TABLE OF CONTENTS

VOLUME 1

Potential Demand for Orbital Space Tourism Opportunities Made Available via Reusable Rocket and Hypersonic Architectures................................................................. 1
Ajay Kothari, Derek Webber

Analysis of the Earth-to-Orbit Launch Market for Nano and Microsatellites ................................................. 16
Dominic Depasquale, A. C. Charania, Hideo Kanamaya, Seiji Matsuda

NASA’s In-Situ Resource Utilization Project: Current Accomplishments and Exciting Future Plans ................. 24
William Larson, Gerald Sanders, Kurt Sacksteder

M. Snyder, E. Joyce, A. Trassare, B. Justice

Robotic Follow-up for Human Exploration .................................................................................................. 46
Terrence Fong, Maria Bualat, Matthew C. Deans, Byron Adams, Mark Allan, Martha Altobelli, Xavier Bouyssounouse, Tamar Cohen, Lorenzo Fluckiger, Joshua Garber, Elizabeth Palmer, Essam Heggy, Mark Helper, Kip V. Hodges, Jose M. Hurtado Jr., Frank Jurgens, Tim Kennedy, Linda Kobayashi, Rob Landis, Pascal Lee, Susan Y. Lee, David Lees, Jason Lun, Mike Lundy, Tim Shin, Tod Milam, Estrellina Pasic, Eric Park, Liam Pedersen, Debra Schreckenghost, Trey Smith, Vinh To, Hans Utz, Dawn Wheeler, Kelsey Young

Dust Removal Technology Demonstration for a Lunar Habitat ...................................................................... 70

Flexible-Path Human Exploration ............................................................................................................. 75

Plymouth Rock: Early Human Missions to Near Earth Asteroids Using Orion Spacecraft .............................. 91
Joshua Hopkins, Adam Dissel

Mission Opportunities for Human Exploration of Nearby Planetary Bodies ............................................... 110
Cyrus Foster, Matthew Daniels

Build a Little, Fly a Lot: An Affordable Evolutionary Approach to Flexible Path, Lunar Surface, and Beyond ........................................................................................................ 129
David Akin

An Alternative Approach to National Space Policy ....................................................................................... 139
James Vedda

SSA Sharing Architecture Options ............................................................................................................. 148
R. Ryalis, J. Rendleman

Miniaturized Radar, Outsized Results ......................................................................................................... 161
M. Hillyard, D. Lavallee, J. Skara, D. Bussey, T. Aldridge, Helene L. Winters

Configuration Management of STEREO Flight Software Memory Objects ................................................. 174
Paul Boie

We’re Here to Help You ............................................................................................................................... 181
L. Bryant, S. Hyman, R. Finch, G. Faris, C. Bell

Architecture Student Designs to Support Moon Habitats ............................................................................. 192
Donna Durck

Creating Architectural Building Blocks with Autonomous Reconfigurable Robotics for Long Term Lunar Habitat Construction ........................................................................ 201
M. Fox

The Challenge of Space Infrastructure Construction .................................................................................... 208
A. Scott Howe, Silvano Colombano

The Automated Transfer Vehicle - A Valuable Asset for ISS Logistics .......................................................... 221
O. De La Bourdonnaye, M. Kinnersley

Cygns: Back to the Future - Applying Commercial Program Lessons learned ............................................ 228
Michael Bain

Heritage and Advanced Technology Systems Engineering Lessons Learned from NASA Deep Space Missions ............................................................................................................. 236
B. Barley, A. Bucskay, M. Newhouse

Concept Design Center Pre-work Overview ............................................................................................... 244
Dan Judnick

Elements of Technology Investment Management: Lessons from Government Agencies for the Space Industry ............................................................................................................ 254
Using Certified Software Validation Tools to Increase Software Reliability in Satellite and Spacecraft Applications
Jay Thomas

262

A Process to System Engineering: Creation of a System Engineering Process Model and its Deployment on the Orion Program
M. Fletcher, B. Airo, J. Clelland

268

An Introduction to the Semantic Web and its Potential Use in the Space Industry
R. Graham, C. Christensen, R. Graham, P. Guthrie, J. Hay

284

Product Lifecycle Management and the Quest for Sustainable Space Exploration
P. Caruso, D. Dumbacher, M. Grieves

291

NanoLauncher: An Affordable and Dedicated Air-Launch Transportation Service for Nanosatellites
Dominic Depasquale, A.C. Charania, Seiji Matsuda, Hideki Kanayama

303

Maximizing Utility on Heavy Lift Launch Vehicles for Unpressurized Cargo Missions within the Solar System
A. Gonzales, A. Zuniga, R. Mink, N. Barthelme, R. Leung

310

Quantifying the Effects of Model Uncertainty on Design Mass Margin in Advanced Earth-to-Orbit Launch Vehicles
Patrick R. Chai, Alan W. Wilhite

322

Solar Probe Plus Reference Vehicle Spacecraft
Mary Kae Lockwood

337

An Overview of Propulsion Concept Studies and Risk Reduction Activities for Robotic Lunar Landers
H. Trinh, G. Story, C. Burnside, A. Kudlach

360

P. Cunio, S. Nothnagel, E. Lanford, R. McLinko, C. Han, C. Olihoff, J. Hoffman, B. Cohanim

372

Evolving to a Depot-Based Space Transportation Architecture
F. Zegler, B. Kutter

386

An Adaptable Transportation Infrastructure for Human and Robotic Exploration
Jack Mulqueen, David Jones, Thomas Percy

400

Modular Approach to Launch Vehicle Design Based on a Common Core Element
D. Creech, E. Tresent Jr., A. Phillips, E. Waters, M. Baysinger

407

Interplanetary Transfer Vehicle Concepts for Near-Term Human Exploration Missions beyond Low Earth Orbit
A. Guest, W. Hofstetter, P. Wooster

427

Design of a Mars Rapid Round Trip Mission
N. Sarzi Amade, J. Wertz

446

RF Communications Architecture for Future Manned Space Flight Programs
B. Edwards, A. Adams, J. Brase, A. Kassa, E. Lieb, T. Liebermann, D. Miller

470

Design and Analysis of Lunar Communication and Navigation Satellite Constellation Architectures
J. Thompson, H. Haygood, M. Kezirian

528

Command, Control, Communication and Information Architectural Analysis via System-of-Systems Engineering
O. Sindly, D. Delaurentis, B. Caldwell

542

Implementation of An Interoperable Architecture for Command, Control, and Communication
H. Bai

563

Environmental Monitoring Technologies on the International Space Station and Their Application to Future Human Exploration of Space
D. Jan, M. Ryan, M. Darrah, A. Chutjian, Daniel B. Gazda

576

Overview of the NASA Entry, Descent and Landing Systems Analysis Study
Thomas Zang, Alicia Dwyer-Cianciolo, David Kinney, Austin Howard, George Chen, Mark Ivanov, Ronald R. Sostaric, Carlos H. Westhelle

587

Environmental Control and Life Support Considerations for a Human Mission to Near Earth Asteroids
James Russell

598

Extravehicular Activity Technology Needs
D. Westheimer, C. Chullen

605

Solar Thermochemical Processing for the Production of Propellants on Mars and Fuels for the Earth
R. Wegeng, C. Pestak, K. Sacksteder

624

The Commercialization of Space in Science Fiction Movies: The Key to Sustainability or the Road to a Capitalist Dystopia?
Laura Delgado

638
Enabling NSS Engineering Development Planning via Novel Knowledge Management Strategies, Tools, and Technologies ................................................................. 991
R. Ewart, J. Betser, S. Sutton, R. Gong, E. Hibbsman, K. Lawton

Control Authority Allocation and Transfer in Complex Mission Operations ................................................................. 1001
Lynn Baroff, Andrew Mishkin, Matthew Leonard

Review of US Concepts for Post-ISS Space HabitationFacilities and Future Opportunities ................................................................. 1007
H. Thronson, D. Lester, R. Moe, G. Sullivan

VR Simulation System for EVA Astronaut Training ................................................................. 1016
Christopher Pestelak, Robert Wegeng

Integrated System Health Management (ISHM) and Affordable Logistics ................................................................. 1029
R. Blaser, B. Nigoghosian

Comparing Supportability Analysis Techniques for Lunar Surface Systems Elements ................................................................. 1040
J. Green, T. Bachman, R. Kline, J. Smith, D. Peterson

The Impact on Flight Hardware Scavenging on Space Logistics ................................................................. 1060
Richard Oeftering

Field Testing of Planetary Drill in the Arctic ................................................................. 1088
Kris Zacny, Gale Paulsen, Brian Glass

Investigating the Efficiency of Pneumatic Transfer of JSC-1a Lunar Regolith Simulant in Vacuum and Lunar Gravity During Parabolic Flights ................................................................. 1097
Kris Zacny, Jack Craft, Megnus Hedlund, Phil Chu, Greg Galloway, Robert Mueller

Advances in Extraction of Oxygen and Silicon from Lunar Regolith ................................................................. 1107
Peter Schubert, Jeffrey Williams, Thomas Bundorf, Alex Di Sciullo Jones

Feasibility Study of Commercial Markets for New Sample Acquisition Devices ................................................................. 1112
Collin Brady, Jimmy Coyne, Sven Bilen, Liz Kisenweather, Garry Miller, Robert Mueller, Kris Zacny

Phase 2 EELV – An Old Configuration Option with New Relevance to Future Heavy Lift Cargo ................................................................. 1121
Jonathan Barr, Bernard Katter

The NASA MLAS Flight Demonstration – A Review of a Highly Successful Test ................................................................. N/A
Anthony Taylor, Christopher Kelley, Eldred Magner, David Peterson, Jeffrey Hahn, Daniel Yuchnovicz

Why the Wings Stay on the Space Shuttle Orbiter During First Stage Ascent ................................................................. 1128
C. Ehrlich Jr.

Economic and Performance Analysis of Indian Space Transportation Systems ................................................................. 1136
Venkatesan Sundararajan

Energy Storage Technology Development for Space Exploration ................................................................. 1148
C. Mercer, A. Jankovsky, C. Reid, T. Miller, M. Hoberecht

Design of a Versatile Regenerative Fuel Cell System for Multi-Kilowatt Applications ................................................................. 1157
E. Joyce, M. Snyder, A. Trassare

Fission Surface Power Technology Development Update ................................................................. 1166
Donald Palac, Lee Mason, Michael Houts, Scott Harlow

Fuel Estimation for Stardust-NExT Mission ................................................................. 1177
Boris Yendler, William Lawson, Allan Cheuvront, Greg McAllister

Next Generation Air Force Spacelift ................................................................. 1183
K. Hamptson, R. Hickman

CHIRP Technology Demonstration Project ................................................................. 1198

Micro-Electromagnetic Formation Flight of Satellite Systems ................................................................. 1205
Daniel Kwon, Raymond Sedwic, Aya Sakaguchi

U.S. Air Force’s SMC/XR NanoSat Effort ................................................................. 1216
Peter Mastro, Catherine Venturini

NASA’s Robotic Lunar Lander Project Update ................................................................. 1220
B. Morse, B. Ballard, C. Reed, D. Chavers, B. Cohen, J. Bassler, Danny W. Harris, Brian D. Mulac

MIC – Magnetically Inflated Cable Robotic Systems for Large Scale Solar Satellites and Other Applications ................................................................. 1234
G. Maile, J. Pouvell, J. Rather

Lunar Prospecting Using Thermal Wadis and Compact Rovers Part A: Infrastructure for Surviving the Lunar Night ................................................................. 1249
K. Sacksteder, R. Wegeng, N. Suzuki

Analysis of Water Surplus at the Lunar Outpost ................................................................. 1260
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underground Mining of Near-Surface Regolith on the Moon and Mars</td>
<td>1282</td>
</tr>
<tr>
<td>Knowledge Transfer and Mentoring the Next Generation of Aerospace</td>
<td>1295</td>
</tr>
<tr>
<td>Engineers: A Case Study for Strategic Intervention</td>
<td></td>
</tr>
<tr>
<td>A Review of the Role of Student-Built Spacecraft in Workforce Training</td>
<td>1305</td>
</tr>
<tr>
<td>and Innovation: Ten Years of Significant Change</td>
<td></td>
</tr>
<tr>
<td>Getting to First Flight: Equipping Space Engineers to Break the</td>
<td>1317</td>
</tr>
<tr>
<td>Start-Stop-Restart Cycle</td>
<td></td>
</tr>
<tr>
<td>A Conceptual Design Phase Risk Assessment Methodology for Space-based</td>
<td>1327</td>
</tr>
<tr>
<td>System of Systems</td>
<td></td>
</tr>
<tr>
<td>Evaluation of Subjective Probability Statements</td>
<td>1334</td>
</tr>
<tr>
<td>Risk Evaluation in the Pre-Phase A Conceptual Design of Spacecraft</td>
<td>1345</td>
</tr>
<tr>
<td>Identification and Classification of Common Risks in Space Science</td>
<td>1357</td>
</tr>
<tr>
<td>Missions</td>
<td></td>
</tr>
<tr>
<td>Enabling Crew Launch on Atlas V and Delta IV</td>
<td>1372</td>
</tr>
<tr>
<td>Solar Power Satellites, Space Elevator, and Reusable Launch</td>
<td>1388</td>
</tr>
<tr>
<td>Realizing Commonality in Exploration Architectures: The Role of</td>
<td>1395</td>
</tr>
<tr>
<td>Effective Contract Structures</td>
<td></td>
</tr>
<tr>
<td>L2 Space Weather Monitoring Constellation Proposal</td>
<td>1404</td>
</tr>
<tr>
<td>QuickSAT/step_SATdb - Satellite Design Automation Tools for the New</td>
<td>1510</td>
</tr>
<tr>
<td>Space Community</td>
<td></td>
</tr>
<tr>
<td>Searching for the New Technologies of 2010 and Beyond: New Technology</td>
<td>1521</td>
</tr>
<tr>
<td>Evaluations Conducted in 2006-2009 at the NASA JSC Innovation</td>
<td></td>
</tr>
<tr>
<td>Partnerships Office</td>
<td></td>
</tr>
<tr>
<td>Commercial Reusable Suborbital Research (CRuSR): NASA Becoming a</td>
<td>1526</td>
</tr>
<tr>
<td>Collaborative Customer For a New Era</td>
<td></td>
</tr>
<tr>
<td>Refractory Materials for Flame Deflector Protection</td>
<td>1533</td>
</tr>
<tr>
<td>Using Prognostic Analysis for Getting to an Working in Space Safely</td>
<td>1542</td>
</tr>
<tr>
<td>Making Working in Space Safe by Predicting On-Orbit Spacecraft and</td>
<td>1554</td>
</tr>
<tr>
<td>Satellite Equipment Analog Behavior Accurately</td>
<td></td>
</tr>
<tr>
<td>Using Telemetry Science, an Adaptation of Prognostic Algorithms for</td>
<td>1566</td>
</tr>
<tr>
<td>Predicting Normal Space Vehicle Telemetry Behavior from Space</td>
<td></td>
</tr>
<tr>
<td>Preliminary Mars Ascent Rendezvous Study</td>
<td>1576</td>
</tr>
<tr>
<td>Using Generic Telemetry Prognostic Algorithms for Launch Vehicle and</td>
<td>1582</td>
</tr>
<tr>
<td>Spacecraft Independent Failure Analysis</td>
<td></td>
</tr>
<tr>
<td>Differential Equations of Relative Motion under the Influence of J2</td>
<td>1598</td>
</tr>
<tr>
<td>Perturbation and Air Drag</td>
<td></td>
</tr>
<tr>
<td>Merits and Limitations of Helium in the Optimization of Spacecraft</td>
<td>1611</td>
</tr>
<tr>
<td>Cabin Atmosphere Composition and Pressure</td>
<td></td>
</tr>
<tr>
<td>An Approach to Automating Mission Operations Telemetry and Ranging</td>
<td>1619</td>
</tr>
<tr>
<td>Contacts with the MESSENGER Spacecraft</td>
<td></td>
</tr>
</tbody>
</table>

**VOLUME 3**
Addressing Value-Centric Design as a Multi-Scale C2 Problem .......................................................... 1999
Robert Weber

Creating Value with Space Based Group Architecture ........................................................................ 2007
P. Collopy, E. Sundberg

Defense Critical Infrastructure Program (DCIP) Space Sector Overview .............................................. 2020
Douglas Thayer

Developing Technologies and Techniques for Robot-Augmented Human Surface Science .................. 2025
D. Akin, M. Bowden, S. Saripalli, K. Hodges

The Application of Simulation Tools to Ultra-deep Water Development Programs and its Relevance to Space Exploration .......................................................... 2047
F. Sager

ATHLETE: Lunar Cargo Handling for International Lunar Exploration ................................................. 2059
Brian Wilcox

Lunar Lander Offloading Operations Using a Heavy-Lift Lunar Surface Manipulator System .............. 2066

Matrix Methods for Optimal Manifesting of Multi-Node Space Exploration Systems ......................... 2082
Paul Grogan, Afreen Siddiqi, Olivier De Weck

Systems Engineering and the Role of Integrated Logistics Support (ILS) within the NASA Project Life Cycle Framework ........................................................................................................ 2099
Kevin Watson, Dale Carpenter

Towards Enhanced Sustainability in the Aerospace Industry ................................................................. 2107
J. K. Watson

Data Management, Collaboration, and Model Integration for Space Exploration System Analysis and Design ........................................................................................................... 2113
I. Ferreira, P. Grogan

From the Pied Piper Infrared Reconnaissance Subsystem to the Missile Defense Alarm System: Space-Based Early Warning Research and Development, 1955-1970 ........................................... 2124
Rick Sturdevant

Apollo Spacecraft Propulsion Systems Design Philosophies ................................................................. 2137
David Owen II

NASA Space Shuttle Program at Johnson Space Center Engineering Directorate Records Archival: Lessons Learned ........................................................................................................ 2144
D. Goodman, C. Shepherd, A. Godbout

Decision Support Framework Development and Application ................................................................. 2149
L. Jocic, R. Hickman, J. Min, M. Broder, R. Weber, J. Aguilar

Enhancing NSS System Performance by Including Value-Centric Analysis (VCA) ......................... 2155
R. Ewart, J. Reiser, J. Penn, G. Richardson, S. Gasster, R. Weber, J. Gee

Comparing and Optimizing the DARPA System F6 Program Value-Centric Design Methodologies ... 2164
Michael O'Neill, Howard Yue, Sreeja Nag, Paul Grogan, Olivier De Weck

An Integrated Traverse Planner and Analysis Tool for Planetary Exploration ................................... N/A
Aaron Johnson, Jeffrey Hoffman, Dava Newman, Erwan Mazarico, Maria Zuber

The Lunar Reconnaissance Orbiter (LRO) Mission Operations Control Center (MOC) Visualization Display System (VDS) ..................................................................................... 2181
Jennifer Sager Cogrove

Surface Operations Analyses for Lunar Missions ................................................................................. 2192

Risk Analysis of On-Orbit Spacecraft Refueling Concepts .................................................................. 2207
W. Cirillo, C. Strongren, G. Cates

On Orbit Satellite Servicing from a Vehicle Routing Viewpoint ......................................................... 2216
Rajarshi Ghosh Dastidar

Space Program Schedule Change Probability Distributions .................................................................... 2225
Edmund Conrow

A Hardware Model Validation Tool for Use in Complex Systems ...................................................... 2237
M. Davies, K. Gundy-Burlet, G. Limes

Modeling Launch Vehicle Reliability Growth as Defect Elimination .............................................. 2250
E. Morse, J. Fragola, B. Panney

System Engineering & Integration Lessons Learned from Commercial Aircraft Integrated Modular Avionics Systems as they Apply to Applications in Space Vehicles ........................................... 2272
B. Birkedahl, T. Bonk
Micro-gravity Cryogenic Experiment Opportunity ........................................................................................................ 2284
M. Gravlee, C. Vera, M. Wollen, C. McLean, L. Walls

Joint Universal Launch Escape & Assist System (JULEAS) .................................................................................................. 2292
M. Sarigul-Klijn, N. Sarigul-Klijn, G. Hudson, B. McKinney

Paraffin and Nitrous Oxide Hybrid Rocket as a Mars Ascent Vehicle Demonstrator .......................................................... 2308
B. Wazman, R. Beckwith, F. Tybor, J. Zimmerman, A. Stoll

Boeing CST-100 Commercial Crew Transportation System .................................................................................................. 2321
Keith Reiley, Michael Burghardt, Jay Ingham, Michael Lembeck

Dynamics and Control of a Tether Sling on a Rotating Body ................................................................................................. 2327
Luis Baars, Steven Tragesser

Electrodynamic Tethers for Energy Harvesting and Propulsion on Space Platforms .......................................................... 2342
Sven Bilen, Jesse McTernan, Brian Gilchrist, Iverson Bell, Nestor Voronka, Robert Hoyt

An Approach to Addressing Human-Centered Technology Challenges for Future Space Exploration .................................... 2353
L. Major, K. Duda, D. Zimpfer, J. West

Framework for a Crew Productivity Figure of Merit for Human Exploration ........................................................................ 2362
M. Cohen, P. Houk

VOLUME 4

An Analog Roadmap to Mars: Recommendations for Policymakers and Space Agencies .................................................. 2391
G. Zhang, T. Nordheim, M. Rosenberg, E. Hammons

Science and Technology Opportunities Driven by the 2010 National Space Policy .......................................................... 2409
Robert Ewart, Joseph Betser, Eric Sundberg

Increased Government Involvement in Developmental Test and Other Lessons Learned from Responsive Space .................. 2414
Clarence Stone, Ari Fershtat

The ABCs of Concept Evolution: A Better-Informed Materiel Development Decision for USAF Programs ........................................... 2425
Jeff Loren

Value-Centric Analysis and Value-Centric Design .................................................................................................................. 2434
Gregory Richardson, Jay Penn, Paul Colloty

Surviving the Space Junkyard: Using a Hypervelocity Ballistic Range to Assess Orbital Debris Impacts ................................. 2445
M. Kaplan, B. Boone, B. Brown, T. Criss, E. Tunstel

Engineering Issues for All Major Modes of In Situ Space Debris Capture ............................................................................. 2453
M. Kaplan, B. Boone, B. Brown, T. Criss, E. Tunstel

Orbital Power Beaming for Humanitarian Applications .................................................................................................. 2473
Philip Turek

Operations Support with a Virtual Space Logistics ReadinessCenter ..................................................................................... 2482
S. Boykin, J. Jordan, A. Johnson

Heavy Lift Vehicle Space Logistics ........................................................................................................................................ 2491
Thomas Taylor

The Rise of the Transnational State: Space Logistics, Sovereignty, and Diaspora off the Earth ............................................. 2518
M. Dudley-Rowley, T. Gangale

Parametric Testing of Launch Vehicle FDDR Models ........................................................................................................ 2531
J. Schumann, A. Bajwa, P. Berg, R. Thirumalainambi

Subcooling for Long Duration In-Space Cryogenic Propellant Storage ............................................................................... 2541
S. Mustafi, W. Johnson, A. Kashani, J. Jurns, B. Kutter, D. Kirk, J. Shull

Application of Structural Optimization Technologies and Methods to Reduce Design Time and Improve Structural Robustness .................................................................................................................. 2550
R. Thue, D. Bennett, R. Yancey

Spectroscopic Investigations of the Effect of Accelerated Protons on Carbon-based High-density Polymethylene Composites .................................................................................................................. 2562
L. Daniel, M. Chipara, R. Wilkins, E. Barrera, M. Chipara

Descartes-Origins: A Simulation-Based Approach to Costs and Schedules of Future Spaceplane Development Programs .................................................................................................................. 2568
Michael J. Kelly, Ronald P. Menich, John R. Olds

High Performance Lox Hydrogen Upper Stage with Pistonless Pump .................................................................................. 2576
S. Harrington

Construction of an International Space Transit Vehicle Using the Space Station ........................................................................ 2586
D. Roukos, M. Thangavelu
Smart Coatings for Autonomous Corrosion Detection and Control ............................................................... 2613
    L. Calle, P. Hintze, W. Li, J. Buhrow

A Dual Launch Robotic and Human Lunar Mission Architecture .............................................................. 2624
    D. Jones, J. Mulqueen, T. Percy, B. Griffin, D. Smitherson

A Mission Architecture for Scientific Exploration of a Trojan Object using Solar Electric Propulsion ........ 2636
    M. Langston, M. Sorgenfrei, R. Dias-Silva, F. Aguilar, A. Fidalgo

Reconciling Scientific Aspirations and Engineering Constraints for a Lunar Mission via Hyperdimensional Interpolation .......................................................... 2648

International Space Cooperation: Implementing a DoD Imperative ........................................................... 2653
    James Rendleman

National Space Technology Capability Base Index ....................................................................................... 2660
    I. Christensen, J. Fuller, Jr.

NASA’s Space Shuttle: Perspectives on Technology Transfer ......................................................................... 2669
    Daniel Lockney

Human-rating Automated and Robotic Systems ......................................................................................... 2679
    Lynn Baroff, Charlie Dischinger, David Fitts

A Bootstrap Approach to an Affordable Exploration Program ....................................................................... 2688
    Richard Oeftering

Establishing a Robotic, LEO-to-GEO Satellite Servicing Infrastructure as an Economic Foundation for Exploration ................................................................. 2710
    Gary Horsham, George Schmidt, James Gilland

Using the International Space Station as a Precursor to In-Orbit Robotic Servicing .................................... 2728
    B. Roberts

RESOLVE’s Field Demonstration on Mauna Kea, Hawaii 2010 ................................................................. 2736
    Janine Captain, Jacqueline Quinn, Thomas Moss, Kyle Weis

Field Testing of a Pneumatic Regolith Feed System During a 2010 ISRU Field Campaign on Mauna Kea, Hawaii .............................................................. 2748

Analog Field Testing of the Carbothermal Regolith Reduction Processing System ....................................... 2757
    Robert Gustafson, Brant White, Michael Fidler

Solar Thermal Power System for Lunar ISRU Applications: Result of ISRU Analog Test, Mauna Kea, HI ........................................................................................................ 2776
    Takashi Nakamura, Benjamin Smith

Incorporation of Flexibility into the Avionics Subsystem for the TALARIS Small Advanced Prototype Vehicle ............................................................................................................ 2792
    C. Olthoff, P. Cunio, J. Hoffman, B. Cohanim

Affordability Engineering: Bridging the Gap between Design and Cost ..................................................... 2801
    John Reeves, Dominic Depasquale, Evan Lim

A Reusable, Rocket and Airbreathing Combined Cycle Hypersonic Vehicle Design for Access-to-Space ........................................................................................... 2818
    A. Kothari, J. Livingston, C. Tarpley, V. Raghavan, K. Bowcutt, T. Smith

Uncertainty Quantification and Propagation Methods for Hypersonic Airbreathing Launch Vehicle System Analysis ............................................................................................ 2842
    David McCormick, Sean Wakayama, Geojoe Kuruvila, Kristopher Atkins, Andrew Booker

EELV Partially Reusable Booster .............................................................................................................. 2856
    M. Gravlee, F. Zegler, T. Bulk

Overview and Analysis of the SOLDIER Satellite Concept for Removal of Space Debris ............................ 2863
    J. Loughman

Delivering Solar Energy to Earth by Reflection ........................................................................................... 2874
    S. Rosen

Satellite Data Export Vehicle (SDEV) .......................................................................................................... 2883
    W. Russell

Implementation and Demonstration of a State-of-the-Art Target Monitor System for the AEDC 7V Chamber Sensor Test Facility ............................................................. 2891
    H. Horne, R. Nicholson, H. Lowry

Towards Thermal Balance Testing Using Thermal Vacuum Chamber HVT-50 ............................................ 2906
    S. Ng

The Past, Present and Future of Display Technology in Space .................................................................... 2912
    K. Sarma, D. Schuck, D. Duke
Design to Cost Methods to Lower the Avionics Cost for NASA Commercial Crew Efforts
M. Fletcher

The Extravehicular Maneuvering Unit’s New Long Life Battery and Lithium Ion Battery Charger
S. Russell, M. Elder, A. Williams, J. Dembeck

Design Parameters and Validation for a Non-Contacting Flux-Pinned Docking Interface
L. Jones, W. Wilson, M. Peck

Critical Advancement in Telerobotic Servicing Vision Technology
K. Miller, J. Masciarelli, R. Rohrschneider, J. Gravseth

An On-Board Image Processing Algorithm for a Spacecraft Optical Navigation Sensor System
John A. Christian, E. Glenn Lightsey

Challenges and Lessons Learned in NASA’s Approach to Development and Demonstration of
Advanced Miniature Radio Frequency Space Flight Systems
Michele M. Gates, Jason C. Crusan, W. Michael Hawes

Hawai’iSat-1: Development Of A University Microsatellite For Testing a Thermal Hyperspectral
Imager
T. Sorensen, L. French, W. Doi, J. Chan, E. Gregory, M. Kobyashi

VIIRS Improvements for the Integrated Polar-orbiting Environmental Satellite System
J. Puschell, E. Kim, W. Menzel

A Fractionated Spacecraft Sensing Mode for Surveillance and Remote Sensing
T. Howard

Athena: Providing Insight into the History of the Universe
Andrew Lyford, Eric Buckenmeyer, Josh Eggleston, Katie Rybacki, Umair Surani, Kris Walbert

Low-Mass Deployable Spacecraft Booms
R. Irwin, J. Vander Veen, E. Buchner-Santos, C. Dhara}

Author Index