

AIAA SPACE 2016

Held at the AIAA SPACE Forum 2016

Long Beach, California, USA
13 - 16 September 2016

Volume 1 of 5

ISBN: 978-1-5108-3195-7

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

ASE-01: EARTH ORBIT ENVIRONMENTAL EFFECTS

Observations of Transient ISS Floating Potential Variations during High Voltage Solar Array Operations (AIAA 2016-5382)	1
<i>Emily Willis, Joseph I. Minow, Linda N. Parker, Maria Z. Pour, Charles Swenson, Ken-ichi Nishikawa, Linda Habash Krause</i>	
Degradation of Beta Cloth Covering for a Battery Orbital Replacement Unit in Low Earth Orbit (AIAA 2016-5383)	10
<i>James R. Gaier, Deborah L. Waters, Sammantha Baldwin, Angela D. Folz, Alyssa Loos</i>	
Unsteady Simulations of Rocket Plume Expansions in Geostationary Earth Orbit (AIAA 2016-5384)	24
<i>Andrew B. Weaver, Iain Boyd</i>	
Adaptive Taxonomy Modeling for Earth-Orbiting Object Differentiation (AIAA 2016-5385)	35
<i>Rochelle Mellish, Carolin Frueh</i>	

ASE-02: PLANETARY AND DUST ENVIRONMENTS

Indirect and Direct Planetary Illumination Modelling for Robotic Surface Exploration Sensing (AIAA 2016-5445)	49
<i>Daren Lee, Yang Cheng, Hari Nayar</i>	
Experimental and Numerical Investigations of Dusty Spacecraft Charging (AIAA 2016-5446)	54
<i>Kevin L. Chou, Joseph J. Wang, Daoru Han</i>	
Numerical Modeling of Dust Dynamics Around Small Asteroids (AIAA 2016-5447)	61
<i>William Yu, Daoru Han, Joseph J. Wang</i>	
Aerobot Design for Planetary Explorations (AIAA 2016-5448)	69
<i>Kanika Garg, M. Reza Emami</i>	
Investigation of the Secondary Neutron Production in Large Space Vehicles for Deep Space (AIAA 2016-5449)	82
<i>Kristina Rojdev, Steven Koontz, Brandon Reddell, William Atwell, Paul Boeder</i>	

ASE-03: UPPER ATMOSPHERIC ENVIRONMENTAL EFFECTS

Aerodynamics of the RANGE Nanosatellites from Direct Flowfield Simulation (AIAA 2016-5520)	89
<i>Kenneth A. Hart, Brian C. Gunter, Robert D. Braun</i>	
Effect of Rarefied Atmosphere on Blunt Body Stagnation Region Flow and Heat Transfer (AIAA 2016-5521)	104
<i>Johnson C. Wang, Mary Vojtek, Charles Griffice</i>	
Dual-head Electromagnetic Variable Sweeping Speed Space Broom for Space Debris Mitigation (AIAA 2016-5522)	113
<i>VR Sanal Kumar, Sharad Sharan, Kumar Ashish, Jerin John, V. K. Vijil Lal, Vignesh Venkatachalam, Chinnasamy Cibi Vishnu, Ajith Sukumaran</i>	
Numerical Evaluation of The Effect of Icing Accretion on An Airship (AIAA 2016-5523)	125
<i>Yanxiang Cui, Qiang Liu, Yanchu Yang, Xiangqiang Zhang</i>	
Three Dimensional Simulation of Stratospheric Airship Ice Accretion in Ascending Process (AIAA 2016-5524)	136
<i>Qiang Liu, Yanxiang Cui, Yanchu Yang, Jingjing Cai, Guoning Xu</i>	

COL-01/EXPL-01: CIS-LUNAR HABITATION

Habitation Concepts For Human Missions Beyond Low-Earth-Orbit (AIAA 2016-5216)	150
<i>David V. Smitherman</i>	
A Resilient Cislunar Spacecraft Architecture to Support Key Mars Enabling Technologies and Operation Concepts (AIAA 2016-5217)	165
<i>Matthew Duggan, James M. Engle, Travis A. Moseman</i>	
Feasibility Study for Using Cygnus as a Habitat in Deep Space Exploration (AIAA 2016-5218)	180
<i>Chad L. Davis, Ken Peek</i>	

COL-02: HUMAN FACTORS AND HABITABILITY

Display and Visualization Methods in Extreme Environments - Spaceship Cockpits (AIAA 2016-5274)	191
<i>Joseph Torkaman</i>	
Adaptive Spaceship Cockpit Architecture - Introduction to Design Theory for the Near Future Human Spaceflight (AIAA 2016-5275)	198
<i>Ondrej Doule, Guy A. Boy</i>	
Design and Testing of an Inflatable Airlock Concept (AIAA 2016-5276)	211
<i>David L. Akin</i>	

ACCESS (Artificial Gravity Centrifuge Space Station in cis-lunar Space): Concept and Operations (AIAA 2016-5277)	223
<i>Akshata Krishnamurthy, Samuel Wald, Roedolph Opperman, Anthony Broll, Charlotte Lowey, Gregory Eschelbach, Johannes Norheim, Jonathan Prout, Sabrina Reyes, Srinivasa Bhattaru, Olivier De Weck</i>	
Why Deep Space Habitats Should be Different from the International Space Station (AIAA 2016-5278)	248
<i>Brand N. Griffin</i>	

COL-03: MOVING BEYOND LOW-EARTH ORBIT: CONSIDERATIONS AND ANALOGS

Challenges of Building the International Space Station (AIAA 2016-5386)	255
<i>John G. Cook</i>	
Simulating Long Duration Deep Space Missions (AIAA 2016-5387)	259
<i>Eleanor E. Morgan</i>	
An Artificial-Gravity Space-Settlement Ground-Analogue Design Concept (AIAA 2016-5388)	276
<i>Gregory A. Dorais</i>	
MOBIUS: An Evolutionary Strategy for Lunar Tourism (AIAA 2016-5389)	308
<i>Mehdi Lali, Madhu Thangavelu</i>	

COL-04: SUPPORTING HUMAN EXPLORATION TECHNOLOGIES

Mars/Moon Net: A Human Assisting Planetary System of Intelligent Controllable Spherical Robots (the Moballs) (AIAA 2016-5450)	325
<i>Faranak Davoodi, Cedric Cocaud</i>	
DIAMOND - An Architecture for Persistent Space Platforms (AIAA 2016-5451)	338
<i>Julian Breidenthal, Thomas George, Marco Villa, Ehson Mosleh</i>	
Solar vs. Fission Surface Power for Mars (AIAA 2016-5452)	349
<i>Michelle A. Rucker, Steven R. Oleson, Patrick George, Geoffrey Landis, James Fincannon, Aimee Bogner, Jeremiah McNatt, Elizabeth Turbull, Robert Jones, Michael Martini, John Gyekenyesi, Anthony Colozza, Paul Schmitz, Thomas Packard</i>	
Establishing Affordable Mars Telecom Relay Service (AIAA 2016-5453)	369
<i>Scott Tilley, Alfred Tadros, Andrew E. Turner</i>	
Development Status for a Combined Solid Oxide Co-Electrolyzer and Carbon Formation Reactor System for Oxygen Regeneration (AIAA 2016-5454)	378
<i>Robert D. Green, Paul H. Matter, Chris Holt, Michael Beachy, James Gaydos, Serene C. Farmer, John A. Setlock</i>	
Sizing a Common Habitat for Multiple Environments and Mission Durations (AIAA 2016-5455)	392
<i>Scott Howe, Matthew A. Simon, Samuel I. Wald</i>	

COL-05: MISSION AND HABITAT ARCHITECTURE DESIGN

Mars in One Month: The GEM Theory of Energy and Momentum Exchange With Spacetime and Forces Observed in the Eaglework Q-V Thruster (AIAA 2016-5525)	440
<i>John E. Brandenburg</i>	
An Affordable Architecture for Establishing a Resource Processing Outpost on the Moon (AIAA 2016-5526)	462
<i>Tony Lavoie, Paul D. Spudis</i>	
Phobos Base (AIAA 2016-5527)	494
<i>Marc M. Cohen</i>	
Mars Ice House: Using the Physics of Phase Change in 3D Printing a Habitat with H₂O (AIAA 2016-5528)	520
<i>Michael Morris, Christina Ciardullo, Kelsey Lents, Jeffrey Montes, Ostap Rudakevych, Masa Sono, Yuko Sono, Melodie Yashar</i>	
Evidence of a Massive Thermonuclear Explosions on Mars in the Past - The Cydonian Hypothesis and Fermi's Paradox (AIAA 2016-5529)	535
<i>John E. Brandenburg</i>	

COLL-06: SETTLEMENT, TOURSIM, AND CONSIDERATIONS

Emerging LEO Economy (AIAA 2016-5585)	565
<i>Carissa B. Christensen, Travis Doom, Phil Smith</i>	
Nutrient Balance and Nitrogen Cycling In a Multistage, Multispecies Space Farm (AIAA 2016-5586)	571
<i>Bryce L. Meyer, Nicholas S. Shepherd</i>	
Economics and Food Provision Options for Luxury Food in an Orbiting Space Hotel (AIAA 2016-5587)	587
<i>Bryce L. Meyer</i>	
Run, Hike, and Camp on the Moon (AIAA 2016-5588)	603
<i>Antoine G. Faddoul</i>	
A Survey of Earth-Mars Transfer Orbits Suitable for Human Passengers (AIAA 2016-5589)	612
<i>Don V Black</i>	

EXPL-02: LUNAR EXPLORATION

A Coordinated International Lunar Exploration Precursor Programme (AIAA 2016-5219)	618
<i>Markus Landgraf, Bernhard Hufenbach, Martin Picard, Yves Gonthier, Christian Lange, Hirtotaka Sawada, Yuya Mimasu, Naoki Sato, Tatsuki Hashimoto, Takeshi Hoshino</i>	
Kickstarting a New Era of Lunar Industrialization via Campaigns of Lunar COTS Missions (AIAA 2016-5220)	629
<i>Allison F. Zuniga, Edgar Zapata, Mark F. Turner, Daniel Rasky, Robert B. Pittman</i>	
NASA Lander Technologies Project Status (AIAA 2016-5221)	647
<i>Donald G. Chavers, Kim Ess, Joshua Moore, Melanie Dervan, William P. Ondocsin, John M. Carson, Wesley L. Johnson</i>	
The Effect of Reusability in Cost-Constrained Human Lunar Exploration Programs (AIAA 2016-5222)	656
<i>David L. Akin</i>	

EXPL-03: IN-SITU RESOURCE UTILIZATION

The World is Not Enough (WINE): Harvesting Local Resources for Eternal Exploration of Space (AIAA 2016-5279)	666
<i>Kris Zacny, Phil Metzger, Kathryn Luczek, James Mantovani, Robert P. Mueller</i>	
International Space Exploration Coordination Group Assessment of Technology Gaps for LOx/Methane Propulsion Systems for the Global Exploration Roadmap (AIAA 2016-5280)	686
<i>Eric A. Hurlbert, Wesley Johnson, Hiroshi Ueno, Leslie Alexander, Mark D. Klem, Emauela Daversa, Jean-Marc Rualt, Chiara Manfretti, Jean-Noel Caruana, Hiroya Asakawa, Ryan J. Whitley, Martin Sippel, Hiroshi Ueno</i>	
Propane to Phobos (AIAA 2016-5281)	703
<i>James A. Martin</i>	

EXPL-05: EVA AND SURFACE OPERATIONS

An Unpowered Exoskeleton to Reduce Astronaut Hand Fatigue During Microgravity EVA (AIAA 2016-5390)	724
<i>Alan J. Carey, Stephen Robinson</i>	
Operational Assessment of Apollo Lunar Surface Extravehicular Activity Timeline Execution (AIAA 2016-5391)	746
<i>Matthew J. Miller, Austin Claybrook, Suraj Greenlund, Karen M. Feigh</i>	
Utilizing ISS EMU as an Exploration Test Bed (AIAA 2016-5392)	765
<i>Mike Hembree, Gregory Quinn, David Graziosi</i>	
Pressurized Adapter for "Shirt-Sleeves" Transfer and Universal Base Expansion (PASSTUBE) (AIAA 2016-5393)	777
<i>Scott Howe</i>	

EXPL-06: IN-SPACE MANUFACTURING AND ASSEMBLY

Systems Analysis of In-Space Manufacturing Applications for the International Space Station and the Evolvable Mars Campaign (AIAA 2016-5394)	788
<i>Andrew Owens, Olivier De Weck</i>	
Quantification of the Responsiveness of On-Orbit Servicing Infrastructure for Modularized Earth-Orbiting Platforms (AIAA 2016-5395)	806
<i>Tristan Sarton du Jonchay, Koki Ho</i>	
Building a Sustainable In-Space Manufacturing Ecosystem: Positrusion™ and CRISSP™ (AIAA 2016-5396)	827
<i>Jesse Cushing, Mason Freedman, Kristen Turner, Rachel L. Muhlbauer, Blaine Levedahl, Jeff Slostad, Robert P. Hoyt, Tony Kim, Mary J. Werkheiser, Allison K. Porter, Robert Dyer, Jeff Wallace, Michael Pfaff, Greg Jimmerson, Tom McConnell, Greg Kachmarik</i>	

VOLUME 2

High Leverage Technologies for In-Space Assembly of Complex Structures (AIAA 2016-5397)	838
<i>Doris Hamill, Lynn Bowman, David A. Gilman, Wendel K. Belvin</i>	

EXPL-08: EVOLVABLE MARS CAMPAIGN

Evolvable Mars Campaign 2016 - A Campaign Perspective (AIAA 2016-5456)	846
<i>Kandyce E. Goodliff, Patrick Troutman, Douglas A. Craig, Jose Caram, Nicole Herrmann</i>	
Mars Base Camp: A Martian Moon Human Exploration Architecture (AIAA 2016-5457)	867
<i>Timothy Cichan, Stephen A. Bailey, Scott D. Norris, Robert P. Chambers, Steven D. Jolly, Andrew Scott</i>	
Architecture Sensitivity to Propulsion Choices for Human Mars Missions (AIAA 2016-5458)	887
<i>Claude R. Joyner, James Horton, Timothy S. Kokan, Daniel J. Levack, Matthew R. Long, Frederick Widman</i>	
Commercial Options for Hybrid Chemical/Electric Propulsion Transportation System to Support Mars Exploration (AIAA 2016-5459)	903
<i>Patrick Chai, Dale C. Arney, Christopher A. Jones, Jordan Klovstad, Kevin Larman</i>	

EXPL-09: LIFE SUPPORT SYSTEMS

NASA Advanced Explorations Systems: Advancements in Life Support Systems (AIAA 2016-5460)	916
<i>Sarah A. Shull, Walter Schneider</i>	
Guiding Requirements for Designing Life Support System Architectures for Crewed Exploration Missions Beyond Low-Earth Orbit (AIAA 2016-5461)	924
<i>Jay L. Perry, Miriam J. Sargusingh, Nikzad Toomarian</i>	
Direct Liquid Contact -- Next Generation Approach to Combined CO₂ Recovery and Humidity Control for Extended Missions (AIAA 2016-5462)	943
<i>Stephen F. Yates, Alexander Bershtsky, Ted Bonk, Phoebe Henson, Allen MacKnight</i>	
Influence of Transient Heat Transfer on Metabolic Functions of <i>Chlorella Vulgaris</i> used for Environmental Control and Life Support Systems of Long Duration Spaceflight (AIAA 2016-5463)	958
<i>Emily Matula, Oscar Monje, James Nabity</i>	

EXPL-10/IS-05: AUTOMATED PLANNING AND SENSING SYSTEMS

Transitioning Autonomous Systems Technology Research to a Flight Software Environment (AIAA 2016-5530)	970
<i>Jeremy D. Frank, Gordon B. Aaseng</i>	
Projective Invariant Based Crater Matching for Visual Navigation in Planetary Landing (AIAA 2016-5531)	991
<i>Kiduck Kim, Youeyun Jung, Hyochoong Bang</i>	
Real-Time Omnidirectional Radiation Monitoring on Spacecraft (AIAA 2016-5532)	998
<i>Martin J. Losekamm, Michael Milde, Thomas Pöschl, Daniel Greenwald, Stephan Paul</i>	
Modal Propellant Gauging in Low Gravity (AIAA 2016-5533)	1007
<i>Kevin M. Crosby, Tessa Rundle, Kevin LeCaptain, Rudy Werlink</i>	

EXPL-11: SMALL BODIES EXPLORATION

PALLAS: A Portable Asteroid Lift and Lock Aggregate System (AIAA 2016-5534)	1015
<i>Charlotte Kiang, Jeffrey Ly, Eric Berg, Priscilla Cancar, Hannah Rudin, Ana Diaz Artilles</i>	
The Robotic In-situ Surface Exploration System for Space Exploration Objectives (AIAA 2016-5535)	1032
<i>Drew M. Goodman, Thomas Evans, Michael Campbell, Chad Panther, Aaron Noble</i>	
Enceladus' Environment and the Design of the Enceladus Ice-Probe Navigation System (AIAA 2016-5536)	1043
<i>Arkadiusz Szumski, Konstantinos Konstantinidis, Roger Förstner, Bernd Eissfeller</i>	

EXPL-12: ENTRY, DESCENT, AND LANDING TECHNOLOGIES

Development of Navigation Doppler Lidar for Future Landing Missions (AIAA 2016-5590)	1054
<i>Farzin Amzajerdian, Diego Pierrotet, Glenn D. Hines, Larry Petway, Bruce Barnes, John M. Carson</i>	
Imaging Flash Lidar for Autonomous Safe Landing and Spacecraft Proximity Operation (AIAA 2016-5591)	1061
<i>Farzin Amzajerdian, Vincent E. Roback, Alexander Bulyshev, Paul F. Brewster, Glenn D. Hines</i>	
COBALT: A Payload for Closed-Loop Flight Testing of Lander GN&C Technologies on Terrestrial Rockets (AIAA 2016-5592)	1073
<i>John M. Carson, Carl R. Seubert, Farzin Amzajerdian, Carlos Villalpando, Chuck Bergh, Travis V. O'Neal, Edward A. Robertson, Glenn D. Hines, Diego Pierrotet</i>	
Controlled Entry of a Slender Body Aeroshell (AIAA 2016-5593)	1082
<i>Robert Booher, Robert D. Braun</i>	
Optimization of a Hot Structure Aeroshell and Nose Cap for Mars Atmospheric Entry (AIAA 2016-5594)	1092
<i>Sarah Langston, Christopher G. Lang, Kamran Daryabeigi, Jamshid Samareh</i>	
Experimental Validation of Semi-Active Landing Gear for Touchdown with Attitude Disturbance (AIAA 2016-5595)	1105
<i>Takao Maeda, Masatsugu Otsuki, Tatsuaki Hashimoto</i>	

EXPL-13: ADVANCED SYSTEM CONCEPTS

Innovative Mars Global International Exploration (IMaGInE) Mission (AIAA 2016-5596)	1113
<i>Davide Conte, Dorota Budzyn, Hayden Burgoyne, Marilena Di Carlo, Dan Fries, Maria Grulich, Sören Heizmann, Henna Jethani, Mathieu Lapôtre, Tobias Roos, Encarnación Serrano Castillo, Marcel Sherrmann, Rhiannon Viececi, Lee Wilson, Christopher Wynard</i>	
Venus Landing Site Analysis (AIAA 2016-5598)	1168
<i>Jason Rabinovitch, Kathryn Stack, Richard Otero, Gary M. Ortiz, Mark A. Bullock</i>	
A Parafol-Based, Hybrid Airship Design for Extended Martian Exploration (AIAA 2016-5599)	1177
<i>Donald O. Shaw</i>	
Mars Robotic Global Exploration Network (AIAA 2016-5600)	1184
<i>R. Sterling, S. Zaki, R Agreda, Y Wang, Gecheng Zhu</i>	

GEPC-01: GREEN ENERGY

Comparative Studies of Combustion Characteristics of Gaseous CH₄/O₂ and H₂/O₂ Coaxial Jets in a Single-Element Combustor (AIAA 2016-5282)	1201
<i>Tae Young Kim, Sun Choi, Hee Kyung Kim, Oh Chae Kwon</i>	
Lightweight, High-Performance Solar Cells for High Power-to-Weight and Deployable Solar Arrays (AIAA 2016-5283)	1207
<i>Aarohi Vijh, Gregory N. Koskovich</i>	

HSP-01: SPACE HISTORY

Of Mice and Steely Eyed Missile Men: The Partnering of Two Visionaries (AIAA 2016-5284)	1212
<i>John C. Rose</i>	
Design Lessons Learned from Temperature Management of Galileo's Retro-Propulsion Module (AIAA 2016-5285)	1216
<i>Robert B. Gounley</i>	
The Viking Biological Experiment at Forty Years (AIAA 2016-5286)	1235
<i>Glenn Bugos, John W. Boyd</i>	

HSP-02: SOCIETY & SPACE

Albert A. Harrison: Outer Space, The Human Dimension, and Astrosociology (AIAA 2016-5398)	1248
<i>Jim Pass</i>	
Understanding Participant Motivations and Goals in Complex Open Innovation Tournaments (AIAA 2016-5399)	1270
<i>Ademir P. Vrolijk, Zoe Szajnarfarber</i>	
Polynesian Colonization as a Model for Human Expansion into the Solar System (AIAA 2016-5400)	1281
<i>Todd F. Sheerin, Phillip M. Cunio</i>	

HSP-03: SPACE POLICY

Shadow Boxing: GLXP Team Relationships to Their Respective National Space Agencies (AIAA 2016-5464)	1291
<i>John M. Wilkes</i>	
Beyond Disaster Management: Innovative Case Studies for Using Remote Sensing Data in International Development Projects (AIAA 2016-5465)	1300
<i>Krystal Wilson</i>	
NASA's Public Participation Universe: Why and How the U.S. Space Agency Is Democratizing Its Approaches to Innovation (AIAA 2016-5466)	1311
<i>Amy Kaminski, Lynn Buquo, Monsi C. Roman, Beth Beck, Michelle Thaller</i>	
Parsing the Role of Civil Space: A New Direction for International Space Policy (AIAA 2016-5467)	1331
<i>Nathan J. Boll</i>	

IS-01: INTEGRATED SYSTEM HEALTH MANAGEMENT FOR SPACE SYSTEMS

Modeling in the State Flow Environment to Support Launch Vehicle Verification Testing For Mission and Fault Management Algorithms in the NASA Space Launch System (AIAA 2016-5223)	1336
<i>Luis C. Trevino, Peter Berg, Stephen Johnson, Dwight England</i>	
Sensor Data Qualification and Consolidation (SDQC) for Real-Time Operation of Launch Systems (AIAA 2016-5224)	1350
<i>Edmond Wong</i>	
Model-Based Fault Detection and Isolation System for Increased Autonomy (AIAA 2016-5225)	1360
<i>Ksenia O. Kolcio</i>	
Functional Fault Model Development Process to Support Design Analysis and Operational Assessment (AIAA 2016-5226)	1375
<i>Kevin J. Melcher, William A. Maul, Joseph A. Hemminger</i>	

IS-03/SATS-04: INFORMATION SYSTEMS FOR MISSION OPERATIONS

Increasing Telemetry Throughput Using Customized and Adaptive Data Compression (AIAA 2016-5401)	1388
<i>Jared R. Coplin, Annie Yang, Andrew R. Poppe, Martin Burtcher</i>	
ESA Constellation Coordination System - Development made easy by CCSDS Mission Operation Services (AIAA 2016-5402)	1398
<i>Vemund Reggestad, Kate Symonds, Tiago Nogueira, Marius Stanciu-Manolescu, Mar González</i>	
Big Data in Mission Operations, the ExoMars 2016 Experience (AIAA 2016-5403)	1407
<i>Gianluca Montroni, Marta Pantoquilho, Rui Santos</i>	
Role of Interoperability in Resilient System-of-Systems for Humanitarian Assistance and Disaster Relief (AIAA 2016-5404)	1417
<i>Kenneth L. Cureton, Azad M. Madni</i>	

IS-04/SSEE-05: MODEL-BASED SYSTEMS ENGINEERING: METHODOLOGIES AND TOOLS I

Towards a Reference Architecture for Model-Based Engineering Environments (AIAA 2016-5468)	1425
<i>Sebastian J. Herzig, Robert Karban, Michel D. Ingham</i>	
Methodologies for Modeling and Simulation in Model-Based Systems Engineering Tools (AIAA 2016-5469)	1439
<i>Kevin A. Reilley, Stephen Edwards, Russell Peak, Dimitri Mavris</i>	
Architecture To Geometry - Integrating System Models With Mechanical Design (AIAA 2016-5470)	1453
<i>Manas Bajaj, Bjorn Cole, Dirk Zwemer</i>	
An Integrated Systems Modeling and Analysis Platform for Flight Project Work (AIAA 2016-5471)	1472
<i>Bjorn Cole, J. Simmons</i>	
A Model Based Systems Engineering Approach Towards Developing a Rapid Analysis and Trades Environment (AIAA 2016-5472)	1483
<i>Tejas Kulkarni, Kevin DeBruin, Adam Nelessen, Kevin A. Reilley, Russell Peak, Stephen J. Edwards, Dimitri N. Mavris</i>	

IS-06/SATS-05: AUTONOMY AND FLIGHT SOFTWARE

Risk-aware Planning in Hybrid Domains: An Application to Autonomous Planetary Rovers (AIAA 2016-5537)	1497
<i>Pedro Santana, Tiago Vaquero, Catharine L. McGhan, Claudio Toledo, Eric Timmons, Brian Williams, Richard Murray</i>	
Modular Attitude Guidance Development using the Basilisk Software Framework (AIAA 2016-5538)	1520
<i>Mar Cols-Margenet, Hanspeter Schaub, Scott Piggott</i>	
SPOC: Deep Learning-based Terrain Classification for Mars Rover Missions (AIAA 2016-5539)	1538
<i>Brandon Rothrock, Ryan Kennedy, Chris Cunningham, Jeremie Papon, Matthew Heverly, Masahiro Ono</i>	
Attitude Control System Design for CubeSats Configured with Exo-Brake Parachute (AIAA 2016-5540)	1550
<i>Sean Shan-Min Swee, Alexander Westfall</i>	
The Resilient Spacecraft Executive: An Architecture for Risk-Aware Operations in Uncertain Environments (AIAA 2016-5541)	1564
<i>Catharine L. McGhan, Tiago Vaquero, Anatha R. Subrahmanya, Oktay Arslan, Richard Murray, Michel D. Ingham, Masahiro Ono, Tara Estlin, Brian Williams, Maged Elaasar, Ravi Lanka</i>	

IS-07/SSEE-07: MODEL-BASED SYSTEMS ENGINEERING: METHODOLOGIES AND TOOLS II

Effort to Accelerate MBSE Adoption and Usage at JSC (AIAA 2016-5542)	1585
<i>Lui Wang, Michel Izygon, Shira Okon, Howard Wagner, Larry Garner</i>	
Identifying where Mission Assurance Can Benefit from Model Based Systems Engineering (AIAA 2016-5543)	1595
<i>Martin Feather, John Evans, Steven Cornford</i>	
Fault Management Ontology and Modeling Patterns (AIAA 2016-5544)	1610
<i>Jean-Francois Castet, Magdy Bareh, Jeffery Nunes, Steven Jenkins, Gene Lee</i>	
Towards a Methodology and Tooling for Model-based Probabilistic Risk Assessment (PRA) (AIAA 2016-5545)	1627
<i>Sam Schreiner, Matthew L. Rozek, Andy Kurum, Chester J. Everline, Michel D. Ingham, Jeffery Nunes</i>	
A Robotic Testing Framework for the Model Based Engineering Environment (AIAA 2016-5546)	1646
<i>Chrishma H. Singh-Derewa, Kae Sawada</i>	

IS-10/NSS-04: CYBERDEFENSE OF SPACE ASSETS

Tailoring NIST Security Controls for the Ground System: Selection and Implementation - Recommendations for Information System Owners (AIAA 2016-5602)	1654
<i>Eduardo Takamura, Kevin Mangum</i>	

VOLUME 3

Mission-Centric Cyber Security Assessment of Critical Systems (AIAA 2016-5603)	1686
<i>Jeremy L. Pecharich, Arun Viswanathan, Suzanne Stathatos, Brian Wright, Kymie Tan</i>	
Achieving Space Mission Resilience To Cyber Attack: Architectural Implications (AIAA 2016-5604)	1709
<i>Thomas Llanso, Dallas Pearson</i>	
Making Space-Link Security Work: Auxiliary Services to Enable the CCSDS Space Data-Link Security Protocol (AIAA 2016-5605)	1721
<i>Daniel Fischer, Ignacio Aguilar Sanchez, David Koisser, Bruno Saba, Gilles Moury, Brandon Bailey, Craig Biggerstaff, Howard Weiss, Dorothea Richter</i>	

IS-11/EXPL-14: INNOVATIVE ADVANCES IN INFORMATION SYSTEMS

Towards Architecture-wide Analysis, Verification, and Validation for Total System Stability During Goal-Seeking Space Robotics Operations (AIAA 2016-5607)	1732
<i>Catharine L. McGhan, Yuh-Shyang Wang, Michele Colledanchise, Tiago Vaquero, Richard Murray, Brian Williams, Petter Ögren</i>	
Super Resolution based on Deep Learning Technique for Constructing Digital Elevation Model (AIAA 2016-5608)	1757
<i>SungHyun Moon, Han-Lim Choi</i>	

A Software Defined Satellite Networking Scheme Based on Segment Control (AIAA 2016-5609)	1765
<i>Guiting Zhong, Jian Yan, Linling Kuang</i>	

NSS-01: INNOVATION

AFSPC Innovation and Science and Technology Outreach to Industry and Academia (AIAA 2016-5227)	1775
<i>Merri J. Sanchez, Anthony Dills, Faith Chandler</i>	
Science and Technology (S&T) Roadmap Collaboration Between SMC, NASA, and Government Partners (AIAA 2016-5228)	1781
<i>Joseph Betser, Roberta Ewart, Faith Chandler</i>	
Big Missions, Small Solutions Advances and Innovation in Architecture and Technology for Small Satellites (AIAA 2016-5229)	1796
<i>Robert B. Friend, Chris Arroyo, Joseph Hansen</i>	
Key Steps Towards Achieving HAIPE Capability for Future Space Architectures (AIAA 2016-5230)	1811
<i>Jeffrey L. Janicik</i>	
Spacecraft Embedded Cyber Defense- Prototypes & Experimentation (AIAA 2016-5231)	1818
<i>Nicholas Cohen, Wayne A. Wheeler, Roberta Ewart, Joseph Betser</i>	

NSS-02: EMERGING TRENDS

Enhanced Space Object Identification: Taking the Guesswork Out of LEO Cubesats (AIAA 2016-5287)	1829
<i>Roberta M. Ewart</i>	
Probabilistic Inference for RSO Event and Threat Detection and Characterization (AIAA 2016-5288)	1839
<i>Vladimir Markov, Stephen Kupiec, Daniel Erwin, Joseph Chavez</i>	
Integrating ISR Data with Open Source Indicators (AIAA 2016-5289)	1849
<i>Matthew G. Richards, Ryan McArdle, Erin Feller, Tsai-Ching Lu, Kangyu Ni, Ryan M. Uhlenbrock</i>	
Advances in Small Satellite Technology and Resilient Space Systems (AIAA 2016-5290)	1857
<i>Catherine C. Venturini, Curtis Iwata</i>	

NSS-03: ADVANCED CONCEPTS

Science and Technology (S&T) Roadmaps to Enhance Military Space System Resilience (AIAA 2016-5473)	1869
<i>Laurence Bellagamba, Stuart Patterson, Klaus Biber, David Pirolo, Roberta M. Ewart</i>	
Cyber Enhanced Space Operations (CESO)- From Frameworks to Enterprise Evolution (AIAA 2016-5474)	1881
<i>Wayne A. Wheeler, Roberta Ewart, Joseph Betser, Nicholas Cohen, Roger Knobbe, James Horejsi, Judy Gonc</i>	
LUNAR SENTINEL™ : Planetary Defense from the Moon (AIAA 2016-5475)	1898
<i>Madhu Thangavelu, Vishal Vasmate</i>	

OPS-01: TECHNOLOGICAL APPROACHES TO SOLVE VARIOUS OPERATIONAL CHALLENGES

ADIA++: An Autonomous Onboard Diagnostic System for Nanosatellites (AIAA 2016-5547)	1911
<i>Gerhard Fellingner, Kirill Djebko, Eric Jäger, Hakan Kayal, Frank Puppe, Simon B. Stier</i>	
Debris Analysis for the Terra Disposal Orbit Candidates (AIAA 2016-5548)	1921
<i>Andrew J. Abraham, Roger C. Thompson, Demitrios C. Mantziaras</i>	

OPS-02: NEW MISSION OPS CONCEPTS TO EXPLORING THE UNIVERSE

Cygnus Return to Flight: the View from the Mission Director’s Console (AIAA 2016-5610)	1940
<i>Ken Peek, Chad L. Davis</i>	
Integration and Pre-experiment Test Flow of the Gravi2 Experiment Performed in the EMCS: From Ground Testing to Space Flight (AIAA 2016-5611)	1951
<i>Irene Karoliussen, Liz H. Coelho, Tore M. Hauan</i>	

OPS-03: SPACE OPERATION EDUCATION

Re-Engineering Student Thought Processes Using Spaceflight Operations (AIAA 2016-5612)	1962
<i>Tor T. Finseth, Clayton C. Anderson</i>	
A Hands-On University Course in Satellite Operations (AIAA 2016-5613)	1969
<i>Christopher A. Kitts, Mike Rasay</i>	
Graduated Stress Exposure of Spaceflight Hazards in a Virtual Environment (AIAA 2016-5614)	1975
<i>Tor T. Finseth, Nir Keren, Warren Franke, Michael Dorneich, Clayton C. Anderson</i>	

PSTR-02: HUMAN SPACE EXPLORATION, ARCHITECTURE, AND COLONIZATION POSTERS

The Destiny Plan: Visionary Communities in Space (AIAA 2016-5344)	1984
<i>Jaspall S. Gill</i>	

Cognitive Function Analysis for Human Spaceflight Cockpits with Particular Emphasis on Microgravity Operations; Part 1/2 (AIAA 2016-5345)	2015
<i>Joseph Torkaman, Azeez S. Batcha, Kareim Elbaz, De Vere M. Kiss, Ondrej Doule, Guy A. Boy</i>	

PSTR-03: SMALL SATELLITES POSTERS

An Open-Source Reaction Wheel System for Oregon’s First Satellite (AIAA 2016-5346)	2017
<i>Jeremy A. Louke, Erin S. Schmidt, Calvin J. Young</i>	

PSTR-04: SPACE AND EARTH SCIENCE POSTERS

Copernicus Sentinel-2A Flight Dynamics Operational Experience (AIAA 2016-5347)	2024
<i>Francesco Affaitati, Javier Sánchez, Jorge Lopez-Merida</i>	
Triton Hopper: Exploring Neptune’s Captured Kuiper Belt Object (AIAA 2016-5348)	2033
<i>Steven R. Oleson, Geoffrey Landis</i>	
Problems of the Lunar Internal Structure and Gravitational Field of Cosmic Mission (AIAA 2016-5351)	2034
<i>Alexey Andreev, Yury Nefedyev, Natalia Petrova, Natalia Demina, Alexander Gusev</i>	
Analysis of a Low Earth Orbit Photoperiod on the Development of Aquaponic Lettuce (AIAA 2016-5352)	2041
<i>Kelsey T. Kalbacher, Eloy Normando Marquez Gonzalez</i>	
Ensemble Classifiers in Optimal Estimation for Ionospheric Disturbances Behavior on Spaceborne Interferometric SAR Systems (AIAA 2016-5353)	2045
<i>Basil A. Massinas, Anastasios Doulamis, Nikolaos Doulamis, Demetris Paradissis</i>	

PSTR-05: SPACE EXPLORATION POSTERS

Simulation and Experimental Validation on Touchdown Dynamics of Lunar and Planetary Lander with Translation-Rotation Motion Converting Mechanism (AIAA 2016-5354)	2056
<i>Takao Maeda, Takeshi Ozaki, Shintaro Matsui, Susumu Hara</i>	
PocketPad™: Concept for an Expendable Safe Lander Touchdown Accessory (AIAA 2016-5355)	2067
<i>Madhu Thangavelu, Andrew M. Chao</i>	
Design and Computation of Trajectory Envelopes for Powered Descent and Precision Landing (AIAA 2016-5356)	2076
<i>Dilmurat Azimov, Melissa M. Onishi</i>	
Trajectory Planning Optimization using Genetic Algorithms (AIAA 2016-5357)	2091
<i>John E. Angarita, Jonathan Black</i>	
Long Duration Space Flight Exposed Whole Human Spine: Biomechanical Changes Predictions (AIAA 2016-5358)	2101
<i>Molly Townsend, Nesrin Sarigul-Klijn</i>	
Generic Calibration Method for Reduction of Position Output Error in Celestial Blind Astrometric Position Estimation Device (AIAA 2016-5359)	2110
<i>Thomas C. Fuller, May-Win Thein</i>	
Adaptive Readily Morphing Optimized Radiation Shielding for Transit Habitat (AIAA 2016-5360)	2124
<i>Joseph Barthel, Nesrin Sarigul-Klijn</i>	

PSTR-08: SPACE SYSTEM POSTERS

Saturn Solar Power - Titan Saturn System Mission (TSSM) Using Solar Power Systems (AIAA 2016-5361)	2134
<i>Steven R. Oleson, Lisa Kohout, Ralph Lorenz</i>	
A Novel Algorithm to Eliminate the Sidelobes for any Planar Antenna Arrays for High Quality Signals and Accurate Positioning and Tracking (AIAA 2016-5362)	2135
<i>Firas A. Al-Saedi, Ahmed N. Jabbar</i>	

PSTR-09: SPACE TRANSPORTATION POSTERS

Developing Additive Manufactured Monopropellant Thrusters for Deep Space CubeSat Applications (AIAA 2016-5363)	2164
<i>Edmond Ngo, Edwin S. Romero</i>	
Electromechanical Nose Cone Separation Ring for Deployment of Amateur Rocket Recover Systems (AIAA 2016-5364)	2181
<i>Jorden Roland, David Edwards, Adam Harris, Katia Pahlua Lopez, Miles Atherly, Benjamin Butler, Andrew Eads, Jason Hamilton, Brian Happ, Alin Resiga</i>	
Design and Manufacture of an Open-Hardware University Rocket Airframe using Carbon Fiber (AIAA 2016-5365)	2186
<i>Joseph P. Shields, Leslie Elwood</i>	

PSTR-10: SYSTEMS ENGINEERING AND ECONOMICS POSTERS

Need for, and Survey of the Multi-Discipline Design, Analysis, and Optimization (MDAO) Method / Process - Emphasis upon Cost Method & Tools (AIAA 2016-5366) 2194
Tom Harwick

RIS-02: REINVENTING SPACE ECONOMICS

Evolving from the “Space Business” to “Doing Business in Space”, Economics, Architectures and Requirements (AIAA 2016-5232) 2210
Daniel P. Martens

Start-Up Space: Rising Investment in Commercial Space Ventures (AIAA 2016-5233) 2226
Carissa B. Christensen, Kirsten Armstrong, Raphael Perrino

Reducing Mission Costs by Extending Crew Stay for Initial Crewed Missions to the Moon and Mars (AIAA 2016-5234) 2243
Doug Plata, James R. Wertz, Anthony Shao

RIS-03: RESILIENT SPACE

Creating a Resilient Space Mission Architecture (AIAA 2016-5291) 2253
James R. Wertz, Thomas Bauer, John Collins, Robert Conger, Frank Czopek, Richard Van Allen, Anthony Shao, James Faist, Markus Rufer

Effects of Fractionation on System Security in Space Systems (AIAA 2016-5292) 2269
Antonio Pugliese, Alejandro Salado, Roshanak Nilchiani

The Inevitability of Persistence (AIAA 2016-5293) 2279
Roger Basl

Analytical Low-Thrust Satellite Maneuvers for Rapid Ground Target Revisit (AIAA 2016-5294) 2285
Ciara N. McGrath, Malcolm Macdonald

RIS-04: REINVENTING SPACE TECHNOLOGIES

Development of a Small Bipropellant Rocket Engine Utilizing Additive Manufacturing Processes (AIAA 2016-5405) 2303
John Tucker, Erin S. Schmidt, Tamara Dib, Taylor Rice, Kristin Travis, Bianca Viggiano

Designated Cost-Reduction Measures for Enabling State-of-the-Art Civil and Military Space Programs (AIAA 2016-5406) 2311
Amir S. Gohardani

Development of a Universal Plug-and-Play Adapter (AIAA 2016-5407) 2330
Saish Sridharan, Ran Qedar

RIS-05: RESPONSIVE MISSION ARCHITECTURES

An ISS Space Ambulance Based on X-37B Technology (AIAA 2016-5476) 2341
Ephriam E. Halberg, Stephen Robinson, Rina Onishi, Nathaniel Blaesser

Affordable Assembly and Servicing Architectures for Large Space Telescopes (AIAA 2016-5477) 2355
Howard A. MacEwen, Charles Lillie

The Restore-L Servicing Mission (AIAA 2016-5478) 2367
Benjamin B. Reed, Robert C. Smith, Bo J. Naasz, Joseph F. Pellegrino, Charles E. Bacon

Launching from the Best Place on Earth (AIAA 2016-5479) 2375
Keith P. Watts

Dedicated Launch of Small Satellites using Scramjets (AIAA 2016-5480) 2383
Dawid Preller, Michael K. Smart, Adriaan Schutte

RSA-01: SPACE ROBOTICS AND AUTOMATION – MISSION APPLICATIONS AND INTEGRATION

Beyond “Man in a Can”: Designing Small In-Space Human Vehicles for Mission and Program Requirements (AIAA 2016-5235) 2407
David L. Akin

Commercial Application of In-Space Assembly (AIAA 2016-5236) 2417
John Lymer, William R. Doggett, John Dorsey, Lynn Bowman, Bruno Hollenstein, Bruce King, Ken Emerick, Mark Hanson, Joel Boccio, Sean Dougherty

Guidance and Control of a Planetary Exploration Rover Via Numerical Navigation Functions and Backstepping (AIAA 2016-5237) 2434
Paul Quillen, Kamesh Subbarao, Josué Muñoz

Mission Operations Control Applications -- A Commercial Mission to Extend, Validate, and Apply the NASA MCT Toolkit for ISS Experiment Control (AIAA 2016-5238)	2447
<i>Gary P. Barnhard</i>	

RSA-02: SPACE ROBOTICS AND AUTOMATION – VERIFICATION TECHNOLOGIES

Suborbital Flight Tests of a Robotics-based Payload for Studying on-Orbit Identification of Spacecraft Inertia Parameters (AIAA 2016-5295)	2455
<i>Gerardo Martinez, Ou Ma, Milton Winkles, Gregory Taylor</i>	
Simulation Environment for the Rendezvous Path and Abort Trajectory of ADReS-A (AIAA 2016-5296)	2477
<i>Susanne Peters, Roger Förstner, Matthias Schopplein</i>	
Verification of the Microgravity Active Vibration Isolation System Based on Air Floating Platform and Parabolic Flight (AIAA 2016-5297)	2486
<i>Yongkang Zhang, Wenbo Dong, Wei Liu, Shimeng Lv, Zongfeng Li, Yang Yang</i>	
Verification of Proof Mass Tracking Based on a Prototype of Inner-Formation Control System (AIAA 2016-5298)	2499
<i>Zhendong Hou, Zhaokui Wang, Yulin Zhang</i>	

VOLUME 4

RSA-03: SPACE ROBOTICS AND AUTOMATION – ADVANCED TECHNOLOGIES I

The Deep-space Positioning System Concept: Automating Complex Navigation Operations Beyond the Earth (AIAA 2016-5409)	2508
<i>Joseph R. Guinn, Joseph E. Riedel, Shyam Bhaskaran, Ryan S. Park, Andrew T. Vaughan, William M. Owen, Todd Ely, Matthew Abrahamsson, Tomas Martin-Mur</i>	
Qualitative Comparison Of Spacecraft Attitude Controllers Based On A Quadrotor Platform (AIAA 2016-5410)	2526
<i>Shuai Chen, May-Win Thein</i>	
Integration of 3D SLAM, Rigid Body Landmarks and 3D Path Planning (AIAA 2016-5411)	2537
<i>Benjamin J. Morrell, Gregory E. Chamitoff, Derek J. Kuether, Mauricio Coen, Peter Gibbens</i>	

RSA-04: SPACE ROBOTICS AND AUTOMATION – ADVANCED TECHNOLOGIES II

Space Assembly of Large Structural System Architectures (SALSSA) (AIAA 2016-5481)	2557
<i>John Dorsey, Judith Watson</i>	
Active Space Debris Removal by Visual Servo Controlled Autonomous Robotics (AIAA 2016-5482)	2575
<i>Zheng Hong Zhu, Gangqi Dong</i>	
1-D Spatial Deconvolution Based Visual Odometry (AIAA 2016-5483)	2581
<i>Ilija Jovanovic, John Enright, Andrei Khramtsov</i>	
Laser Augmented Attitude Control for Spacecraft with Solar Sail (AIAA 2016-5484)	2592
<i>Erik S. Proano, Carlos Bernaza, Dongeun Seo</i>	
Obtaining Vibration Data for Autonomous Health Monitoring of Interplanetary Drills (AIAA 2016-5485)	2602
<i>Dean Bergman, Brian J. Glass, Thomas Stucky, Kris Zacny, Gale Paulsen, Chris McKay</i>	
Development and Test of an Adaptable Docking Mechanism Based on Mushroom-Shaped Adhesive Microstructures (AIAA 2016-5486)	2615
<i>Christopher Trentlage, Pascal Mindermann, Mohamed Khalil Ben Larbi, Enrico Stoll</i>	

SATS-01: SMALL SATELLITE SUBSYSTEMS

Thermal Analytical Procedure for Small Satellite Bound for a Lunar Mission (AIAA 2016-5239)	2631
<i>Kartik P. Naik</i>	
Telemetry, Tracking and Command Subsystem of SRMSAT - 2 (AIAA 2016-5240)	2642
<i>Sri Harsha Pavuluri, Harsh B. Bhate</i>	
Mechanical Systems of SRMSAT - 2 (AIAA 2016-5241)	2659
<i>Subham K. Gupta, Kartik P. Naik, Akash Ratheesh</i>	

SATS-02: SMALL SATELLITE MISSIONS

VELOX-II: Challenges of Developing a 6U Nanosatellite (AIAA 2016-5299)	2674
<i>Lip San Lim, Tran Duy Vu Bui, Kay Soon Low, Mihindukulasooriya Seral Crescent Tissera, Van Hong Phuc Pham, Rai Abhishek, Jing Jun Soon, Jia Min Lew, Htet Aung, Shu Ting Goh, Shoushun Chen</i>	
SONATE - A Nano Satellite for the In-Orbit Verification of Autonomous Detection, Planning and Diagnosis Technologies (AIAA 2016-5300)	2685
<i>Hakan Kaya, Oleksii Balagurin, Kirill Djebko, Gerhard Fellingner, Frank Puppe, Andreas Scharfel, Tobias Schwarz, Ana Vodopivec, Harald Wojtkowiak</i>	
OPS-SAT Experiments' Software Management with the NanoSat MO Framework (AIAA 2016-5301)	2694
<i>César Coelho, Mario Merri, Otto Koudelka, Mehran Sarkarati</i>	

Halfway to Anywhere -- Cis-lunar and Deep Space Cubesats Missions From ISS (AIAA 2016-5302)	2705
<i>Gary P. Barnhard, Eric L. Dahsstrom</i>	

SATS-03: SMALL SATELLITES FUSION

NASA's Cube Quest Challenge Awards Prizes for Non-Government Nano-Satellite Achievements in Deep Space (AIAA 2016-5303)	2724
<i>Jim Cockrell, Monsi C. Roman, Eric Eberly, Dave Klumpar, Kay Twitchell, John Hanson, Elizabeth Hyde, Jasper Wolfe</i>	
Small Satellites: Applications in Resiliency and Redundancy (AIAA 2016-5304)	2741
<i>Nathan J. Boll</i>	

SATS-06/IS-09: SMALL SATELLITE DESIGN AND MISSION DESIGN

Study of Scientific Payloads and Locations for Small Satellite Lunar Missions (AIAA 2016-5549)	2748
<i>Akash Ratheesh, Amin Ali Mody, Peeyush Tekriwal, Sakshi Namdeo, Kartik P. Naik, Kuldeep R. Barad, Arunima Prakash</i>	
CubeSat Model-Based Systems Engineering (MBSE) Reference Model - Development and Distribution - Interim Status (AIAA 2016-5551)	2762
<i>David Kaslow, Bradley Ayres, Philip T. Cahill, Michael J. Chonoles, Laura Hart, Curtis K. Iwata, Alejandro G. Levi, Rose Yntema</i>	

SATS-07/IS-12: SMALL SATELLITE SOFTWARE AND AUTONOMY

Neural Networks for Event Detection: An Interplanetary Cubesat Asteroid Mission Case Study (AIAA 2016-5615)	2774
<i>Lorenzo Feruglio, Sabrina Corpino, Daniele Calvi</i>	
Development of a Low-Cost and Open Source CubeSat Command, Control and Communications System (AIAA 2016-5616)	2779
<i>William Harrington, James Heath</i>	
Real-Time Optimal Control, & Tracking of Autonomous Micro-Satellite Proximity Operations (AIAA 2016-5617)	2800
<i>Kevin M. Nastasi, Dylan Thomas, Kristen Tetreault, Ian Elliott, Jonathan Black</i>	
Design Features and Flight Results for the Autonomous Mobile On-orbit Diagnostic System (AMODS) (AIAA 2016-5618)	2814
<i>Edward A. Hanlon, Morgan E. Lange, Benjamin P. Keegan, John G. Roser, Dakota L. Wenberg, Jin S. Kang</i>	
Robust Nonlinear Combined Attitude Control Algorithm Using Control Moment Gyro for Agile Satellites (AIAA 2016-5619)	2831
<i>Mohamed A. Elkhayyat, Yehia Elhalwagy, Ahmed Yehia Eltraffi, Gamal Ahmed Elnashar</i>	

SLS-01: ADVANCED SUPPORTABILITY CONCEPTS

GEO Robotic Servicer Trajectory Optimization (AIAA 2016-5242)	2850
<i>Andrew Verstraete, Nicole St. Louis, Jennifer Hudson</i>	
CRISP: Customizable, Recyclable Launch Packaging (AIAA 2016-5243)	2859
<i>Rachel L. Muhlbauer, Kristen Turner, Robert Dyer, Jeff Slostad, Robert P. Hoyt</i>	
In-Space Manufacturing of Constructable™ Long-Baseline Sensors using the Trusselator™ Technology (AIAA 2016-5244)	2869
<i>Robert P. Hoyt, Jeff Slostad, Jesse Cushing, Todd Moser, Greg J. Jimmerson, Rachel L. Muhlbauer, Andrew J. Conley, Steven R. Alvarado, Robert Dyer</i>	

SLS-02: ADVANCED SPACE LOGISTICS AND CAMPAIGN PLANNING

Engineering the Cis-Lunar Economic System Based on ULA's Cis-Lunar-1000 Vision (AIAA 2016-5305)	2878
<i>Trevor Bennett, Charles Cain, Nicholas Campbell, Andrew J. Gemer, Thomas Green, Tobias Niederweiser</i>	
Architecture Study for a Fuel Depot Supplied From Lunar Resources (AIAA 2016-5306)	2899
<i>Thomas M. Perrin, James G. Casler</i>	
The Threat of Uncertainty - Why Using Traditional Approaches for Evaluating Spacecraft Reliability Are Insufficient for Future Human Mars Missions (AIAA 2016-5307)	2920
<i>Chel Stromgren, Kandyce E. Goodliff, William Cirillo, Andrew Owens</i>	
Limitations of Reliability for Long-Endurance Human Spaceflight (AIAA 2016-5308)	2933
<i>Andrew Owens, Olivier De Weck</i>	
Integrated Space Mission Planning and In-Orbit Infrastructure Design with Mixed-Integer Programming (AIAA 2016-5309)	2949
<i>Hao Chen, Koki Ho</i>	

SSEE-01: COST METHODS AND ANALYSIS

A Survey of Cost Estimating Methodologies for Distributed Spacecraft Missions (AIAA 2016-5245)	2982
<i>Veronica L. Foreman, Jacqueline Le Moigne, Olivier De Weck</i>	

Evaluating Weapon System Maturity to Support Should Cost Initiatives (AIAA 2016-5246)	2999
<i>Patrick K. Malone</i>	
Application of a Weapon System Sustainment Model to the Space Industry (AIAA 2016-5247)	3018
<i>Charles T. Vono, Justin Kugler</i>	
A Business-Driven Optimization Methodology Applied to Suborbital Vehicle Programs (AIAA 2016-5248)	3036
<i>Frederic Burgaud, Christopher Frank, Dimitri N. Mavris</i>	

SSEE-02/IS-02: MODEL-BASED SYSTEMS ENGINEERING: SPACE SYSTEM APPLICATIONS

Architecture Modeling on the Europa Project (AIAA 2016-5310)	3062
<i>Gregory Dubos, Sam Schreiner, David A. Wagner, Grailing Jones, Aleksandr A. Kerzhner, Justin Kaderka</i>	
Virtual Systems Integration using Model Based Systems Engineering (AIAA 2016-5311)	3080
<i>Dale Thomas, Bryan Mesmer</i>	
Application of Model-Based Systems Engineering for the Development of the Asteroid Redirect Robotic Mission (AIAA 2016-5312)	3090
<i>Oleg Sindiy, Tanaz Mozafari, Charles Budney</i>	
Integrating MBSE into Ongoing Projects: Requirements Validation and Test Planning for the ISS SAFER (AIAA 2016-5313)	3103
<i>Antony G. Williams, Herbert A. Anderson, Gregory J. Pierce</i>	
Launch: A Model Based Systems Engineering Platform for Rapid Collaboration on NASA Launch-Flight System Integration (AIAA 2016-5314)	3116
<i>Chrishma H. Singh-Derewa, Priyanka Srivastava</i>	

SSEE-03: ECONOMIC ANALYSIS

Analysis of the Commercial Satellite Industry (AIAA 2016-5315)	3131
<i>Carissa B. Christensen, Tom Stroup, Kirsten Armstrong, Anton Dolgoplov, Philippe M. Smith</i>	
Incentivizing the Creation of Aerospace Economic Development Clusters in the United States (AIAA 2016-5316)	3137
<i>Jeff Matthews</i>	
Exergy Based Analysis for the Environmental Control and Life Support Systems of the International Space Station (AIAA 2016-5317)	3146
<i>Kirk A. Clem, George Nelson, Bryan Mesmer, Michael Watson, Jay L. Perry</i>	
Evaluating NASA as a 'Heritage-based' Brand-oriented Network: A Stakeholder Value Perspective (AIAA 2016-5318)	3159
<i>Venkatesan Sundararajan</i>	

SSEE-04: SYSTEMS MANAGEMENT

A Study in Launch Site Mission Assurance (LSMA) (AIAA 2016-5412)	3169
<i>Jaime Larios-Barbosa, Keegan McCoy, Hanna Calvert, Kris E. Barcomb</i>	
Reliability Index and Structural Fire Resistance of Spacecraft and Aircraft Framing Systems (AIAA 2016-5413)	3180
<i>Leo Razdolsky</i>	
Toward Development of Resilient Multi-UAV System-of-Systems (AIAA 2016-5414)	3214
<i>Edwin Ordoukhanian, Azad M. Madni</i>	

SSEE-06: DECISION ANALYSIS

Resiliency and Affordability Tradeoffs Across A System Portfolio (AIAA 2016-5487)	3222
<i>Marilee J. Wheaton, Azad M. Madni</i>	
Cost-Benefit Analysis for the Advanced Near Net Shape Technology (ANNST) Method for Fabricating Integrally Stiffened Cylinders (AIAA 2016-5488)	3230
<i>Marie L. Ivanco, Marcia Domack, Mary Cecilia Stoner, Austin Hehir</i>	
A COTS-Style Acquisition Strategy for Human Exploration Beyond LEO (AIAA 2016-5489)	3249
<i>Dale C. Arney, Jordan Klovstad, Christopher A. Jones</i>	
NASA Space Flight Instruments: Cost Time Trends (AIAA 2016-5490)	3264
<i>Joseph Mrozinski, Michael DiNicola, Hamid Habib-Agahi</i>	

SSEE-08: VERIFICATION AND OPTIMIZATION

Pre-testing Analysis of Large Remote Sensing Satellite's Structure (AIAA 2016-5552)	3277
<i>Amir M. Wagih, Moutaz Hegazy, Mohamed Kamel</i>	
Assessment of the Orion-SLS Interface Management Process in Achieving the EIA 731.1 Systems Engineering Capability Model Generic Practices Level 3 Criteria (AIAA 2016-5553)	3289
<i>John W. Jellicorse, Shamim A. Rahman</i>	

SSEE-09: SYSTEMS DESIGN

The Importance of Human Factors as it Relates to the Design of Launch Facilities (AIAA 2016-5620)	3305
<i>Michael Fehlinger, Alice M. Schultz</i>	
Human Factor Analysis of Light Emitting Diode Technologies for Commercial Manned Space Flight Applications (AIAA 2016-5621)	3313
<i>Todd H. Treichel</i>	
Evolution and Status of the Orion-ESM Propulsion Subsystem (AIAA 2016-5622)	3325
<i>Jan-Hendrik Meiss, Markus Jaeger, Matthias Gronowski, Thierry Kachler, Kevin Dickens</i>	

VOLUME 5

ST-02: REUSABLE LAUNCH VEHICLES AND TECHNOLOGY

Design Evolution and AHP-based Historiography of Lifting Reentry Vehicle Space Programs (AIAA 2016-5319)	3340
<i>Loveneesh Rana, Bernd Chudoba</i>	
Two Stage to Orbit Conceptual Vehicle Designs Using the SABRE Engine (AIAA 2016-5320)	3380
<i>Barry M. Hellman, John E. Bradford, Brad D. St. Germain, Kevin Feld, Mark Schaffer</i>	
Performance Efficient Launch Vehicle Recovery and Reuse (AIAA 2016-5321)	3396
<i>Mohamed Ragab, F McNeil Cheatwood, Stephen Hughes, John DiNonno, Richard Bodkin, Allen Lowry, John Kelly, John G. Reed</i>	
Assessing Factors that Affect the Safety of Space Launch and Reentry Operations in the National Airspace System (AIAA 2016-5322)	3411
<i>Zheng Tao, Ganghuai Wang, Jon Semanek, Ashley Williams, Jonathan L. Schwartz</i>	
Aerothermodynamic Simulation Model for New Hypersonic Propulsion: Rocket Ignited Supersonic Combustion Ram Jet (AIAA 2016-5323)	3421
<i>Marco Gabaldo, Jose E. Barros, Marcelo D. Guerra, Eduardo Oliveira</i>	

ST-03: ORION/SLS DEVELOPMENT

The Space Launch System: Development Progress (AIAA 2016-5415)	3434
<i>Ben B. Donahue, Darby Cooper, Sheldon Sigmon, Mike Fuller</i>	
Orion: Lessons Learned From EFT-1 and EM-1, AA-2, and EM-2 Status (AIAA 2016-5416)	3449
<i>Scott D. Norris, Paul Marshall, Timothy Cichan, Roger McNamara, Bryce Cox</i>	
Damping Effects of Drogue Parachutes on Orion Crew Module Dynamics (AIAA 2016-5417)	3462
<i>Vanessa V. Aubuchon, Bruce Owens</i>	
Space Launch System Spacecraft and Payload Elements: Making Progress Toward First Launch (AIAA 2016-5418)	3498
<i>Andrew A. Schorr, Stephen D. Creech, Michael Ogles, David Hitt</i>	

ST-05: IN-SPACE TRANSPORTATION

Cislunar-1000: Transportation Supporting a Self-sustaining Space Economy (AIAA 2016-5491)	3512
<i>Bernard F. Kutter</i>	
Design and Development of a Methane Cryogenic Propulsion Stage for Human Mars Exploration (AIAA 2016-5492)	3526
<i>Thomas Percy, Tara Polsgrove, Leslie Alexander, Jason Turpin</i>	
Cis-Lunar Reusable In-Space Transportation Architecture for the Evolvable Mars Campaign (AIAA 2016-5493)	3545
<i>Christopher A. Jones, Raymond G. Merrill, Eric McVay</i>	
Human Mars Entry, Descent and Landing Architecture Study Overview (AIAA 2016-5494)	3557
<i>Tara Polsgrove, Alicia M. Dwyer-Cianciolo</i>	
Enabling Long Duration Spaceflight Via an Integrated Vehicle Fluid System (AIAA 2016-5495)	3566
<i>Michael J. Holguin</i>	

ST-06: EMERGING LAUNCH SYSTEMS

Vertical Airlaunch Sled 1/32nd Scaled Flight Test Article and Experimentally Validated Stability Predictions (AIAA 2016-5554)	3571
<i>Brittney S. Peterson, Nesrin Sarigul-Klijn, Martinus Sarigul-Klijn</i>	
A Strategic Roadmap for Commercializing Low-Cost Beamed Energy Propulsion Launch Systems (AIAA 2016-5555)	3590
<i>Jonathan C. Coopersmith, Eric Davis</i>	
Innovation at United Launch Alliance (AIAA 2016-5556)	3602
<i>Gregory J. Schiller</i>	
U.S. Air Force EELV New Entrant Launch Vehicle Certification Process (AIAA 2016-5557)	3614
<i>Akhil Gujral, Jeffery L. Emdee</i>	

ST-07: SPACE TRANSPORTATION TECHNOLOGY AND INTEGRATION

Deterministic Ethernet for Scalable, Modular Launcher Avionics (AIAA 2016-5623)	3623
<i>Christian Fidi, Jean-Francois Dufour</i>	
Large Payload Ground Transportation and Test Considerations (AIAA 2016-5624)	3634
<i>Michelle A. Rucker</i>	
Rocket Launch Noise and the Coanda Effect (AIAA 2016-5625)	3644
<i>Caroline P. Lubert, Jon N. Romero, James S. Sochacki, Zev C. Woodstock</i>	
Thermo-Mechanical Numerical Model Set-up and Validation Approach for a CMC Control Surface for Re-entry Vehicles (AIAA 2016-5626)	3654
<i>Roberto Scigliano, Marika Belardo, Mario De Stefano Fumo, Angelo Esposito</i>	
Aerothermal Design of the Hexafly-int Glider (AIAA 2016-5627)	3663
<i>Roberto Scigliano, Giuseppe Pezzella, Marco Marini, Sara Di Benedetto, Johan Steellant</i>	

ST-08: SPACE TRANSPORTATION ANALYSIS AND DESIGN

Further Extended Structural Modeling and Modal Analysis of Liquid Propellant Launch Vehicles for Pogo Analysis (AIAA 2016-5648)	3680
<i>JiSoo Sim, Junbeom Kim, SangGu Lee, Sang Joon Shin, Huisu Choi, Woongsup Yoon</i>	
Application of Design of Experiments and Surrogate Modeling within the NASA Advanced Concepts Office, Earth-to-Orbit Design Process (AIAA 2016-5649)	3690
<i>Mathew R. Zwack, Patrick D. Dees, James B. Holt</i>	
Augmenting Conceptual Design Trajectory Tradespace Exploration with Graph Theory (AIAA 2016-5650)	3706
<i>Patrick D. Dees, Matthew R. Zwack, Stephen Edwards, Michael J. Steffens</i>	
Response Surface Regressions for Low-Thrust Interplanetary Mission Design (AIAA 2016-5651)	3722
<i>Eugina D. Mendez Ramos, Pranay Mishra, Stephen Edwards, Dimitri Mavris</i>	
Orbital Debris Mitigation for Commercial Launch Vehicles (AIAA 2016-5652)	3732
<i>John H. Schilling</i>	

SYS-01: LARGE SYSTEMS

A Proposed LOX and LCH4 Propellant Depot (AIAA 2016-5249)	3751
<i>Roy Paul, Bernardo Senna, Christopher Leeney</i>	
Artificial Gravity for Low Earth Orbit (ISS) & Deep Space Exploration (AIAA 2016-5250)	3798
<i>Raju Dharmaraj, James M. Engle, Torin K. Clark</i>	
James Webb Space Telescope Integration & Test (AIAA 2016-5251)	3810
<i>Gregory S. Jones, James M. Marsh</i>	
Design and Performance of a Marsokhod Inspired Rover for the Robo-Ops Challenge (AIAA 2016-5252)	3820
<i>Nathan Justus, Dane Schoelen, Bill Doyle, Jacob Jordan, Brent Wolf, Alex Borgerding, Janella Clary, Aaron Condreay, Kevin Cotrone, Ashley Findley, Oskar Paredes, Matthew Solcher, David Miller</i>	

SYS-02: MULTIFUNCTIONAL SYSTEMS

Multifunctional Systems for Planetary Exploration (AIAA 2016-5324)	3831
<i>Marco B. Quadrelli, James Lyke</i>	
FabricSat (AIAA 2016-5325)	3854
<i>James C. Lyke, Marco B. Quadrelli, Kelvin Ma, Glenn Forman, James Edmondson</i>	
Transformers of Extreme Environments and Their Integration in a Solar Power Infrastructure (AIAA 2016-5326)	3868
<i>Adrian Stoica, Michel D. Ingham, Leslie Tamppari, Karl Mitchell, Marco B. Quadrelli, Gary Gutt</i>	
Software Solutions for Distributed Autonomous Multi-Functional Robotics in Space (AIAA 2016-5327)	3887
<i>James Edmondson, Sagar Chaki, Jeff Hansen, David Kyle</i>	
Smart Tiles—An Energy Infrastructure for the Solar System (AIAA 2016-5328)	3897
<i>Howard K. Bloom</i>	
Multifunctional Reconfigurable/Deployable Antennas for Space Applications (AIAA 2016-5329)	3930
<i>Christos Christodoulou</i>	

SYS-03: SYSTEMS OF SYSTEMS

Modular Power Interface Standard for Space Explorations Missions (AIAA 2016-5419)	3937
<i>Richard C. Oeftering, Brent G. Gardner</i>	
Space to Space Power Beaming -- A Commercial Mission to Unbundle Space Power Systems to Foster Space Applications (AIAA 2016-5420)	3952
<i>Gary P. Barnhard, Daniel Faber</i>	
DSEDS: Multi-mission Flight Dynamics Simulator for NASA Missions (AIAA 2016-5421)	3967
<i>Jonathan M. Cameron, Abhinandan Jain, Paul D. Burkhart, Erik S. Bailey, Bob Balaram, Eugene Bonfiglio, Havard Grip, Mark Ivanov, Evgeniy Sklyanskiy</i>	

Graphical Visualization of Human Exploration Capabilities (AIAA 2016-5422)	3985
<i>Erica Rodgers, Christopher Barsoum, Julie A. Williams-Byrd, Dale C. Arney, Matthew A. Simon, Phillip A. Williams, Tyler Cowan, Jason Hay, Kevin Larman, Alex Burg</i>	

International Space Exploration Coordination Group Assessment of Technology Gaps for Dust Mitigation for the Global Exploration Roadmap (AIAA 2016-5423)	4003
<i>James R. Gaier, Scott Vangen, Phil Abel, Juan Agui, Jesse Buffington, Carlos Calle, Natalie Mary, Jonathan Drew Smith, Sharon Straka, Raffaele Mugnuolo, Simone Pirrotta, Mireille Bedirian, Daniel Lefebvre, Martin Picard, Taryn Tomlinson, Michel Wander, Henry Wong</i>	

SYS-04: SUBSYSTEMS AND INTERFACES

System Design and Thermal Stability Analysis for the IRASSI Infrared Space Interferometer (AIAA 2016-5496)	4016
<i>Eloi Ferrer, Luisa Buinhas, Roger Förstner</i>	
Low-Temperature Operation of Gallium Nitride Based Ultraviolet Photodetectors (AIAA 2016-5497)	4038
<i>Ruth A. Miller, Caitlin Chapin, Karen Dowling, Ruiqi Chen, Ateeq Suria, Debbie G. Senesky</i>	
HF Vector Sensor for Radio Astronomy: Ground Testing Results (AIAA 2016-5498)	4044
<i>Mary Knapp, Ryan Volz, Frank D. Lind, Frank C. Robey, Alan Fenn, Kerry Johnson, Mark Silver, Alex Morris, Sarah Klein</i>	
A Spaceborne Small SAR Design with Reflector Antenna Associated with Compact Polarimetry (AIAA 2016-5499)	4061
<i>Márcio M. Costa, Adenilson Roberto de Silva, Rafael Lemos Paes, Angelo Passaro</i>	

SYS-05: SYSTEMS ENGINEERING

Examples of Systems Engineering in an Undergraduate Astronautics Program (AIAA 2016-5559)	4075
<i>Kaela M. Martin, Julio Benavides, Gary Yale</i>	
Modelling IPPD for an Interdisciplinary Planetary Defense Project (AIAA 2016-5560)	4083
<i>Jackelynn P. Silva-Martinez, Alaa Hussein, Thomas Wilson</i>	
Streamlining the Design Tradespace for Earth Imaging Constellations (AIAA 2016-5561)	4095
<i>Sreeja Nag, Steven P. Hughes, Jacqueline Le Moigne</i>	
Trade Studies for Cubesat Optical Communication Payload Development (AIAA 2016-5562)	4112
<i>Colston Polly, Peter Rockhold, Tae W. Lim, Tyler Dickenson, Rachel Griffin</i>	
Designing and Testing a CubeSat Bus with High-Thrust High-DeltaV Propulsion Capabilities (AIAA 2016-5563)	4124
<i>Faris Hamdi, Kenneth Benedictos, Christopher R. Ellis, Ester Park</i>	
Author Index	