

IAF Space Transportation Solutions and Innovations Symposium

Held at the 73rd International Astronautical Congress
(IAC 2022)

Paris, France
18-22 September 2022

Volume 1 of 2

ISBN: 978-1-7138-7414-0

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2022) by International Astronautical Federation
All rights reserved.

Printed with permission by Curran Associates, Inc. (2023)

For permission requests, please contact International Astronautical Federation
at the address below.

International Astronautical Federation
100 Avenue de Suffren
75015 Paris
France

Phone: +33 1 45 67 42 60
Fax: +33 1 42 73 21 20

www.iafastro.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2633
Email: curran@proceedings.com
Web: www.proceedings.com

TABLE OF CONTENTS

VOLUME 1

LAUNCH VEHICLES IN SERVICE OR IN DEVELOPMENT

Ariane 5 Launch System Adaptation for JWST Mission Preparation.....	1
<i>Hélène Requiston-Costantini, Marco Calcabrini, Klaus Sell</i>	
Ariane 6 Launch System Development Update.....	8
<i>Mathieu Chaize, Stefano Bianchi, François Deneu, Pier Domenico Resta, Guy Pilchen, Alessandro Ciucci, Olivier Bugnet</i>	
Research on the Development of Test and Launch Control System in Chinese Next Generation Launch Vehicle	16
<i>Ziyu Wang, Yu Hu, Yuandong Zhang, Yue Peng</i>	
The Latest H3 Development Status and Next-Gen Innovative Launch Concept.....	17
<i>Yorichika Mihara, Hiroki Ashida, Osamu Kitayama, Mayuki Niitsu</i>	
Evolution and Development of the VEGA Launcher Family and Lessons Learned	26
<i>G. Cecchetti, M. Marcone, E. Nardi</i>	
ARIANE 6 - Development and Qualification of Large Structures & Tanks.....	36
<i>Aicke Patzelt, Moritz Ellerbeck, Armin Steinacher</i>	
ESA Technology Strategy to Support the Space Transportation Sector in Europe	50
<i>Giorgio Tumino, Alain Conde Reis, Sandrine Palerm</i>	
Evolution of Launch Strategies for Assured Access to Space	57
<i>Akhil Gujral, Vinay Goyal, Doug Conley, Randolph Kendall, Peter Broussinos, Jon Strizzi</i>	
The Overall Scheme of Solid Launch Vehicles Suitable for Land and Sea Launch and Its Lift Capacity Analysis	71
<i>Zhang Wen, He Lei, Dong Xiaobin</i>	
A Study on the Aerodynamic Interference and the Improvement of Protuberances of the First Chinese Commercial Liquid Launcher “ZQ-2”.....	81
<i>Geng Hao</i>	

LAUNCH SERVICES, MISSIONS, OPERATIONS, AND FACILITIES

Ariane 6 Launcher – Launch Base Combined Tests.....	82
<i>Olivier Bugnet, Pier Domenico Resta, Charline Dutertre, Carole Deremaux, Olivier Ryckebosch, François Deneu, Frédéric Facchin, Frédéric Munos</i>	
Energy Transition Program at the European Space Port.....	87
<i>Claire Jonckea, Didier Cauquil, Hélène Ben Aïm Drieux, Jérémy Hedin</i>	
Design and Experimental Testing of a Microlaunchers Eject System Operated from Naval Platform.....	94
<i>Maurizio Parisse, Stefano Carletta, Mauro Panzanaro, Giovanni Carfagna, Hugo Pennanech, Dario Sgobbi, Enrico Vignola, Paolo Teofilatto</i>	

ESA Space Rider System: Multi-Purpose Service for Commercial Application.....	107
<i>Fabio Caramelli, S. Sinopoli, A. Scaccia, D. Galli</i>	
Research on Development Strategy of China Space Launch Service and Support Technology.....	116
<i>Litian Xiao, Jianbin Su, Zhanpeng Cui, Zhicheng Zhang, Ying Liu, Fenglin Zhang, Xi Ding, Nan Xiao</i>	
Environmentally Friendly Production and Operation of Space Transportation Systems.....	122
<i>Josef Wiedemann, Patrick Starke, Marc Scheper</i>	
Price Elasticity of Launch Services.....	123
<i>Christopher Kunstader, Kate Maliga</i>	
Feasibility Study to Avoid Launch Collision with Orbital Objects by Modifying Flight Trajectory of Launch Vehicle.....	130
<i>Yuji Takaki, Toyonori Kobayakawa, Tomohisa Kimura</i>	
Next Generation Autonomous Flight Termination System (AFTS) for Launchers.....	134
<i>M. Sánchez-Nogales, S. Ramírez-Navidad, C. Tato-Ribera, S. Caporossi</i>	
Parametric Life Cycle Assessment of a Space Launch Service Based on a LOx/Biomethane Semi-Reusable Launcher.....	145
<i>Loïs Miraux, Léonard Pineau, Pascal Noir</i>	

UPPER STAGES, SPACE TRANSFER, ENTRY & LANDING SYSTEMS

Space Rider Mission Engineering: Current Status in Support of CDR Assessment.....	160
<i>I. Pontijas Fuentes, G. De Zaiacomo, G. Medici, F. Trovarelli, G. Guidotti</i>	
Space Rider Re-Entry Module: GNC Design and Development for Europe's Reusable Space Transportation System.....	172
<i>J. Cardin, F. Cacciatore, R. Sanchez, J. Veenman, G. Blanco, M. Lucrezia, C. Recupero, V. Fernandez, F. Tache, A. Tarabic, A. Cojocar, D. Bottero, S. Vidano</i>	
Integration of Guidance System with Model Reference Adaptive Control for a Re-Entry Spaceplane.....	185
<i>Raja Munusamy, Nithin S. Pushpagiri, Sarath Menon, Anand S. Pradhan</i>	
Hyper Velocity Demonstration Mission to Prepare Europe for Sample Return and Future Explorations (HEARTED).....	196
<i>J. Bertrand, G. Pinaud, P. Tran, M. Régnier, S. Chandesris, Thierry Pichon, I. Sakraker, H. Weihs, L. Ferracina</i>	
A Magnetohydrodynamic Enhanced Entry System for Space Transportation (MEESST).....	201
<i>Manuel La Rosa Betancourt, Marcus Collier-Wright, Elias Bögel</i>	
Assessment of Propulsion System Architectures for Green Propellants-Based Orbital Stages.....	208
<i>Alberto Sarritzu, Felix Lauck, Lukas Werling, Angelo Pasini</i>	
Per ASTRIS Ad Astra – How Ariane’s Kick Stage Propels Europe into Future In-Orbit Applications.....	224
<i>Tina Buechner da Costa, Christian Santini, Pier Domenico Resta, Agata Jozwicka-Perlant, Denis Regenbrecht, Sven Rakers, Jan Alting</i>	
PHOEBUS, an ArianeGroup & MT-A Cooperation for Preparation of an Optimized Lightweight Low Cost Future Upper Stage.....	233
<i>Diana Gaulke, Matthias Malcherzyk, Matthias Meyer, Birte Höck, Stefan Schmitt, Thomas Probst</i>	

Flying Qualities and Mission Analysis for the Return Leg of MESO’s Launcher First Stage.....	242
<i>Giovanni Medici, Giuseppe Guidotti, Gabriele de Zaiacomo, Federico Trovarelli, Rasmus Bergström, Sébastien Paris, Alan Viladegut</i>	

Project Boomerang: Innovative Architecture of a Lightweight and Modular Recovery System for Launcher Upper Stage	254
<i>F. Flory, Erwan Zamora Medina, Alexandre Louzet ,T. Pouget, Loeiz Zamora Medina</i>	

FUTURE SPACE TRANSPORTATION SYSTEMS

Family of Launchers Approach vs. “Big-Size-Fits-All”	262
<i>Martin Sippel, Sven Stappert, Steffen Callsen, Kevin Bergmann, Ingrid Dietlein, Leonid Bussler</i>	

Medium- to Long-Term Strategies for the Research Field of Space Transportation System in ISAS/JAXA	277
<i>Shinichiro Tokudome, Yusuke Maru, Satoshi Nonaka</i>	

Hypersonic Capabilities and Research Activity in the UK & Europe - A Review.....	283
<i>Malcolm Claus, Charles Simpson</i>	

Analysis on Propulsion Technological Development Synergy and Applications for Future Brazilian Launch Vehicle Family.....	284
<i>Danilo Sakay, Arthur Bahdur, Tiago Araújo, Artur Bertoldi, Leonardo Gouvêa, Fábio Santos</i>	

Cargo and Crew Transportation to LEO and Beyond.....	292
<i>Marie-Christine Bernelin, Marc Vales, Elise Ballée, Bruno Rodrigues, Marc Dubois, Tillo Vanthuyne, Daniele Francesconi, Roberto Provera</i>	

A Study on Methods to Overcome Geopolitical Conditions for the Development of Korean Two-Stage Reusable Launch Vehicle.....	294
<i>Daeban Seo, Keum-Oh Lee, Keejoo Lee, Jaesung Park</i>	

Feasible Options for Point-to-Point Passenger Transport with Rocket Propelled Reusable Launch Vehicles	300
<i>Steffen Callsen, Jascha Wilken, Sven Stappert, Martin Sippel</i>	

Aerodynamic Interference and Separation Analyses of a Two-Stage Spaceplane for Small Satellite Launch.....	312
<i>Tsuyoshi Otsuki, Koichi Yonemoto, Takahiro Fujikawa</i>	

Interplanetary Transfer Network Design and Technology Roadmap for a Sustainable Off-World Human Community	326
<i>Koldo Zuniga Alvarez, Joan Pau Sanchez</i>	

Orbital Accelerator: Energy Saving Infrastructure for Interplanetary Space Travel.....	344
<i>David Gschliesser, Daniel Valtiner, Gernot Grömer, Julia Weratschnig</i>	

TECHNOLOGIES FOR FUTURE SPACE TRANSPORTATION SYSTEMS

SpaceCase: Development of a Commercial Test Platform for Reentry Experiments.....	357
<i>J. Bertrand, M. Régnier, G. Pinaud, P. Tran</i>	

Development Status and Flight Demonstration Plan of Experimental Winged Rocket WIRES#015 at Tokyo University of Science.....	362
<i>Koichi Yonemoto, Takahiro Fujikawa</i>	
Development of a Supercritical Helium Cryogenic Storage for Ariane 6 Launcher	374
<i>Sébastien Bianchi, Susana Perez-Diago, François Barbier, François Peyraud, Léa Duprat, Patrick Bravais, Géraud Des Courtils</i>	
Experimental Investigation of a Continuously Controlled Pressurization System for Reusable Launch Vehicles.....	379
<i>Huazhao Zhang, Sheng Zhao, Jialin Ren, Liang Guozhu</i>	
In-Orbit Refuelling with Hydrogen Peroxide: An Architecture and Transfer Mechanism	385
<i>Eoghan Gilleran, Botchu Vara Siva Jyoti, Dinesh Mengu</i>	
CFD Analysis of Interaction Effects Between Vehicles in Formation Flight for In-Air Capturing of Reusable Launchers.....	399
<i>Yakut Cansev Kucukosman, Sophia Buckingham, Sylvania Lopes, Philippe Planquart, Sunayna Singh, Leonid Bussler, Sven Stappert, Martin Sippel</i>	
RETALT: Development of Key Flight Dynamics and GNC Technologies for Reusable Launchers.....	411
<i>G. De Zaiacomo, G. Medici, A. Princi, P. Ghignoni, A. Botelho, M. Martinez Arlandis, C. Recupero, A. Fabrizi, V. Fernandez, G. Guidotti</i>	
Alternative Pyrotechnic Composition for Reusable Pyromechanisms	424
<i>Gaël Le Breton, Bertrand Haguenauer, Francois Degryse</i>	
Novel Low-Shock Separation Systems for Payload Fairings	425
<i>Jakob Faber, João Esteves, Alberto Sanchez Cebrian</i>	
A New Concept of Compact End-to-End Pyrochains Initiator Solution Integrating Safe & Arm.....	431
<i>Marina Guy-Chevanne, Sébastien Gondet, Bertrand Haguenauer, Francois Degryse</i>	
Numerical Modelling Verification for Re-Entry Vehicles Using Enhanced MHD Simulation Tools.....	433
<i>V. Sharma, V. Giangaspero, N. Donaldson, J. Giacomelli, A. Lani, M. Kim, G. Herdrich</i>	

FUTURE SPACE TRANSPORTATION SYSTEMS VERIFICATION AND IN-FLIGHT EXPERIMENTATION

CALLISTO: A Prototype Paving the Way for Reusable Launch Vehicles in Europe and Japan	442
<i>Etienne Dumont, Michel Illig, Shinji Ishimoto, Christophe Chavagnac, Yasuhiro Saito, Sven Krummen, Silas Eichel, Hauke Martens, Sofia Giagkozoglou, Janis Häseker, Tobias Ecker, Josef Klevanski, Felix Krziwanie, Waldemar Rotärmel, Silvio Schröder, Anton Schneider, Christian Grimm, Svenja Woicke, Marco Sagliano, Markus Schlotterer, Markus Markgraf, Benjamin Braun, Moritz Aicher, Moritz Ertl, Lâle Evrim Briese, Ivaylo Petkov, Johannes Riehmer, Bodo Reimann</i>	
Design and Development of a System Drop Test for the Validation of Space Rider Descent and Landing Mission Phase.....	455
<i>Giuseppe Rufolo, Paolo Vernillo, Giovanni Cuciniello, Francesca Maria Pisano, Angelo De Fenza</i>	
SPADS: Design and In-Flight Demonstration of a Precision Landing Parafoil System.....	456
<i>J. Cardin, H. Gutiérrez, G. Rodríguez, A. Figueroa, S. De La Riva, F. Cacciatore</i>	

The Reusability Flight Experiment – ReFEx: Agile AIV Processes for Prototype Flight Experiments.....	464
<i>P. Rickmers, W. Bauer, S. Kottmeier, B. Suhr, T. Delovski, S. Klinkner</i>	
Themis Demonstration Programme.....	477
<i>Charles Bertorello, Olivier Gogdet, Jérôme Breteau, Yann Tincelin, Elisa Cliquet-Moreno, Emmanuel Coletti, Sorya Bensalem</i>	
Final Design Summary and High-Altitude Test Flight Plan of a Reusable Suborbital PERUN Rocket.....	486
<i>Marek Lubieniecki, Robert Magiera, Adam Matusiewicz, Kacper Zielinski, Piotr Szczepinski, Bartosz Moczala, Blazej Zielinski, Tomasz Chelstowski, Adrian Szwaba, Jędrzej Michalczyk, Rafal Ciana, Kacper Lorek</i>	
Objectives and Achievements of the Hypersonic Flight Experiment STORT	495
<i>A. Gülhan, D. Hargarten, M. Zurkaulen, F. Klingenberg, F. Siebe, G. die Martino, T. Reimer</i>	

VOLUME 2

Advanced European Re-Entry System Based on Inflatable Heat Shields EFESTO Project Overview: Preliminary IOD Mission and System Definition.....	504
<i>G. Guidotti, F. Trovarelli, I. Pontijas Fuentes, A. Rivero Martín, T. Schleutker, I. Dietlein, G. Gambacciani, G. Governale, R. Gardi, J.-L. Verant, Y. Dauvois, Y. Prevèreaud</i>	
Providing Affordable Space Exploration with Nyx, a Modular and Reusable Orbital Vehicle - The Exploration Company.....	514
<i>Jon Reijneveld, Markus Jaeger, Antonio Figueroa, Antoine Pallois, Francesco Stortini</i>	

SMALL LAUNCHERS: CONCEPTS AND OPERATIONS

Smallsats by the Numbers 2022: Growing Smallsat Activity and Its Implications for the Small Launch Market	522
<i>Carissa Christensen, Nickolas Boensch, C. Reid Herrera, Richard Leshner, Fletcher Franklin, Carie Mullins</i>	
HyImpulse – Hybrid Propulsion Based Small Launcher - Updates.....	528
<i>Goutham Karthikeyan, Mario Kobald, Christian Schmierer</i>	
HyPr Space: A New Generation of Microlaunchers Based on Innovative Hybrid Rocket Engines.	534
<i>Alexandre Mangeot</i>	
MIURA Next on the Pad	535
<i>Pablo Gallego</i>	
Comparison of Wind Tunnel Test Results of Suborbital Spaceplane FuJin with CFD Analysis	538
<i>Arash Piran, Koichi Yonemoto, Takahiro Fujikawa, Niklas Wendel, Junnai Zhai, Ali Gülhan</i>	
Development, Manufacturing and Testing of Small Launcher Structures from Portugal.....	548
<i>Andre Guerra, Daniel Alonso, Catarina Silva, Alexander Costa, Joaquim Rocha, Luis Colaço, Sandra Fortuna, Tiago Pires, Luis Pinheiro, Nuno Carneiro, André João, Gonçalo Araújo, Pedro Meireles, Stephan Schmid</i>	
A Comparative Analysis of Recovery Modes for Reusable Launch Vehicles (RLVs) with an Overview of Optimal Technologies Supporting Reusability of a Small Satellite Launcher.....	558
<i>Raj Panchal</i>	

Application of Multidisciplinary Design Optimization to the Development of an Unmanned Suborbital Spaceplane by Industry-Government-Academia Collaboration.....	559
<i>Takahiro Fujikawa, Koichi Yonemoto</i>	
Structural Analysis for a Nanolauncher's Body with an Aerospike Nozzle	570
<i>Irving Enrique Gomez Fernandez, Julio Alberto Ramos Meza</i>	
Cost Estimation of Small and Medium Payload Commercial Spaceflight Launch Systems	571
<i>Adam Baker, Andy Bradford, Liam Graham, Victoria Montag, Andrew Ratcliffe, Tristan Stindt</i>	

SPACE TRANSPORTATION SOLUTIONS FOR DEEP SPACE MISSIONS

Interstellar Terminal and Starship Assembly in the Kuyper Belt.....	579
<i>Giorgio Gaviraghi</i>	
NASA Envisioned Future Priorities for In-Space Transportation.....	580
<i>John Dankanich, Ron Litchford</i>	
The Ceres Human Exploration and Transit Architecture (CHEATA): A Mission Architecture for Small Bodies Exploration.....	596
<i>Jessica Todd, Rachel Bellisle, Benjamin Martell, Chloe Gentgen, Allison Porter, Jeffrey Hoffman</i>	
Mission to Mars Using Space-Sourced Propellant	607
<i>J. Thoemel, M. Ludwikowski, P. Karakatsanis, R. Zong, R. Weber, R. Schmidt, A. Hein</i>	
Cryogenic Electronics in Deep Space Missions	613
<i>Ashly Thomas</i>	
Protection Against Radiation with the Use of Fungi - Multipurpose Use of Mushrooms	614
<i>Eszter Gulacsi, Danijela Ignjatovic Stupar, Radames Cordero</i>	
Using Upgraded Versions of Close Approach Maneuvers as Transportation Solutions for Deep Space Missions	629
<i>Antonio Fernando Bertachini Almeida Prado</i>	
Hexagonal Prisms Structure for Tether used for Space Elevator.	635
<i>Abhishek Singh, Prathmesh Barapatre</i>	
Exploratory Mission to Heliopause and Beyond for Precursor to Interstellar Space Travel	636
<i>Ugur Drguven, Gurunadh Velidi</i>	
Comparative Assessment of Patched Conic Mission to Titan Vis-A-Vis Cassini Mission	637
<i>Deepak Gaur</i>	

EMERGING SPACE VENTURES, INCLUDING SPACE LOGISTICS AND SPACE SAFETY FOR SUSTAINABILITY

System Dynamics of the Small Satellite Industry: Presentation of a Novel Framework for Staged Licensing and Investment - Interim Results	638
<i>Dan Erkel, Alexander Hillman</i>	
Development of a Launch Vehicle Sustainability Rating	655
<i>Mathieu Udriot, Emmanuelle David, Adrien Saada, Jean-Paul Kneib</i>	

Roadmap Toward a Greener Kick-Stage Propulsion System	668
<i>Lily Blondel-Canepari, Livia Ordonez-Valles, Angelo Pasini, Uwe Apel, Martin Tajmar, Arturs Jasjukevics, Marco Wolf, Stephane Dussy</i>	
The First Reusable Satellite Transportation System	681
<i>Michael Vergalla, Jason Dunn</i>	
The Development of a Refueling Tug for Servicing GEO Satellites	689
<i>Kathleen Blyth, Thomas Hurot, Jérôme Lacapère</i>	
Spaceport Proposal for Peru: Impact and Economic Importance	697
<i>Victor Romero-Alva, Avid Roman-Gonzalez</i>	
Space Traffic Management; Improvements and Proposals for the Sustainability of Space Tourism Flights.....	703
<i>Abner Plata, Andrea Dominguez</i>	
European Newspace Vertical Orbital Launcher: Achievements of the H2020 ENVOL Project.....	704
<i>G. Liggieri, A. Kolsgaard, R. Ricciardi, N. Frischauf, E. Diez, S. Imm, S. Haugsnes, M. C. Gutierrez, D. Dautzenberg, C. Andersson</i>	
Standardized Recovery and Reuse Solution for All Launch Vehicles Launched from French Guiana.....	717
<i>Lisa Viallon, Guillaume Barbereau, Florian Lacaze, Matteo Pozzoli</i>	

INTERACTIVE PRESENTATIONS - IAF SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM

New Battery Model for Consolidating a Health Monitoring System Model of a Reusable Launcher Power Harness	724
<i>Mickael Cartron, Mariem Slimani, Nicolas Grégis, David Monchaux, Dominique Besson</i>	
The Challenges of Designing a Student Sounding Rocket for a 100 km Apogee.....	730
<i>Szymon Malecki, Kacper Kaczmarek, Nezar Sahbon, Mateusz Sochacki, Piotr Rodo, Izabela Lechowicz, Maciej Michalów, Jolanta Szulim, Jędrzej Chrostowski</i>	
Aerothermodynamics of a Sphere-Cone with a Forward Facing Cavity in Martian Atmosphere	739
<i>Alinda Sharma, Harmit Janak Vyas, Janhavi Pachori, Rajesh Yadav, Abhay Kaushik Nudurupati</i>	
Deployment Strategy and Simulation of an Adaptive Aeroshell Under Various Speed Envelopes with Distinct Configuration	747
<i>Monish Mathur, Rohan Chandra, Hari Bharath Chitta</i>	
Challenges and Recommendations for Intercontinental Suborbital Commercial Liner Transportation	748
<i>Mangai Prabakar, Michal Ziso, Vivan Raaj Rajalingam, Sucheshnadevi Patil, Evangelia Gkaravela, Garima Patel, Saswati Das, Jan Walter Schroeder</i>	
Study of Drag Characteristics of a Parachute for Landing on Planets and Moons with Different Atmospheric Conditions and Its Optimization Using Gases with Varying Properties.....	761
<i>Vageesha Sharma, Darpan Byahatti, Greeshma Avinash, Anshul Jain, Rithwik Ramaprasad, A. Trisha</i>	
Perspectives for the Use of New Solutions in the Creation of Suborbital Launch Vehicles	772
<i>Vladyslav Proroka, Mykola Dron, Oleksii Kulyk, Vadym Solntsev, Svitlana Klymenko, Aleksandr Dobrodomov</i>	

Development of an On-Demand, Small Payload Return Capability from LEO	781
<i>John Bradford, J. T. Madigan, Tyler Kunsu</i>	
Application Scenario of Composite Materials to the HTV-X for ISS and Beyond	789
<i>Toshiaki Endo, Hiroaki Tanaka, Shinya Suzuki, Daisuke Tsujita</i>	
Review of the Environmental Impact of Space Transportation Systems in a Full Life Cycle Assessment	794
<i>Jan-Steffen Fischer, Stefanos Fasoulas</i>	
Core Launch Range Renewal at the Guiana Europe Space Port.....	809
<i>Fabienne Serene</i>	
A Shrinking Horizon Model Predictive Control for Landing of Reusable Launch Vehicles	810
<i>Guillermo Zaragoza Prous, Leonard Felicetti</i>	
On-Board Guidance Gain Optimization for Mars EDL Trajectory Shaping	824
<i>Shayna Hume, Jay W. McMahon</i>	
A Study on the Hot-Run Test for the Entire 1st Stage Propulsion System of ZQ-2 Launch Vehicle.....	837
<i>Zheng Zhi Zhang</i>	
A Study on the Base Heating of the First Chinese Liquid Oxygen-Methane Commercial Launch Vehicle “ZQ-2”	838
<i>Geng Hao</i>	
The Vertical Landing Vehicles Library (VLVLib): A Modelica-Based Approach to High-Fidelity Simulation and Verification of GNC Systems for Reusable Rockets	839
<i>Stefano Fari</i>	
Space Transportation Systems - Lesson Learned from Past Deep Space Missions	861
<i>Irina Kovalenko, Yashdeep Chaudhary, Alberto Za, Ana Thompson-Gálvez, Komsun Tamanakijprasart, May Hammad, Sanjeeviraja Thangavel, Smit Patel, Sara Sabry</i>	
Development of Simple PAF: Satellite Emission System and Its Performance Evaluation	880
<i>Youichi Horie, Shunsuke Zama, Masakazu Kobayashi</i>	
The Advent of Ballistic Re-Entry Probes: A New Era in Extra-Terrestrial Space Exploration	883
<i>A. K. Pradikshan, Monica Shanmugam, S. Sudhir</i>	
Conceptual Design of Autonomous Mobile Landing Platform to Expedite Multiple Crew and Cargo Landings	884
<i>Indra Muthuvijayan, Raja Pandi Perumal, Naveen Rajamanickam, Sumedh Deshpande</i>	
Stochastic Control of Launch Vehicle Upper Stage with Chance-Constrained Splash-Down.....	890
<i>Boris Benedikter, Alessandro Zavoli, Guido Colasurdo, Simone Pizzurro, Enrico Cavallini</i>	
The Koonibba Test Range: How Australia’s First Nations People Answer to Global Market Demand for NewSpace Activities	905
<i>Scott Schneider</i>	
Morazán Projects (MRZ-SAT): Academic Facilities of the Ground Segment of Space Mission	906
<i>Fernando José Zorto-Aguilera, Fabricio Ortíz, Gabriela Nicolle Muñoz-Enamorado, Maria Jose Anderson, José Wuilmer Garcia-Ortiz, Williams Steven Fernandez-Zuniga, Ivan Castro- Sierra, René Flores-Pon, José Gabriel Zorto- Aguilera, Julio César Salgado-Lagos, Emmanuel Roberto Rosales-Cerna</i>	

Instantaneous Impact Point Prediction for Sounding Rocket Launch Safety	914
<i>Maciej Michalów, Piotr Uminski, Tomasz Noga</i>	
Punctual Launch Strategy Research of Typhoon Response for Mars Exploration Mission Within Annual Launch Window	925
<i>Zheng Yan, Wen-An Zhong, Liang-Ping Zhu, Jun-Xin Zhang, Xiao-Le Zhu</i>	
Launch Integration Operations in the Era of Satellites Constellations	932
<i>Antoine Arveiller</i>	
Control Design for Transfer of Payload Between Reusable Rocket and Lower End of the Skyhook	933
<i>Aditya Prakash, Dipak Kumar Giri</i>	
Low Cost UK Launched Small Satellite Booster for Commercial Spaceflight	951
<i>Adam Baker, Jennifer Kingston, Bob Parkinson</i>	
The Cruiser-Feeder Concept for Interplanetary Transportation.....	952
<i>Giorgio Gaviraghi</i>	
An Optimal Aerodynamic-Driven Rocket Landing Strategy.....	953
<i>Stefano Carletta, Alessio V. Pelella, Paolo Teofilatto</i>	
Cislunar Space Transportation System of Large-Scale Cislunar Exploration and Exploitation in Future	961
<i>Rong Chen, Xiaowei Wang, Sichao Deng, Zhaohui Gao</i>	
Impact of Life Cycle Assessment Considerations on Launch Vehicle Design	967
<i>Thomas Bellier, Annafederica Urbano, Cees Bil, Joseph Morlier, Adrian Pudsey</i>	
SIRIUS SPACE SERVICES: A Sustainable and Affordable Access to Space with a Range of Mini- Launch Vehicles.....	975
<i>Francois Maroquene Froissart</i>	
Design of an In-Space Transportation Vehicle for a Human Exploration Mission of Mars	981
<i>Jose Cavero, Nihar Modi, Thomas Lovell, Sedat Izcan, Asnate Plocina, Alexander Smith, Parin Vyas, Amit Bhoyar, Federico Giraldo, Lokdeep Kalaiselvam, Riccardo Moro, Matteo Nobili, Leonardo Ricci, Baptiste Rubino-Moyner, Angela Tosti, Vincent Bourinet, Pauline Carpi, Ryan Dahoumane, Nicolas Pironnet, Louis Plard, Julien Rondey, Timothée Simon, Sacha Sylvestre, Guillaume Truong-Allié, Jialian Yu</i>	
Development Update on Modul Interplanetary Transport System (M-ITS) 2022 Case Study of Converting Lunar Orbital Platform-Gateway (LOP-G) into Universal Transport Spacecraft (UTS).....	996
<i>Rok Kete</i>	
S.E.V.E.N.: Space Exploration Vehicle Emergency Navigation.....	997
<i>Natausha Chohan</i>	
Development Analysis of On-Orbit Service and Maintenance Application	1003
<i>Zipeng Yang, Min Liu, Qun Zhang, Xin Li, Xinyu Zhang, Yi Chen</i>	
Ariane 6 ASTRIS Kick-Stage.....	1005
<i>Julio Monreal</i>	

LATE BREAKING ABSTRACTS

Development of a Cryo-Dock for Refueling in Low Earth Orbit 1006
William Notardonato

Author Index