multi-Sensor Management under Information Constraints  
19-  
663** *Kirsten Tuggle, The University of Texas at Austin; Maruthi R. Akella, The University of Texas at Austin*
- 8:20 AAS Uncertainty Analysis of a Generalized Coning Algorithm for Inertial  
19-  
827** *James Brouk, Missouri University of Science and Technology; Kyle DeMars, Texas A&M University*
- 8:40 AAS Generalized Composite Noncertainty-Equivalence Adaptive Control of  
19-  
621** *Keum Lee, CatholicKwandong Univ; Sahjendra Singh, University of Nevada Las Vegas*
- 9:00 AAS The Surface Navigation Approach for the Dragonfly Lander  
19-  
722** *Benjamin Schilling, Johns Hopkins Applied Physics Laboratory; Benjamin Villac, Johns Hopkins University Applied Physics Laboratory; Douglas Adams, The Johns Hopkins University Applied Physics Laboratory*

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- 9:20 AAS A Framework for Scaling in Filtering and Linear Covariance Analysis**  
**19-687** *Christopher D'Souza, NASA - Johnson Space Center; Renato Zanetti, University of Texas at Austin; David Woffinden, NASA Johnson Space Center*
- 9:40 AAS An Analysis of the Theory of Connections Subject to Inequality Constraints**  
**19-732** *Hunter Johnston, Texas A&M University; Carl Leake, Texas A&M University; Daniele Mortari, Texas A&M University*
- 10:00 Morning Break**
- 10:20 AAS ADDRESSING VARYING LIGHTING CONDITIONS WITH APPLICATION TO TERRAIN RELATIVE NAVIGATION**  
**19-925** *Jonathan Manni, University of Colorado Boulder; Jay McMahan, University of Colorado Boulder; Nisar Ahmed, University of Colorado Boulder*
- 10:40 AAS Adaptive, Dynamically Constrained Process Noise Estimation for Autonomous Orbit Determination**  
**19-809** *Nathan Stacey, Stanford University; Simone D'Amico, Stanford University*
- 11:00 AAS An Explanation and Implementation of Multivariate Theory of Connections via Examples**  
**19-734** *Carl Leake, Texas A&M University; Daniele Mortari, Texas A&M University*
- 11:20 AAS Characterization of Candidate Vehicle States for XNAV Systems**  
**19-645** *Kevin Lohan, University of Illinois at Urbana-Champaign; Zachary Putnam, University of Illinois at Urbana-Champaign*

Aug 12, 2019 Rines A

**Relative Motion, Formation Flying, Rendezvous and Proximity Operations I**

Chair: Simone D'Amico, Stanford University, Alex Sizemore, NRC

- 8:00 AAS Monte Carlo Analysis of a Particle Swarm Optimizer of Space-based Receivers for Geolocation Using Heterogeneous TDOA**  
**19-659** *David Lujan, University of Colorado Boulder; Alan Lovell; Troy Henderson, Embry-Riddle Aeronautical University*
- 8:20 AAS Sensor Selection Strategies for Satellite Swarm Collaborative Localization**  
**19-920** *William Bezouska, University of Southern California; David Barnhart, University of Southern California*

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- 8:40 AAS Desensitized Optimal Attitude Guidance for Differential-Drag Rendezvous**  
**19-651** *Andrew Harris, University of Colorado Boulder; Ethan Burnett, University of Colorado Boulder; Hanspeter Schaub, University of Colorado*
- 9:00 AAS Second-Order Solution for Relative Motion on Eccentric Orbits in**  
**19-810** **Curvilinear Coordinates**  
*Matthew Willis, Stanford University; Simone D'Amico, Stanford University; Kyle T. Alfriend, Texas A&M University*
- 9:20 AAS Precise rendezvous guidance in cislunar orbit via surrogate modelling**  
**19-764** *Satoshi Ueda, Japan Aerospace Exploration Agency*
- 9:40 AAS Dynamical Issues in Rendezvous operations with Third Body Perturbation**  
**19-610** *Giordana Bucchioni, Department of information engineering ; Mario Innocenti, University of Pisa - Department of Information Engineering*
- 10:00 Morning Break**
- 10:20 AAS Applied Reachability Analysis of Spacecraft Rendezvous With a Tumbling**  
**19-699** **Object**  
*Costantinos Zagaris, Air Force Institute of Technology; Marcello Romano, Naval Postgraduate School*
- 10:40 AAS Desensitized Optimal Spacecraft Rendezvous Control with Poorly Known**  
**19-685** **Gravitational and Solar Radiation Pressure Perturbations**  
*Ethan Burnett, University of Colorado Boulder; Andrew Harris, University of Colorado Boulder; Hanspeter Schaub, University of Colorado*
- 11:00 AAS MMS Extended Mission Eclipse Mitigation and Solar Wind Turbulence**  
**19-913** **Science Campaign**  
*Trevor Williams, NASA/Goddard Space Flight Center; Eric Palmer, a.i. solutions, Inc.; Dominic Godine, ai Solutions, Inc.; Neil Ottenstein, a.i. solutions, Inc.; Jacob Hollister, ai Solutions, Inc.; Babak Vint, a.i. solutions, Inc.*

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**Trajectory Design & Optimization I**

Chair: Angela Bowes, NASA LaRC

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- 8:00 AAS NAVIGATING TO A KUIPER BELT OBJECT: MANEUVER  
19- PLANNING ON THE APPROACH TO ULTIMA THULE  
836** *Dale Stanbridge, KinetX Aerospace; Michael Salinas, KinetX Aerospace; Kenneth Williams, KinetX Aerospace, Inc.; Frederic Pelletier, KinetX Inc.; Jeremy Bauman, KinetX Inc.; Joel Fischetti, KinetX Aerospace; Derek Nelson, KinetX, Inc.; Erik Lessac-Chenen, KinetX Aerospace, Inc.; Coralie Adam, KinetX, Inc.; John Pelgrift, KinetX, Inc.; Bobby G. Williams, KinetX, Inc.; Yanping Guo, JHUAPL; Gabe D. Rogers, The Johns Hopkins University Applied Physics Laboratory; Mark Holdridge, Johns Hopkins APL; H. A. Weaver, Johns Hopkins Univ. Applied Physics Lab; Alan Stern, Southwest Research Institute; Cathy Olkin; John Spencer, Southwest Research Institute; Marc Buie, Southwest Research Institute; Simon Porter, Southwest Research Institute*
- 8:20 AAS Rapid Evaluation of Low-Thrust Transfers from Elliptical Orbits to  
19- Geostationary Orbit  
733** *Mason Kelchner, University of Missouri; Craig Kluever, University of Missouri*
- 8:40 AAS Endgame Design for Europa Lander: Ganymede to Europa Approach  
19- Rodney L. Anderson, Jet Propulsion Laboratory/Caltech; Stefano Campagnola,  
745 Jet Propulsion Laboratory; Dayung Koh, JPL; Tim McElrath, JPL/Caltech;  
Robyn Woollands, Jet Propulsion Laboratory**
- 9:00 AAS Homo- and Heteroclinic Connections in the Spatial Solar-Sail Earth-Moon  
19- Three-Body Problem  
782** *Jeannette Heiligers, Delft University of Technology*
- 9:20 AAS Interplanetary Low-Thrust Design Using Proximal Policy Optimization  
19- Daniel Miller, Massachusetts Institute of Technology; Jacob Englander, NASA  
779 Goddard Space Flight Center; RICHARD LINARES, Massachusetts Institute of  
Technology**
- 9:40 AAS Missed-Thrust Analysis of BepiColombo's Interplanetary Transfer to  
19- Mercury Orbit  
883** *Pablo Muñoz, European Space Agency*
- 10:00 Morning Break**
- 10:20 AAS Through the Looking Glass: Mission Design using Interactive and  
19- Immersive Visualization Environments  
694** *Jeffrey Stuart, Jet Propulsion Laboratory; Amos Byon, Jet Propulsion Laboratory; Alexander Menzies, Jet Propulsion Laboratory; Try Lam, Jet Propulsion Laboratory; Brent Buffington, NASA / Caltech JPL; Sonia Hernandez, Jet Propulsion Laboratory*

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- 10:40 AAS Theory of Connections applied to nonlinear programming under equality  
19- constraints  
675** *Daniele Mortari, Texas A&M University; Yalchin Efendiev, Texas A&M University*
- 11:00 AAS Revisiting “How Many Impulses?” Question  
19-  
915** *Ehsan Taheri, Auburn University; John L. Junkins, Texas A&M University*
- 11:20 AAS FAST SOLUTION OF OPTIMAL CONTROL PROBLEMS WITH L1  
19- COST  
904** *Simon Le Cleac’h, Stanford University; Zachary Manchester, Stanford University*

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**Guidance, Navigation & Control II**

Chair: Peter Lai, NASA Jet Propulsion Laboratory

- 13:30 AAS SUN-AVOIDANCE SLEW PLANNING ALGORITHM WITH  
19- POINTING AND ACTUATOR CONSTRAINTS  
801** *Mohammad A. Ayoubi, Santa Clara University; Junette Hsin, Maxar Space Solutions*
- 13:50 AAS CHANGO: A Software Tool for Boost Stage Guidance of the Space Launch  
19- System Exploration Mission 1  
726** *Matthew Hawkins, Jacobs Space Exploration Group; Naeem Ahmad, NASA MSFC; Paul von der Porten, NASA Marshall Space Flight Center*
- 14:10 AAS Fuel-efficient Powered Descent Guidance on Planetary Bodies via Theory  
19- of Connection  
718** *Enrico Schiassi, University of Arizona; Roberto Furfaro, The University of Arizona; Hunter Johnston, Texas A&M University; Daniele Mortari, Texas A&M University*
- 14:30 AAS Error Analysis of Closed-loop Attitude Estimation and Control System for  
19- Spacecraft High Accuracy Pointing  
739** *Divya Bhatia, Institute of Flight Guidance, Technical University of Braunschweig*

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- 14:50 AAS Onboard Optical Navigation for Asteroid Explorer by Asteroid Shape  
19- Model  
881** *Shuya Kashioka, SOKENDAI; Yuichi Tsuda, Japan Aerospace Exploration Agency; Yuki Takao, The University of Tokyo; Takatoshi Iyota, Soka University; Genki Ohira, SOKENDAI*
- 15:10 AAS Control and Simulation of a Deployable Entry Vehicle with Aerodynamic  
19- Control Surfaces  
919** *Benjamin Margolis, NASA*
- 15:30 Afternoon Break**
- 15:50 AAS Variational Lambert Problem with uncertain dynamics  
19- Paolo Panicucci; Jay McMahon, University of Colorado Boulder; Michel  
868** *Delpech, CNES; Emmanuel Zenou, ISAE-SUPAERO*
- 16:10 AAS Analytical State Transition Matrix For Dual-Quaternions For Spacecraft  
19- Pose Estimation  
804** *Andrew Goodyear, Penn State University; Puneet Singla, Pennsylvania State University; David B. Spencer, Pennsylvania State University*
- 16:30 AAS Collision Avoidance Around Small Bodies Using Low-Thrust Guidance  
19- Donald Kuettel, Colorado Center for Astrodynamics Research; Jay McMahon,  
916** *University of Colorado Boulder*
- 16:50 AAS SUN SEARCH DESIGN FOR THE PSYCHE SPACECRAFT  
19- Daniel Cervantes, NASA Jet Propulsion Laboratory; Peter Lai, NASA Jet  
650** *Propulsion Laboratory; Alex Manka, NASA Jet Propulsion Laboratory; Aditi Ratnaparkhi, Maxar Space Solutions; Eric Turner, SSL MDA*
- 17:10 AAS The Evolution of Deep Space Navigation: 2009-2012  
19- Lincoln Wood, Jet Propulsion Laboratory, Caltech  
655**

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**Orbital Dynamics, Perturbations, and Stability**

Chair: Roby Wilson, Jet Propulsion Laboratory

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- 13:30 AAS Approximate Analytic Representations For Fixed-angle Low-thrust Trajectories**  
**19-731** *Guanwei He, Pennsylvania State University; Robert Melton, Pennsylvania State University*
- 13:50 AAS Analytic Approximations of Orbit Geometry in a Rotating Higher Order Gravity Field**  
**19-684** *Ethan Burnett, University of Colorado Boulder; Hanspeter Schaub, University of Colorado*
- 14:10 AAS Orbit Propagation via the Theory of Connections**  
**19-736** *Hunter Johnston, Texas A&M University; Daniele Mortari, Texas A&M University*
- 14:30 AAS Quasi-Heliosynchronous Orbits**  
**19-780** *Maria Livia da Costa, National Institute For Space Research; Rodolpho Moraes, UNIFESP; Antonio Fernando Bertachini Prado, INPE; Jean Paulo S. Carvalho, UNIFESP - Instituto de Ciência e Tecnologia*
- 14:50 AAS Long-Term Numerical Propagation for Earth Orbiting Satellites**  
**19-601** *David A. Vallado, Analytical Graphics, Inc.*
- 15:10 AAS Lunisolar Perturbations of High-Eccentricity Orbits Such as the Magnetospheric Multiscale Mission**  
**19-914** *Trevor Williams, NASA/Goddard Space Flight Center; Eric Palmer, a.i. solutions, Inc.; Dominic Godine, ai Solutions, Inc.; Neil Ottenstein, a.i. solutions, Inc.; Rich Burns, NASA; Jacob Hollister, ai Solutions, Inc.*
- 15:30 Afternoon Break**
- 15:50 AAS Computing Kepler Equations for Analytic Orbit Propagation**  
**19-624** *Gim Der, DerAstrodynamics*
- 16:10 AAS Navigation Models for Psyche Electric Propulsion Uncertainty**  
**19-644** *Nicholas Bradley, CalTech / Jet Propulsion Laboratory; Steve Snyder, CalTech / Jet Propulsion Laboratory; Drew Jones, Jet Propulsion Laboratory, Caltech; Denis Trofimov, CalTech / Jet Propulsion Laboratory; Dayung Koh, JPL*
- 16:30 AAS APPLICATION OF UDWADIA-KALABA FORMULATION TO THREE-BODY PROBLEM**  
**19-805** *Harshkumar Patel, Embry-Riddle Aeronautical University; Troy Henderson,*



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*Embry-Riddle Aeronautical University; Morad Nazari, Embry-Riddle  
Aeronautical University*

- 16:50 AAS Long-term Survey of LAMR and HAMR Objects Using Analytic  
19- Techniques  
642 Smriti Nandan Paul, Purdue University; Carolin Frueh, Purdue University**

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**Relative Motion, Formation Flying, Rendezvous and Proximity Operations II**

Chair: Jeffrey Stuart, Jet Propulsion Laboratory

- 13:30 AAS Constellation Planning Methods for Sequential Spacecraft Rendezvous  
19- Using Multi-Agent Scheduling  
648 Skylar Cox, Space Dynamics Laboratory; Nathan Stastny, Space Dynamics  
Laboratory; Greg Droge, Utah State University; David Geller, Utah State  
University**
- 13:50 AAS Geometric Formations Using Relative Orbital Elements and Artificial  
19- Potential Functions  
679 Sylvain Renevey, Purdue University; David A. Spencer, Purdue University**
- 14:10 AAS Launch, Transport, Aggregation, and Assembly of an In-Space Assembled  
19- Telescope  
941 Bo Naasz, NASA**
- 14:30 AAS Constrained Energy-Optimal Guidance in Relative Motion via Theory of  
19- Functional Connections and Rapidly-Explored Random Trees  
662 Kristofer Drozd, University of Arizona; Roberto Furfaro, The University of  
Arizona; Daniele Mortari, Texas A&M University**
- 14:50 AAS Analytic Center of Illumination solutions to aid Relative Navigation with  
19- Partially Resolved Imagery  
832 Kevin Kobylka, Rensselaer Polytechnic Institute; John Christian, Rensselaer  
Polytechnic Institute; Jacob Puritz, Rensselaer Polytechnic Institute**
- 15:10 AAS Autonomous Characterization of an Asteroid from a Hovering Trajectory  
19- Shota Takahashi, University of Colorado Boulder; Daniel Scheeres, University  
850 of Colorado Boulder**
- 15:30 Afternoon Break**

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- 15:50 AAS Morse-Lyapunov-Based Decentralized Consensus Control of Rigid Body  
19- Spacecraft in Orbital Relative Motion  
713 Eric Butcher, University of Arizona; Mohammad Maadani, University of  
Arizona**
- 16:10 AAS Nonlinear Optimal Tracking Control of Two-Craft Coulomb Formation in  
19- Elliptic Chief Orbits  
706 Muhammad Wasif Memon, Embry-Riddle Aeronautical University; Morad  
Nazari, Embry-Riddle Aeronautical University; Richard Prazenica, Embry-  
Riddle Aeronautical University ; Dongeun Seo, Embry-Riddle Aeronautical  
University**
- 16:30 AAS HelioSwarm: Space-Based Relative Ranging for a Cubesat Cluster Mission  
19- in a 2:1 Lunar Resonant Orbit  
627 Lisa Policastri, Space Exploration Engineering (SEE); James Woodburn,  
Analytical Graphics, Inc.**

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**Trajectory Design & Optimization II**

Chair: Pradipto Ghosh, Analytical Graphics, Inc.

- 13:30 AAS Robust Trajectory Optimization Using Minimum-Error Cost Functions  
19- Erica Jenson, University of Colorado Boulder; Daniel Scheeres, University of  
838 Colorado Boulder**
- 13:50 AAS A Convex Optimization Approach for Finite-Thrust Time-Constrained  
19- Cooperative Rendezvous  
763 Boris Benedikter, Sapienza University of Rome; Alessandro Zavoli; Guido  
Colasurdo, Università di Roma Sapienza**
- 14:10 AAS Launch Opportunity Analysis of GEO Transfer with High Inclination  
19- using Lunar Gravity Assist  
690 Su-JIN Choi, Korea Aerospace Research Institute; John Carrico, Space  
Exploration Engineering, LLC; Michel Loucks, Space Exploration Engineering  
(SEE); Hoonhee Lee, Korea Aerospace Research Institute; Se-Jin Kwon, Korea  
Advanced Institute of Science and Technology**

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- 14:30 AAS Design and Synthesis of Entry, Powered Descent and Landing Maneuver  
19- Trajectories using Motion Envelopes  
932 Melissa Onishi, University of Hawaii at Mānoa**
- 14:50 AAS Dependent Variable Integration for event finding with validation in orbit  
19- propagation  
768 Anthony Iannuzzi, U.S. Naval Research Laboratory**
- 15:10 AAS ACCURATE LOW-THRUST ORBIT TRANSFER SOLUTIONS IN  
19- EQUINOCTIAL ELEMENTS USING AN ANALYTIC  
770 REPRESENTATION OF THE GEOPOTENTIAL  
Zachary Folcik, MIT Lincoln Laboratory; Paul J. Cefola, University at Buffalo  
(SUNY)**
- 15:30 Afternoon Break**
- 15:50 AAS Copernicus 5.0: Latest Advances in JSC's Spacecraft Trajectory  
19- Optimization and Design System  
719 Jacob Williams, NASA Johnson Space Center; Anubhav Kamath, MRI  
Technologies; Randy Eckman, NASA Johnson Space Center; Gerald Condon,  
NASA; Ravishankar Mathur, Emergent Space Technologies, Inc.; Diane Davis,  
a.i. solutions, Inc.**
- 16:10 AAS Parker Solar Probe Mission Design  
19- Yanping Guo, JHUAPL  
789**
- 16:30 AAS High-Fidelity Multiple-Flyby Trajectory Optimization Using Multiple-  
19- Shooting  
661 Donald Ellison, NASA Goddard Space Flight Center; Jacob Englander, NASA  
Goddard Space Flight Center**

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**Dynamical Systems Theory I**

Chair: Natasha Bosanac, University of Colorado, Boulder

- 8:00 AAS High-Energy Lunar Capture via Low-Thrust Dynamical Structures  
19- Andrew Cox, Purdue University; Kathleen C. Howell, Purdue University; David  
696 Folta, NASA Goddard Space Flight Center**

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- 8:20 AAS Linking Low- to High-Energy Dynamics of Invariant Manifold Tubes, 19- Transit Orbits, and Singular Collision Orbits 769**  
*Kenta Oshima, National Astronomical Observatory of Japan*
- 8:40 AAS Canonical Transformations via a Sparse Approximation-Based Collocation 19- Method for Dynamical Systems 855**  
*Roshan Thomas Eapen, Texas A&M University; Kyle T. Alfriend, Texas A&M University; Manoranjan Majji, Texas A&M University, College Station; Puneet Singla, Pennsylvania State University*
- 9:00 AAS Enabling Broad Energy Range Computations at Libration Points Using 19- Isolating Neighborhoods 744**  
*Rodney L. Anderson, Jet Propulsion Laboratory/Caltech; Robert Easton; Martin Wen-Yu Lo, Jet Propulsion Laboratory*
- 9:20 AAS Transfers from GTO to Sun-Earth Libration Orbits 19- 814**  
*Juan Ojeda Romero, Purdue University; Kathleen C. Howell, Purdue University*
- 9:40 AAS Accessing Highly Out-of-Ecliptic Science Orbits via Low-Energy, Low- 19- Thrust Transport Mechanisms 728**  
*Jeffrey Stuart, Jet Propulsion Laboratory; Rodney L. Anderson, Jet Propulsion Laboratory/Caltech; Christopher Sullivan, University of Colorado Boulder; Natasha Bosanac, University of Colorado, Boulder*
- 10:00 Morning Break**
- 10:20 AAS Design and Control of Spacecraft Trajectories in the Full Restricted Three 19- Body Problem 637**  
*Isabelle Jean, McGill University; Arun K. Misra, McGill University; Alfred Ng, Canadian Space Agency*
- 10:40 AAS OSIRIS-REx Navigation Small Force Models 19- 717**  
*Jeroen Geeraert, KinetX; Jason Leonard, KinetX; Patrick Kenneally; Peter Antreasian, KinetX Aerospace; Michael Moreau, NASA Goddard Space Flight Center*
- 11:00 AAS Asteroid Deflection with Active Boulder Removal 19- 785**  
*Daniel Brack, University of Colorado Boulder; Jay McMahon, University of Colorado Boulder*

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- 11:20 AAS Stability of highly inclined orbits around the asteroid (153591) 2001 SN263**  
**19-** *Diogo Merguizo Sanchez, National Institute for Space Research - INPE;*  
**798** *Antonio Fernando Bertachini Prado, INPE*
- 11:40 AAS Koopman Operator Theory in Astrodynamics**  
**19-** *RICHARD LINARES, Massachusetts Institute of Technology*  
**821**

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**Flight Dynamics, Operations and Atmospheric GN&C**

Chair: Brian Gunter, Georgia Institute of Technology

- 8:00 AAS Autonomous Satellite Navigation using Intersatellite Laser**  
**19- Communications**  
**928** *Pratik Dave, Massachusetts Institute of Technology; Kerri Cahoy, Massachusetts Institute of Technology*
- 8:20 AAS Mid-Lift-to-Drag ratio Rigid Vehicle 6-DoF EDL Performance Using**  
**19- Tunable Apollo Powered Descent Guidance**  
**619** *Breanna Johnson, NASA; Ping Lu, San Diego State University; Christopher Cerimele, NASA Johnson Space Center*
- 8:40 AAS Radiometric Autonomous Navigation Fused with Optical For Deep Space**  
**19- Exploration**  
**797** *Todd Ely, Jet Propulsion Laboratory; Shyam Bhaskaran, Jet Propulsion Laboratory; Jill Seubert, NASA / Caltech JPL; Nicholas Bradley, CalTech / Jet Propulsion Laboratory; Theodore Drain, Jet Propulsion Laboratory*
- 9:00 AAS THE FIRST COMMERCIAL LUNAR LANDER MISSION:**  
**19- BERESHEET**  
**747** *John Carrico, Space Exploration Engineering, LLC; Michel Loucks, Space Exploration Engineering (SEE); Haim Shyldkrot, SpaceIL; Eran Shmidt, SpaceIL; Daniela Geron, SpaceIL; Joseph Kronenfeld, SpaceIL; John Taylor, SSC Satellite Management Systems; Lisa Policastri, Space Exploration Engineering (SEE)*
- 9:20 AAS Improved Atmospheric Estimation for Aerocapture Guidance**  
**19-** *Evan Roelke; Robert Braun, University of Colorado Boulder; Philip Hattis, The*  
**725** *Charles Stark Draper Laboratory*

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- 9:40 AAS THE DEVELOPMENT OF AN OPEN-LOOP ANGULAR MOMENTUM UNLOAD METHODOLOGY FOR THE LUNAR RECONNAISSANCE ORBITER AND OF ALGORITHMS TO PREDICT SYSTEM PERFORMANCE**  
19-638  
*Russell DeHart, KBRwyle*
- 10:00 Morning Break**
- 10:20 AAS Aerobraking Trajectory Control Using Articulated Solar Panels**  
19-682  
*Giusy Falcone, University of Illinois at Urbana-Champaign; Zachary Putnam, University of Illinois at Urbana-Champaign*
- 10:40 AAS Entry Trajectory Tracking Using Equivalent Elevation State Feedback**  
19-933  
*Jason Tardy*
- 11:00 AAS Estimation of Entry Vehicle Parameters from Trajectory Data**  
19-856  
*Kevin Bonnet, University of Colorado at Boulder; Robert Braun, University of Colorado Boulder*

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**Orbit Determination & Space Surveillance Tracking I**

Chair: Puneet Singla, Pennsylvania State University

- 8:00 AAS Maximum A Posteriori Estimation of Hamiltonian Systems with High Order Series Expansions**  
19-875  
*Simone Servadio, University of Texas at Austin; Renato Zanetti, University of Texas at Austin; Roberto Armellin, University of Surrey*
- 8:20 AAS A Study on Effective Initial Guess Finding Method Based on Bezier Curves: Orbit Determination Applications**  
19-746  
*Daegyun Choi, Mississippi State University; Sungwook Yang, Mississippi State University; Henzeh Leeghim, Chosun University; Donghoon Kim, Mississippi State University*
- 8:40 AAS Gaussian Mixture Filter Angles-Only Orbit Determination using Modified Equinoctial Osculating Elements**  
19-843  
*Mark Psiaki, Virginia Tech*

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- 9:00 AAS ROBUST PARTICLE FILTER FOR SPACE OBJECTS TRACKING  
19- UNDER SEVERE UNCERTAINTY  
845** *Cristian Greco, University of Strathclyde; Lorenzo Gentile, TH Koeln; Massimiliano Vasile, University of Strathclyde; Edmondo Minisci; Thomas Bartz-Beielstein, TH Koeln*
- 9:20 AAS Computing Gauss-Laplace Equations for Optical Data Processing  
19- Gim Der, DerAstrodynamics  
626**
- 9:40 AAS Cis-Lunar Navigation Accuracy using Optical Observations of Natural and  
19- Artificial Targets  
643** *Nicholas Bradley, CalTech / Jet Propulsion Laboratory; Zubin Olikara, NASA Jet Propulsion Laboratory; Shyam Bhaskaran, Jet Propulsion Laboratory; Brian Young, Jet Propulsion Laboratory, California Institute of Technology.*
- 10:00 Morning Break**
- 10:20 AAS OPTIMAL QUADRATURE BASED FILTERING IN REGULARIZED  
19- COORDINATES FOR ORBIT DETERMINATION  
775** *David Ciliberto, The Pennsylvania State University; Puneet Singla, Pennsylvania State University; JOSEPH RAQUEPAS, Air Force Research Laboratory*
- 10:40 AAS Consider Filtering Applied to Maneuver Detection for Relative Orbit  
19- Determination  
872** *Peter Scarcella, The Pennsylvania State University; Kirk W. Johnson, US Air Force; Joshuah Hess, Air Force Institute of Technology*
- 11:00 AAS Computing Multi-rev Lambert Equations for Radar data Processing  
19- Gim Der, DerAstrodynamics  
625**
- 11:20 AAS Track Initiation for CubeSat Cluster Deployment Tracking  
19- John Gaebler, University of Colorado at Boulder; Penina Axelrad  
862**
- 11:40 AAS Root Locus Method of Determining Sensitivity of Polynomial Systems to  
19- Error in Orbit Determination Problems  
757** *Kenneth Horneman, Emergent Space Technologies, Inc.; Alex Sizemore, NRC; Alan Lovell; Troy Henderson, Embry-Riddle Aeronautical University; David Zuehlke, Embry-Riddle Aeronautical University; Heidi Darsey, University of New Mexico; Christopher Ertl, Rensselaer Polytechnic Institute*

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**Trajectory Design & Optimization III**

Chair: Yanping Guo, JHUAPL

- 8:00 AAS LOW THRUST TRANSFERS BETWEEN HALO ORBITS IN THE  
19- EARTH-MOON SYSTEM  
851** *Mohammad Azhar, The Pennsylvania State University; Robert Melton, Pennsylvania State University*
- 8:20 AAS Mid-Course Correction Contingency Analysis for James Webb Space  
19- Telescope  
816** *Taabish Rashied, A.I. Solutions Incorporated; Benjamin Stringer, a.i. solutions; Jeremy Petersen, a.i. solutions; Karen Richon, NASA GSFC*
- 8:40 AAS Leveraging NASA's Lunar Gateway and Human Landing System for Low-  
19- Cost and Low-Risk Mars Orbital Missions  
800** *Robert Potter, Purdue University; Sarag Saikia, School of Aeronautics and Astronautics, Purdue University; James Longuski, Purdue*
- 9:00 AAS Exploration of IMAP Science Orbit Design Space to Balance Nominal and  
19- Extended Mission Trades  
834** *AMANDA HAAPALA CHALK, JHU Applied Physics Lab; Fazle Siddique, Johns Hopkins University Applied Physics Laboratory*
- 9:20 AAS Missed Thrust Analysis for a Potential Mars Sample Return Orbiter  
19-  
767** *Jose Manuel Sanchez Perez, ESA; Gábor Varga, European Space Agency*
- 9:40 AAS End to End Optimization of a Mars Hybrid Transportation Architecture  
19-  
618** *Min Qu, AMA; Raymond Merrill, NASA Langley Research Center; Patrick Chai, NASA Langley Research Center*
- 10:00 Morning Break**
- 10:20 AAS Optimization of the Lucy Interplanetary Trajectory via Two-Point Direct  
19- Shooting  
633** *Jacob Englander, NASA Goddard Space Flight Center; Donald Ellison, NASA Goddard Space Flight Center; Kenneth Williams, KinetX Aerospace, Inc.; Jim McAdams, KinetX, Inc.; Jeremy Knittel, KinetX Aerospace, Inc.; Brian Sutter, Lockheed-Martin; Chelsea Welch, Lockheed-Martin Space Systems; Dale Stanbridge, KinetX Aerospace; Kevin Berry, NASA Goddard Space Flight Center*



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- 10:40 AAS Enabling Sustainable Human Exploration of Mars via an Orbital Logistics Node**  
**19-918** *Rachana Agrawal, Purdue University; Robert Potter, Purdue University; Sarag Saikia, School of Aeronautics and Astronautics, Purdue University; James Longuski, Purdue*
- 11:00 AAS Survey of Twenty Unique Low-Thrust Earth-Mars Cycler Geometries**  
**19-799** *Robert Potter, Purdue University; James Longuski, Purdue*

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**Asteroid & Non-Earth Orbiting Missions I**

Chair: Ossama Abdelkhalik, Iowa State University

- 13:30 AAS Experimental Field Testing and Confirmation of Particle Swarm Optimization for Autonomous Extraterrestrial Surface Search and Exploration**  
**19-876** *Gregory Hatfield, University of New Hampshire; Alex Cook, University of New Hampshire; May-Win Thein, University of New Hampshire*
- 13:50 AAS Fast Estimation Method for Trajectories to Near-Earth Asteroids**  
**19-761** *Lorenzo Casalino, Politecnico di Torino - DIMEAS; Luigi Mascolo, Politecnico di Torino; Alessandro Bosa, Politecnico di Torino*
- 14:10 AAS Initial Near-Earth Object Accessibility Insights From The NHATSchecker Utility**  
**19-623** *Daniel Adamo*
- 14:30 AAS Multi-Arc Filtering During the Navigation Campaign of the OSIRIS-REx Mission**  
**19-738** *Andrew French, University of Colorado ; Jason Leonard, KinetX; Jeroen Geeraert, KinetX; Brian Page, KinetX Aerospace, Inc.; Peter Antreasian, KinetX Aerospace; Michael Moreau, NASA Goddard Space Flight Center; Jay McMahon, University of Colorado Boulder; Daniel Scheeres, Colorado Center for Astrodynamics Research; Dante Lauretta, OSIRIS-REx*
- 14:50 AAS Design and Reconstruction of the Hayabusa2 Precision Landing on Ryugu**  
**19-762** *Shota Kikuchi, Japan Aerospace Exploration Agency; Fuyuto Terui, ISAS/JAXA; Naoko Ogawa, Japan Aerospace Exploration Agency; Takanao Saiki, JAXA / ISAS; Go Ono, Japan Aerospace Exploration Agency; Kent*

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*Yoshikawa, Japan Aerospace Exploration Agency; Yuto Takei; Yuya Mimasu, Japan Aerospace Exploration Agency; Hitoshi Ikeda, Japan Aerospace Exploration Agency; Hirotaka Sawada, Japan Aerospace Exploration Agency; Tomokatsu Morota, Nagoya University; Naru Hirata, Aizu University; Naoyuki Hirata, Kobe University; Toru Kouyama, National Institute of Advanced Industrial Science and Technology; Shingo Kameda, Rikkyo University; Yuichi Tsuda, Japan Aerospace Exploration Agency*

- 15:10 AAS OSIRIS-REX NAVIGATION CAMPAIGN TRAJECTORY DESIGN AND  
19- MANEUVER PERFORMANCE  
676** *Daniel Wibben, KinetX, Inc.; Andrew Levine, KinetX, Inc.; Samantha Rieger; Jim McAdams, KinetX, Inc.; Peter Antreasian, KinetX Aerospace; Jason Leonard, KinetX; Michael Moreau, NASA Goddard Space Flight Center; Dante Lauretta, OSIRIS-REx*
- 15:30 AAS Navigation Preparations for a Possible Binary System During the New  
19- Horizons Extended Mission  
886** *Joel Fischetti, KinetX Aerospace; John Pelgrift, KinetX, Inc.; Erik Lessac-Chenen, KinetX Aerospace, Inc.; Jeremy Bauman, KinetX inc.; Derek Nelson, KinetX, Inc.; Dale Stanbridge, KinetX Aerospace; Michael Salinas, KinetX Aerospace; Peter Wolff, KinetX Aerospace, Inc.; Bobby G. Williams, KinetX, Inc.; Frederic Pelletier, NorthStar Earth and Space; Mark Holdridge, Johns Hopkins APL; H. A. Weaver, Johns Hopkins Univ. Applied Physics Lab; John Spencer, Southwest Research Institute; Simon Porter, Southwest Research Institute; Marc Buie, Southwest Research Institute; Cathy Olkin; Alan Stern, Southwest Research Institute*
- 15:50 AAS Spacecraft Asteroid Hovering using Udwadia-Kalaba Formulation with  
19- Time-Varying Coefficients  
641** *Wesley Stackhouse, Embry-Riddle Aeronautical University; Morad Nazari, Embry-Riddle Aeronautical University; Troy Henderson, Embry-Riddle Aeronautical University; Tansel Yucelen, Department of Mechanical Engineering, University of South Florida*

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**High Performance Computing, Large Space Structures & Tethers**

Chair: Fabio Curti, School of Aerospace Engineering

- 13:30 AAS Cloud Computing Methods for Near Rectilinear Halo Orbit Trajectory  
19- Design  
874** *Diane Davis, a.i. solutions, Inc.; Sean Phillips, Johns Hopkins University Applied Physics Labs*

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- 13:50 AAS 19-794** **NLPAROPT: A Parallel Nonlinear Programming Solver - Applications to Spacecraft Trajectory Optimization**  
*Ryne Beeson, University of Illinois at Urbana-Champaign; Patrick Haddox, CU Aerospace; Samah Karim, University of Illinois at Urbana-Champaign; Bindu Jagannatha, CU Aerospace LLC; Deivn Bunce, University of Illinois at Urbana Champaign; Kyle Cochran, University of Illinois at Urbana-Champaign; Edgar Solomonik, University of Illinois at Urbana-Champaign; Alexander Ghosh, University of Illinois at Urbana-Champaign*
- 14:10 AAS 19-793** **Robust Optimal Fuzzy Sun-Point Control of a Large Solar Power Satellite Subject to Actuators Amplitude and Rate Constraints**  
*Chokri Sendi, University of Alaska Anchorage; Antonio Won, University of Alaska Anchorage; Luke McCue, University of Alaska Anchorage*
- 14:30 AAS 19-639** **A Unified Formulation for State-Space Based Recovery of Mass, Stiffness, and Damping Matrices**  
*Minh Phan, Dartmouth College; Dong-Huei Tseng; Richard Longman, Columbia University*
- 14:50 AAS 19-864** **Design of a Distributed Modular Attitude Controller for Spacecraft Composed of Reconfigurable Joined Entities with Compliant Coupling**  
*Deepti Kannapan, The Aerospace Corporation*
- 15:10 AAS 19-783** **VALIDATION OF SIMULATION OF SPACE NET DEPLOYMENT PHASE WITH PARABOLIC FLIGHT EXPERIMENT DATA**  
*Rachael Gold, University at Buffalo; Eleonora Botta, University at Buffalo*

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**Special Session: GTOC - X (Global Trajectory Optimization Competition)**

Chair: Anastassios Petropoulos, NASA / Caltech JPL

- 13:30 AAS 19-891** **GTOC X: Settlers of the Galaxy Problem Description and Summary of the Results**  
*Anastassios Petropoulos, NASA / Caltech JPL; Eric Gustafson, NASA / JPL Caltech; Gregory Whiffen, NASA / Caltech JPL; Brian Anderson, NASA / Caltech JPL*
- 13:50 AAS 19-894** **GTOC X: Solution approach of Team Sapienza-PoliTo**  
*Alessandro Zavoli; Lorenzo Federici, Sapienza University of Rome; Boris*

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*Benedikter, Sapienza University of Rome; Lorenzo Casalino, Politecnico di Torino - DIMEAS; Guido Colasurdo, Università di Roma Sapienza*

- 14:10 AAS Settler of the Galaxy: The CSU Solution to GTOCX**  
**19-902** *Chen Zhang, Technology and Engineering Center for Space Utilization, Chinese Academy of Sciences; Chihang Yang, Technology and Engineering Center for Space Utilization, Chinese Academy of Sciences,; Hao Zhang, Technology and Engineering Center for Space Utilization, Chinese Academy of Sciences; RENYONG ZHANG, Technology and Engineering Center for Space Utilization, Chinese Academy of Sciences; Hao Peng, Rutgers, The State University of New Jersey; Gao Yang*
- 14:30 AAS GTOC X: Methods and Results from the HIT\_BACC Team**  
**19-896** *Ouyang Qi, Beijing Aerospace Control Center; Yong Liu, Beijing Aerospace Control Center; Pengfei Cao, Beijing Aerospace Control Center; zichen fan, Harbin Institute of Technology ; Yabo Hu, Harbin Institute of Technology; Cunyan Xia, Harbin Institute of Technology; Gang Zhang, Harbin Institute of Technology*
- 14:50 AAS GTOC X: Our Plan to Settle the Galaxy (ESA-ACT)**  
**19-897** *Dario Izzo, European Space Agency; Marcus Märten, European Space Agency; Ekin Öztürk, European Space Agency; Mate Kisantal, European Space Agency; Kostas Konstantinidis, ESA; Luís Simoes, ML Analytics; Chit Hong Yam, ispace, inc.; Javier Hernando-Ayuso, ispace, inc.*
- 15:10 AAS GTOC X: Results and Methods of Team 38 - Tsinghua & XINGYI**  
**19-898** *Zhibo E, School of Aerospace Engineering Of Tsinghua University; Di Wu, Tsinghua University; Haiyang Li, Politecnico di Milano; Tsinghua University; Anastassios Petropoulos, NASA / Caltech JPL*
- 15:30 AAS GTOC X: Results and Methods of National University of Defense Technology and Xi'an Satellite Control Center**  
**19-899** *Ya-Zhong Luo, National University of Defense Technology; Hong-Xin Shen, Chinese Xi'an satellite control center; An-Yi Huang, National University of Defense Technology; Tian-Jiao Zhang, Chinese Xi'an satellite control center; Yue-He Zhu, National University of Defense Technology; Zhao Li, Chinese Xi'an satellite control center; Peng Shu, National University of Defense Technology; Zhen-Jiang Sun, National University of Defense Technology; Jian-Hui Li, Chinese Xi'an satellite control center; Zhen-Yu Li, National University of Defense Technology; Jian-Jun Shi, National University of Defense Technology; Bing Yan, National University of Defense Technology; Xiang-Nan Du, National University of Defense Technology; Zhen Yang, National University of Defense Technology*

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**15:50 AAS GTOC X: General Question and Answer Session**  
**19-** *Anastassios Petropoulos, NASA / Caltech JPL*  
**900**

**16:10 AAS GTOC X: Trophy Award Presentation**  
**19-** *Anastassios Petropoulos, NASA / Caltech JPL*  
**901**

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**Special session: NASA CARA CA Requirements Development Initiative**

Chair: Alinda Mashiku, NASA GSFC, Matthew Hejduk, Astrorum Consulting LLC

**13:30 AAS NASA Conjunction Assessment Risk Analysis Updated Requirements**  
**19-** **Architecture**  
**668** *Lauri Newman, NASA Goddard Space Flight Center; Alinda Mashiku, NASA GSFC; Matthew Hejduk, Astrorum Consulting LLC; Megan Johnson, a.i. Solutins, Inc.; Joseph Rosa, Omitron, Inc.*

**13:50 AAS Recommended Methods for Setting Mission Conjunction Analysis Hard**  
**19-** **Body Radii**  
**702** *Alinda Mashiku, NASA GSFC; Matthew Hejduk, Astrorum Consulting LLC*

**14:10 AAS Assessing GEO and LEO Repeating Conjunctions Using High Fidelity**  
**19-** **Brute Force Monte Carlo Simulations**  
**612** *Luis Baars, Omitron, Inc.; Doyle Hall, Omitron, Inc.; Steve Casali, Omitron, Inc.*

**14:30 AAS Satellite Collision ‘Probability,’ ‘Possibility,’ and ‘Plausibility’: A**  
**19-** **Categorization of Competing CA Risk Assessment Paradigms**  
**652** *Matthew Hejduk, Astrorum Consulting LLC; Dan Snow, Omitron Inc.*

**14:50 AAS An Operational Algorithm for Evaluating Satellite Collision Consequence**  
**19-** *Travis Lechtenberg, Omitron Inc.*  
**669**

**15:10 AAS MULTIVARIATE NORMALITY OF CARTESIAN-FRAMED**  
**19-** **COVARIANCES: EVALUATION AND OPERATIONAL**  
**671** **SIGNIFICANCE**  
*Travis Lechtenberg, Omitron Inc.*

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- 15:30 AAS 19-631** **Determining Appropriate Risk Remediation Thresholds from Empirical Conjunction Data Using Survival Probability Methods**  
*Doyle Hall, Omitron, Inc.*
- 15:50 AAS 19-632** **Implementation Recommendations and Usage Boundaries for the Two-Dimensional Probability of Collision Calculation**  
*Doyle Hall, Omitron, Inc.*

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**Asteroid & Non-Earth Orbiting Missions II**

Chair: Diane Davis, a.i. solutions, Inc.

- 8:00 AAS 19-819** **NASA Goddard Independent Navigation Results for OSIRIS-REx Initial Encounter at Bennu**  
*Dolan Highsmith, The Aerospace Corporation; Andrew Liounis, NASA Goddard Space Flight Center; Kenneth Getzandanner, NASA Goddard Space Flight Center; Jason Swenson, NASA Goddard Space Flight Center; Benjamin Ashman, NASA Goddard Space Flight Center; Jeffrey Small, The Aerospace Corporation; Jennifer Donaldson, NASA Goddard Space Flight Center; David Rowlands, NASA Goddard Space Flight Center; Erwan Mazarico, Massachusetts Institute of Technology / EAPS; Michael Moreau, NASA Goddard Space Flight Center; Jason Leonard, KinetX; Coralie Adam, KinetX, Inc.; Peter Antreasian, KinetX Aerospace; Dante Lauretta, OSIRIS-REx*
- 8:20 AAS 19-756** **Earth-Moon Halo Orbit – Gateway or Tollbooth?**  
*David Dunham, KinetX, Inc.; Kjell Stakkestad, KinetX Aerospace, Inc.; Jim McAdams, KinetX, Inc.; Anthony Genova, NASA; Jerry Horsewood, SpaceFlightSolutions, Inc.*
- 8:40 AAS 19-709** **Sensitivity of Trajectories to Mass Parameters in the Restricted Full Three Body Problem**  
*Alex Davis, University of Colorado Boulder; Daniel Scheeres, University of Colorado Boulder*
- 9:00 AAS 19-678** **Autonomous Estimation of Spin and Shape of a Small Body via Extended Target Tracking**  
*Enrico Zucchelli, The University of Texas at Austin; Brandon Jones, University of Texas at Austin; Ryan Russell, The University of Texas at Austin*

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- 9:20 AAS OSIRIS-REx Orbit Determination Performance During the Navigation  
19- Campaign  
714** *Jason Leonard, KinetX; Jeroen Geeraert, KinetX; Andrew French, University of Colorado ; Brian Page, KinetX Aerospace, Inc.; Peter Antreasian, KinetX Aerospace; Coralie Jackman, KinetX Aerospace; Michael Moreau, NASA Goddard Space Flight Center; Dante Lauretta, OSIRIS-REx; Daniel Wibben, KinetX, Inc.*
- 9:40 AAS Dynamics of a non-rigid Orbital Siphon at a near-Earth asteroid  
19-  
708** *Andrea Viale, University of Glasgow; Colin McInnes, University of Glasgow; Matteo Ceriotti, University of Glasgow*

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**Orbit Determination & Space Surveillance Tracking II**

Chair: Craig McLaughlin, University of Kansas Aerospace Engineering, David Lujan, University of Colorado Boulder

- 8:00 AAS High-fidelity drag coefficient models for orbit determination  
19-  
754** *Vishal Ray, CU Boulder; Daniel Scheeres, University of Colorado Boulder*
- 8:20 AAS Application of Dual Number Theory to Statistical Orbital Determination  
19-  
716** *Christopher Rabotin, Advanced Space LLC*
- 8:40 AAS Light Curve Inversion Observability Analysis  
19-  
788** *Alex Friedman, Purdue University; Siwei Fan, Purdue University; Carolin Frueh, Purdue University*
- 9:00 AAS NEW HORIZONS' ORBIT DETERMINATION PERFORMANCE  
19-  
704** *THROUGHOUT THE EXTENDED MISSION TO ULTIMA THULE  
Jeremy Bauman, KinetX Inc.; Derek Nelson, KinetX, Inc.; Frederic Pelletier, KinetX Inc.; Bobby G. Williams, KinetX, Inc.; Peter Wolff, KinetX Aerospace, Inc.; John Pelgrift, KinetX, Inc.; Dale Stanbridge, KinetX Aerospace; Joel Fischetti, KinetX Aerospace; Michael Salinas, KinetX Aerospace; Alan Stern, Southwest Research Institute; Leslie Young, Southwest Research Institute; Mark Holdridge, Johns Hopkins APL; Yanping Guo, JHUAPL; Gabe D. Rogers, The Johns Hopkins University Applied Physics Laboratory; H. A. Weaver, Johns Hopkins Univ. Applied Physics Lab; John Spencer, Southwest Research Institute; Marc Buie, Southwest Research Institute; Simon Porter, Southwest Research Institute; Erik Lessac-Chenen, KinetX Aerospace, Inc.; Cathy Olkin*

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- 9:20 AAS 19-849** **Sensor Configuration Trade Study for Navigation in Near Rectilinear Halo Orbits**  
*Sehyun Yun, The University of Texas at Austin; Kirsten Tuggle, The University of Texas at Austin; Renato Zanetti, University of Texas at Austin; Christopher D'Souza, NASA - Johnson Space Center*
- 9:40 AAS 19-636** **The effect of small forces on Juno Orbit Determination during the orbit phase**  
*Yu Takahashi, Jet Propulsion Laboratory; Paul Stumpf, Jet Propulsion Laboratory; Brian Rush, NASA / Caltech JPL; Nicholas Bradley, Jet Propulsion Laboratory; John Bordi, NASA / Caltech JPL*
- 10:00 Morning Break**
- 10:20 AAS 19-689** **Independent Navigation Team Orbit Estimation of 2014MU69 for New Horizons' Kuiper Belt Object Flyby**  
*Dylan Boone, Jet Propulsion Laboratory / California Institute of Technology; Shyam Bhaskaran, Jet Propulsion Laboratory; Gerhard Kruijzinga, NASA / Caltech JPL; William Owen, Jet Propulsion Laboratory; Ed Riedel, NASA Jet Propulsion Laboratory; Jeffrey Stuart, Jet Propulsion Laboratory; Declan Mages, NASA / Caltech JPL; Dianna Velez, NASA / Caltech JPL*
- 10:40 AAS 19-752** **Implementing an Idan Speyer Cauchy Drag Estimator**  
*Craig McLaughlin, University of Kansas Aerospace Engineering; Micaela Crispin, University of Kansas ; Frank Bonet, University of Kansas*
- 11:00 AAS 19-781** **Analysis of Relative Merits of Unscented and Extended Kalman Filters in Orbit Determination**  
*James Woodburn, Analytical Graphics, Inc.; Vincent Coppola, Analytical Graphics, Inc.*
- 11:20 AAS 19-885** **Automated Navigation Analysis for the Lucy Mission**  
*Jeremy Knittel, KinetX Aerospace, Inc.; Dale Stanbridge, KinetX Aerospace*
- 11:40 AAS 19-890** **Orbit determination and tests of general relativity in the cruise phase of BepiColombo**  
*Luciano Iess, Sapienza University of Rome; Ivan Di Stefano, Sapienza University of Rome; Paolo Cappuccio, Sapienza University of Rome; Gael Cascioli, Sapienza University of Rome*



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**Special Session: Artificial Intelligence in Astrodynamics I - Machine Learning**

Chair: Simone D'Amico, Stanford University, Islam Hussein, Applied Defense Solutions

- 8:00**    **AAS**    **Uncertainty Characterization and Surrogate Modeling for Angles Only**  
**19-**       **Initial Orbit Determination**  
**776**    *David Schwab, The Pennsylvania State University; Puneet Singla, Pennsylvania State University; JOSEPH RAQUEPAS, Air Force Research Laboratory*
- 8:20**    **AAS**    **Deep Imitation Learning and Clustering in Astrodynamics**  
**19-**       *Roberto Furfaro, The University of Arizona; RICHARD LINARES,*  
**700**    *Massachusetts Institute of Technology; Kristofer Drozd, University of Arizona; Brian Gaudet, The University of Arizona; Andrea Scorsoglio, University of Arizona*
- 8:40**    **AAS**    **Deep Learning Applications to Astrodynamics Problems**  
**19-**       *Jordan Murphy, University of Colorado; Daniel Scheeres, University of*  
**813**    *Colorado Boulder*
- 9:00**    **AAS**    **Towards Robust Learning-Based Pose Estimation of Noncooperative**  
**19-**       **Spacecraft**  
**840**    *Tae Ha Park, Stanford University; Sumant Sharma, Stanford University; Simone D'Amico, Stanford University*
- 9:20**    **AAS**    **Gaussian Process models for preliminary low-thrust trajectory**  
**19-**       **optimization**  
**873**    *Kevin Cowan, Delft University of Technology; Lieve Bouwman, Delft University of Technology; Yuxin Liu, Delft University of Technology*
- 9:40**    **AAS**    **Covariance Fusion Method of Gaussian Processes Covariance and Orbital**  
**19-**       **Prediction Uncertainty**  
**830**    *Hao Peng, Rutgers, The State University of New Jersey; Xiaoli Bai, Rutgers*
- 10:00**    **Morning Break**
- 10:20**    **AAS**    **Calibration of atmospheric density model based on Gaussian process**  
**19-**       *Tianyu Gao, Rutgers, The State University of New Jersey; Hao Peng, Rutgers,*  
**697**    *The State University of New Jersey; Xiaoli Bai, Rutgers*
- 10:40**    **AAS**    **Adaptive Online Learning Strategy for Post-capture Attitude Takeover**  
**19-**       **Control of Noncooperative Space Target**  
**784**    *Yueyong Lyu, Harbin Institute of Technology; Yuhan Liu, Harbin Institute of Technology; Sun Zhaowei; Guangfu Ma, Harbin Institute of Technology*

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- 11:00 AAS Neural Network Based Optimal Control: Resilience to Missed Thrust  
19- Events for Long Duration Transfers  
773 Ari Rubinsztein, University of Alabama; Rohan Sood, University of Alabama;  
Frank Laipert, Jet Propulsion Laboratory**

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**Trajectory Design & Optimization IV**

Chair: Jennifer Hudson, Western Michigan University

- 8:00 AAS Efficient Computation of Optimal Low Thrust Perturbed Orbit Transfers  
19- with Shadow Constraints  
688 Robyn Woollands, Jet Propulsion Laboratory; Ehsan Taheri, Auburn University**
- 8:20 AAS Refining Lucy Mission Delta-V during Spacecraft Design using Trajectory  
19- Optimization within High-Fidelity Monte Carlo Maneuver Analysis  
614 Jim McAdams, KinetX, Inc.; Kenneth Williams, KinetX Aerospace, Inc.; Jacob  
Englander, NASA Goddard Space Flight Center; Donald Ellison, NASA  
Goddard Space Flight Center; Jeremy Knittel, KinetX Aerospace, Inc.; Dale  
Stanbridge, KinetX Aerospace; Brian Sutter, Lockheed-Martin; Kevin Berry,  
NASA Goddard Space Flight Center**
- 8:40 AAS Novel Chebyshev Collocation Method for Trajectory Optimization  
19- Tyler Doogan, Texas A&M University; Manoranjan Majji, Texas A&M  
924 University, College Station**
- 9:00 AAS Revisiting Trajectory Design with STK Astrogator, Part 1  
19- Cody Short, Analytical Graphics, Inc.; Pradipto Ghosh, Analytical Graphics,  
824 Inc.; Austin Claybrook, Analytical Graphics, Inc.**
- 9:20 AAS Libration Orbit Eclipse Avoidance Maneuver Study for the James Webber  
19- Space Telescope Mission  
705 Wayne Yu, NASA GSFC; Karen Richon, NASA GSFC**
- 9:40 AAS Low thrust variable specific impulse fuel-optimal transfers between  
19- planetary parking orbits  
611 Padmanabha Prasanna Simha, California Institute of Technology; Ramanan R  
V, Indian Institute of Space Science and Technology**
- 10:00 Morning Break**

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- 10:20 AAS OPTIMIZATION IN SPACE-BASED PURSUIT-EVASION GAMES  
19- THROUGH COMPETITIVE COEVOLUTION  
750** *Jason Reiter, Penn State ARGoPS; David B. Spencer, Pennsylvania State University*
- 10:40 AAS ANALYSIS OF A CONSTRAINED OPTIMAL MULTIPLE-PHASE  
19- LANDING TRAJECTORY FOR A SMALL ROBOTIC LUNAR LANDER  
865** *J.P. Carrico; Alisa Hawkins, Google/Skybox; Jae-ik Park, Korea Aerospace Research Institute; Dong-Young Rew, Korea Aerospace Research Institute*
- 11:00 AAS Selecting Planning Horizon Length for Sequential Low-Thrust Orbit-  
19- Raising Optimization Problem  
878** *Pardhasai Chadalavada, Wichita State University; Atri Dutta, Wichita State University*

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**Attitude Dynamics & Control I**

Chair: Atri Dutta, Wichita State University

- 13:30 AAS ICESat-2 Precision Pointing Determination  
19- Sungkoo Bae, The University of Texas at Austin; Benjamin Helgeson, The  
777 University of Texas at Austin; Michael James, The University of Texas at  
Austin; Jonathan Sipps, The University of Texas at Austin**
- 13:50 AAS Magnetorquer-Only Attitude Control of Small Satellites using Trajectory  
19- Optimization  
927** *Andrew Gatherer, Stanford University; Zachary Manchester, Stanford University*
- 14:10 AAS Reaction Wheel Friction Analysis for the Fermi Spacecraft  
19- Benjamin Ellis, KBRwyle, Inc.; Russell DeHart, KBRwyle  
844**
- 14:30 AAS Modelling and Simulation of the ADCS Subsystem for JY1-SAT  
19- Ahmad Fares, Crown Prince Foundation; Ahmad Bani Younes, San Diego State  
607 University**
- 14:50 AAS Performance Improvements for the Lunar Reconnaissance Orbiter  
19- Gyroless Extended Kalman Filter  
615** *Julie Halverson, NASA GSFC; Philip Calhoun; Oscar Hsu*

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- 15:10 AAS QuateRA: The Quaternion Regression Algorithm**  
**19-** *Marcelino Mendes de Almeida, The University of Texas at Austin; Maruthi R.*  
**654** *Akella, The University of Texas at Austin; Renato Zanetti, University of Texas at Austin; Daniele Mortari, Texas A&M University*
- 15:30 Afternoon Break**
- 15:50 AAS SINGULARITY-FREE EXTRACTION OF A DUAL QUATERNION**  
**19-** **FROM FEATURE-BASED REPRESENTATION OF MOTION**  
**735** *Daniel Condurache, Technical University of Iasi*
- 16:10 AAS Recursive and Non-dimensional Star-Identification**  
**19-** *Carl Leake, Texas A&M University; Daniele Mortari, Texas A&M University*  
**609**
- 16:30 AAS NEW CONTROL SCHEMES AND FLIGHT RESULTS OF WORLD'S**  
**19-** **SMALLEST SS-520 NO.5 FOR MICRO-SATELLITE**  
**620** *Hirohito Ohtsuka, IHI Aerospace Co.,Ltd.; Yasuhiro Morita, Japan Aerospace Exploration Agency; Naruhisa Sano, IHI Aerospace Co.,Ltd; Takahiro Ito, Japan Aerospace Exploration Agency*

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**Dynamical Systems Theory II & Asteroid and Non-Earth Orbiting Missions III**

Chair: Siamak Hesar, Blue Canyon Technologies

- 13:30 AAS Frequency Structure of the NRHO Family in the Earth-Moon System**  
**19-** *David Lujan, University of Colorado Boulder; Daniel Scheeres, University of*  
**723** *Colorado Boulder*
- 13:50 AAS Observability and Estimability Analysis of the Orbit Problem**  
**19-** *Alex Friedman, Purdue University; Carolin Frueh, Purdue University*  
**825**
- 14:10 AAS Transfer Trajectory Options for Servicing Sun-Earth-Moon Libration**  
**19-** **Point Missions**  
**724** *David Folta, NASA Goddard Space Flight Center; Cassandra Webster, NASA Goddard Space Flight Center*

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- 14:30 AAS Survey of Ballistic Lunar Transfers to Near Rectilinear Halo Orbit**  
**19-** *Nathan Parrish, Advanced Space, LLC; Ethan Kayser, Advanced Space, LLC;*  
**740** *Shreya Udupa, Advanced Space, LLC; Jeff Parker, Advanced Space, LLC;*  
*Bradley Cheetham, Advanced Space; Diane Davis, a.i. solutions, Inc.*
- 14:50 AAS The Long-Term Forecast of Station View Periods for Elliptical Orbits**  
**19-** *Andrew Graven, Cornell University; Martin Wen-Yu Lo, Jet Propulsion*  
**681** *Laboratory*
- 15:10 AAS Dynamical Structures Nearby NRHOs with Applications in Cislunar Space**  
**19-** *Emily Zimovan-Spreen, Purdue University; Kathleen C. Howell, Purdue*  
**808** *University*
- 15:30 Afternoon Break**
- 15:50 AAS OPTICAL NAVIGATION FOR NEW HORIZONS' FLYBY OF KUIPER**  
**19-** **BELT OBJECT (486958) 2014 MU69**  
**871** *Derek Nelson, KinetX, Inc.; Erik Lessac-Chenen, KinetX Aerospace, Inc.; John*  
*Pelgrift, KinetX, Inc.; Coralie Adam, KinetX, Inc.; Frederic Pelletier, KinetX*  
*Inc.; Jeremy Bauman, KinetX inc.; Dale Stanbridge, KinetX Aerospace; John*  
*Spencer, Southwest Research Institute; Simon Porter, Southwest Research*  
*Institute; Marc Buie, Southwest Research Institute; Mark Holdridge, Johns*  
*Hopkins APL; H. A. Weaver, Johns Hopkins Univ. Applied Physics Lab; Cathy*  
*Olkin; Alan Stern, Southwest Research Institute*
- 16:10 AAS OSIRIS-REX FROZEN ORBIT DESIGN AND FLIGHT EXPERIENCE**  
**19-** *Daniel Wibben, KinetX, Inc.; Andrew Levine, KinetX, Inc.; Samantha Rieger;*  
**677** *Jim McAdams, KinetX, Inc.; Peter Antreasian, KinetX Aerospace; Jason*  
*Leonard, KinetX; Michael Moreau, NASA Goddard Space Flight Center; Dante*  
*Lauretta, OSIRIS-REx*
- 16:30 AAS Autonomous Architectures for Small Body Exploration**  
**19-** *Daniel Scheeres, University of Colorado Boulder; Jay McMahan, University of*  
**656** *Colorado Boulder*
- 16:50 AAS Spacecraft Trajectory Tracking and Parameter Estimation in the Presence**  
**19-** **of a Splitting Contact Binary Asteroid**  
**887** *Tiago Silva, University of Illinois at Urbana-Champaign; Koki Ho, University*  
*of Illinois, Urbana-Champaign; Jean-Baptiste Bouvier, University of Illinois;*  
*Kathleen Xu, University of Illinois; Masatoshi Hirabayashi, Auburn University*

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**Orbital Debris and Space Environment**

Chair: Juan Arrieta, Nabla Zero Labs

- 13:30 AAS Spaceflight Hazards of Escape-Velocity-Domain Impact Ejecta in the**  
**19- CR3BP**  
**616** *Matthew Wittal, National Aeronautics and Space Administration; Shaun Butts, National Aeronautics and Space Administration*
- 13:50 AAS Real-Time Neutral Density Estimation Via Two-Line-Element Data Fusion**  
**19- In A Quasi-Physical Thermosphere Model**  
**707** *David Gondelach, Massachusetts Institute of Technology; RICHARD LINARES, Massachusetts Institute of Technology*
- 14:10 AAS Multiple Small-Satellite Salvage Mission Sequence Planning for Debris**  
**19- Mitigation**  
**730** *Guanwei He, Pennsylvania State University; Robert Melton, Pennsylvania State University*
- 14:30 AAS Characterizing the India ASAT debris evolution using diverse,**  
**19- complementary tools**  
**889** *Daniel L. Oltrogge, Analytical Graphics, Inc; T.S. Kelso; Timothy Carrico, Analytical Graphics, Inc.*
- 14:50 AAS Tracking Multiple Maneuvering Satellites Using a Generalized Labeled**  
**19- Multi-Bernoulli Filter**  
**841** *Nicholas Ravago, The University of Texas at Austin; Brandon Jones, University of Texas at Austin*
- 15:10 AAS Collision Probability for Parallelogram Cross Sections**  
**19- Ken Chan, Chan Aerospace Consulting**  
**910**
- 15:30 Afternoon Break**
- 15:50 AAS Collision Probability for General Polygonal Cross Sections**  
**19- Ken Chan, Chan Aerospace Consulting**  
**911**
- 16:10 AAS Evaluation of the 27 March 2019 Indian ASAT Demonstration**  
**19- Andrew Abraham, The Aerospace Corporation**  
**942**

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- 16:30 AAS Tracking and Maneuver Detection for Large Satellite Constellations Using  
19- a Partitioned GLMB Filter and Smoother  
674 Benjamin Reifler, The University of Texas at Austin; Brandon Jones, University  
of Texas at Austin**
- 16:50 AAS A Technique for Space Object Catalog Evaluation  
19- Alan Segerman, U.S. Naval Research Laboratory; Zachary Sibert, Naval  
807 Research Laboratory; Felix R. Hoots, Aerospace Corporation; Paul  
Schumacher, Air Force Research Laboratory**

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**Trajectory Design & Optimization V**

Chair: David B. Spencer, Pennsylvania State University

- 13:30 AAS Flyby in the spatial three-body problem  
19- Davide Menzio, Politecnico di Milano; Camilla Colombo, Politecnico di Milano  
909**
- 13:50 AAS Risk-aware Trajectory Design with Continuous Thrust: Primer Vector  
19- Theory Approach  
912 Kenshiro Oguri, University of Colorado Boulder; Jay McMahon, University of  
Colorado Boulder**
- 14:10 AAS SPACECRAFT MANEUVER STRATEGY OPTIMIZATION FOR  
19- DETECTION AVOIDANCE USING REACHABILITY SETS  
749 Connor Clary, Pennsylvania State University; Jason Reiter, Penn State  
ARGoPS; David B. Spencer, Pennsylvania State University**
- 14:30 AAS Optimal Inspection Trajectories with Enforcement of Chief and Inspector-  
19- Centered Dynamic Zone Constraints  
895 Mark Mercier, U.S. Air Force; Kirk W. Johnson, US Air Force**
- 14:50 AAS A Time-Dependent TSP Formulation for the Design of an Active Debris  
19- Removal Mission using Simulated Annealing  
701 Lorenzo Federici, Sapienza University of Rome; Alessandro Zavoli; Guido  
Colasurdo, Università di Roma Sapienza**
- 15:10 AAS HelioSwarm: Swarm Mission Design in High Altitude Orbit for  
19- Heliophysics  
831 Laura Plice, Metis Technology Solutions; Andres Dono, NASA Ames Research  
Center/MEI; Stephen West, Metis Technology Solutions**

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**15:30 Afternoon Break**

**15:50 AAS Constructing a Set of Motion Primitives in the Circular Restricted Three-  
19- Body Problem via Clustering**

**686** *Thomas Smith, University of Colorado Boulder; Natasha Bosanac, University of Colorado, Boulder*

**16:10 AAS Trajectory Design for a Solar Polar Observing Constellation**

**19- 829** *Thomas Smith, University of Colorado Boulder; Natasha Bosanac, University of Colorado, Boulder; Thomas Berger, University of Colorado Boulder; Nicole Duncan, Ball Aerospace & Technologies Corporation; Gordon Wu, Ball Aerospace & Technologies Corporation*

**16:30 AAS A Unified Framework for Aerocapture Systems Analysis**

**19- 811** *Athul Pradeepkumar Girija, Purdue University; Sarag Saikia, School of Aeronautics and Astronautics, Purdue University; James Cutts, NASA Jet Propulsion Laboratory; James Longuski, Purdue University*

**16:50 AAS OPTIMAL SPACECRAFT DOCKING MANEUVER USING DIRECT  
19- AND INDIRECT COLLOCATION METHOD AND PARTICLE SWARM  
848 OPTIMIZATION**

*Damien GUEHO, The Pennsylvania State University; Guanwei He, Pennsylvania State University; Puneet Singla, Pennsylvania State University; Robert Melton, Pennsylvania State University*

**17:10 AAS Aerocapture Performance Analysis for a Neptune Mission Using a Heritage  
19- Blunt-Body Aeroshell**

**815** *Athul Pradeepkumar Girija, Purdue University; Sarag Saikia, School of Aeronautics and Astronautics, Purdue University; James Longuski, Purdue University; Shyam Bhaskaran, Jet Propulsion Laboratory; Matthew Smith, NASA Jet Propulsion Laboratory; James Cutts, NASA Jet Propulsion Laboratory*

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**Attitude Dynamics & Control II**

Chair: John Christian, Rensselaer Polytechnic Institute, Kenneth Horneman, Emergent Space Technologies, Inc.



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- 8:00 AAS ATTITUDE DETERMINATION STRATEGY BASED ON KALMAN  
19- FILTER FOR THE SPORT CUBESAT SCIENCE MISSION  
812** *Kátia Maier dos Santos, Universidade Federal de Santa Maria (UFSM); Willer Gomes dos Santos, Aeronautics Institute of Technology (ITA); Valdemir Carrara, Aeronautics Institute of Technology (ITA); Charles Swenson, Utah State University (USU); Lidia H. S. Sato, Aeronautics Institute of Technology (ITA); Luis E. V. L. Costa, Aeronautics Institute of Technology (ITA); André Luís da Silva, Universidade Federal de Santa Maria (UFSM)*
- 8:20 AAS Efficient B-dot Law for Spacecraft Detumbling  
19- Mohammed Desouky, Michigan Technological University ; Ossama  
665 Abdelkhalik, Iowa State University**
- 8:40 AAS Evaluating the Stability Boundary and Derivation of a Sufficient Condition  
19- for Second Order Repetitive Control  
935** *Ayman Ismail, Columbia University; Richard Longman, Columbia University; Peiling Cui, Beihang University; Zhiyuan Liu, Beihang University; Han Xu, Beihang University*
- 9:00 AAS Opportunities and Limitations of Adaptive Augmented Control for Launch  
19- Vehicle Attitude Control in Atmospheric Flight  
765** *Domenico Trotta, Sapienza University of Rome; Alessandro Zavoli; Guido De Matteis, Full Professor; Agostino Neri, ESA ESRIN - VEGA Integrated Project Team*
- 9:20 AAS Orthogonal range searching in n-dimensional spaces using k-vector  
19- David Arnas, Centro Universitario de la Defensa - Zaragoza; Carl Leake,  
629 Texas A&M University; Daniele Mortari, Texas A&M University**
- 9:40 AAS Relative Positioning and Tracking of Tethered Small Spacecraft Using  
19- Optical Sensors  
833** *Yanjie Guo, Georgia Institute of Technology ; Brian Gunter, Georgia Institute of Technology*
- 10:00 Morning Break**
- 10:20 AAS Proof of Stable Inverses not Involving Factorization and Evaluations of  
19- Their Superiority  
884** *Xiaoqiang Ji, Columbia University MC4703 ; Richard Longman, Columbia University*
- 10:40 AAS Time-varying feedback for attitude regulation in prescribed finite-time  
19- Marcelino Mendes de Almeida, The University of Texas at Austin; Maruthi R.  
653 Akella, The University of Texas at Austin**

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- 11:00 AAS Efficient Magnetic Attitude Regulation Control**  
**19-664** *Mohammed Desouky, Michigan Technological University ; Ossama Abdelkhalik, Iowa State University*
- 11:20 AAS Relative Attitude Control of Two Spacecraft Using Electrostatic Interactions**  
**19-877** *John Galjanic, Embry-Riddle Aeronautical University, Daytona Beach; Dongeun Seo, Embry-Riddle Aeronautical University; Morad Nazari, Embry-Riddle Aeronautical University*
- 11:40 AAS Optimum Momentum Bias for Zero-Feedback Reaction Wheel Slews**  
**19-741** *Lara Magallanes, Naval Postgraduate School; Mark Karpenko, Naval Postgraduate School*

Aug 15, 2019 Longfellow

**Space Situational Awareness & Conjunction Analysis**

Chair: Matthew Wilkins, L3 Applied Defense Solutions

- 8:00 AAS Covariance Realism is Not Enough**  
**19-605** *J. Russell Carpenter, NASA Goddard Space Flight Center*
- 8:20 AAS The YORP Effect for Tumbling Defunct GEO Satellites**  
**19-858** *Conor Benson, University of Colorado Boulder; Daniel Scheeres, University of Colorado Boulder*
- 8:40 AAS Very Low Resolution Spacecraft Recognition and Pose Estimation for Close-Range Rendezvous and Proximity Operations**  
**19-846** *William Bezouska, University of Southern California; Ryan Williams, The Aerospace Corporation; Daniel Hernandez, The Aerospace Corporation*
- 9:00 AAS CubeSats Hovering Collision Probability**  
**19-905** *Ken Chan, Chan Aerospace Consulting; Yuchen Xie, Beijing Institute of Technology; Jingrui Zhang*
- 9:20 AAS Data-Driven Framework for Space Weather Modeling with Uncertainty Treatment towards Space Situational Awareness and Space Traffic Management**  
**19-603** *Piyush Mehta, West Virginia University; Christina Kay, NASA GSFC/Catholic*

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*University of America; Richard Licata, West Virginia University; Nicholas Sia,  
West Virginia University*

- 9:40 AAS A New Look at Predictive Probability of Collision, Predictive Maneuver  
19- Trade Spaces  
720 Mark Vincent, Raytheon; Theodore H. (Ted) Sweetser, Jet Propulsion  
Laboratory**
- 10:00 Morning Break**
- 10:20 AAS No Feedback Multi-Sensor Tasking  
19- Carolin Frueh, Purdue University; Bryan Little, Purdue University  
869**
- 10:40 AAS Design & Development Of An Optimized Sensor Scheduling & Tasking  
19- Program For Tracking Space Objects  
879 David Shteinman, Industrial Sciences Group ; Mark Yeo, Industrial Sciences  
Group ; Alex Ryan, Industrial Sciences Group ; James Bennett, EOS ; Michael  
Lachut, EOS**
- 11:00 AAS Space-Based Target Search Methods using an Optical Sensor Model for  
19- Space Situational Awareness  
600 Ryne Beeson, University of Illinois at Urbana-Champaign; Kento Tomita,  
University of Illinois at Urbana-Champaign ; Onalli Gunasekara; Andrew J.  
Sinclair, Air Force Research Laboratory; Koki Ho, University of Illinois,  
Urbana-Champaign**

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**Special Session: Artificial Intelligence in Astrodynamics II - Reinforcement Learning**

Chair: Roberto Furfaro, The University of Arizona

- 8:00 AAS Value Iteration and Q-Learning for Optimal Control by High Dimensional  
19- Model Representation (HDMR)  
640 Minh Phan, Dartmouth College**
- 8:20 AAS A New approach to Autonomous Asteroid Close Proximity Maneuvers  
19- Enabled by Reinforcement Learning  
628**

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*Brian Gaudet, Deep AnalytX, LLC; RICHARD LINARES, Massachusetts Institute of Technology; Roberto Furfaro, The University of Arizona*

- 8:40 AAS ELM-based Actor-Critic approach to Lyapunov vector fields relative  
19- motion guidance in Near-Rectilinear Orbits  
692** *Andrea Scorsoglio, University of Arizona; Roberto Furfaro, The University of Arizona*
- 9:00 AAS PREDICTING SATELLITE CLOSE APPROACHES USING  
19- STATISTICAL PARAMETERS IN THE CONTEXT OF ARTIFICIAL  
703 INTELLIGENCE.**  
*Alinda Mashiku, NASA GSFC; Carolin Frueh, Purdue University; Nargess Memarsadeghi, NASA; Mitchell Zielinski, Purdue University; Evana Gizzi; Alexander Burton, Purdue University*
- 9:20 AAS Contingency Planning in Complex Dynamical Environments via  
19- Heuristically Accelerated Reinforcement Learning  
822** *Ashwati Das-Stuart, Purdue University; Kathleen C. Howell, Purdue University*
- 9:40 AAS Reinforcement Learning and Topology of Orbit Manifolds for  
19- Stationkeeping of Unstable Symmetric Periodic Orbits  
680** *Davide Guzzetti, Auburn University*
- 10:00 Morning Break**
- 10:20 AAS SPACECRAFT MANEUVER STRATEGY OPTIMIZATION FOR  
19- DETECTION AVOIDANCE USING REINFORCEMENT LEARNING  
751** *Jason Reiter, Penn State ARGoPS; David B. Spencer, Pennsylvania State University*
- 10:40 AAS Evaluation of Use of Zero Phase Circulant Low Pass Filters for  
19- Robustification of Iterative Learning Control  
907** *Tianyi Zhang, Columbia University; Richard Longman, Columbia University*

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**Trajectory Design & Optimization VI**

Chair: Rohan Sood, University of Alabama

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- 8:00 AAS Unconstrained Spacecraft Trajectory Optimization using Embedded  
19- Boundary Value Problems  
929** *David Ottesen, The University of Texas at Austin; Ryan Russell, The University of Texas at Austin*
- 8:20 AAS L2 Station Keeping Maneuver Strategy for the James Webb Space  
19- Telescope  
806** *Jeremy Petersen, a.i. solutions; Karen Richon, NASA GSFC*
- 8:40 AAS Solar Sail Trajectories and Orbit Phasing of Modular Spacecraft for  
19- Segmented Telescope Assembly about Sun-Earth L2  
774** *Gabriel Soto, Cornell University; Erik Gustafson, Cornell University; Dmitry Savransky, Cornell University; Jacob Shapiro, Cornell University; Dean Keithly, Cornell University*
- 9:00 AAS Maneuver planning for NISAR mission  
19-  
926** *Francois Rogez, JPL; Sara Hatch; Allen Halsell, JPL/Caltech*
- 9:20 AAS Mission Feasibility from Trajectory Optimization and the State of Space  
19- Systems Research at the University of Auckland  
758** *Darcey Graham, University of Auckland; Nicholas Rattenbury, University of Auckland; John Cater, University of Auckland*
- 9:40 AAS Micro-Pulsed Plasma Thruster Maneuver Characterization  
19-  
847** *Jennifer Hudson, Western Michigan University*
- 10:00 Morning Break**
- 10:20 AAS Heliocentric Escape and Lunar Impact From Near Rectilinear Halo Orbits  
19-  
867** *Diane Davis, a.i. solutions, Inc.; Kenza Boudad, Purdue University; Kathleen C. Howell, Purdue University*
- 10:40 AAS Risk-aware Trajectory Design with Impulsive Maneuvers: Convex  
19- Optimization Approach  
893** *Kenshiro Oguri, University of Colorado Boulder; Jay McMahon, University of Colorado Boulder*