

IAF Space Systems Symposium 2020

Held at the 71st International Astronautical Congress
(IAC 2020)

Online
12 – 14 October 2020

ISBN: 978-1-7138-3280-5

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© (2020) by International Astronautical Federation
All rights reserved.

Printed with permission by Curran Associates, Inc. (2021)

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

INNOVATIVE AND VISIONARY SPACE SYSTEMS

ADVANCED EUROPEAN RE-ENTRY SYSTEM BASED ON INFLATABLE HEAT SHIELDS: TECHNOLOGY ROADMAP AND TECHNICAL CHALLENGES (EFESTO PROJECT).....	1
<i>Giuseppe Governale, Davide Bonetti, Giovanni Gambacciani, Giuseppe Guidotti, Ysolde Preveraud, Nicole Viola, Ingrid Monika Dietlein</i>	
A PRAGMATIC APPROACH TO ARTIFICIAL GRAVITY: TESTBED FOR GRAVITY SIMULATION PLATFORM ON-ORBIT.....	8
<i>Albert Rajkumar, Olga Bannova</i>	
STMF - SATELLITE THERMAL MANAGEMENT WITH FERROFLUIDS	18
<i>Thomas Imhulse, Benny Rievers</i>	
VIBRATION SUPPRESSION OF FLEXIBLE MULTI-ARM SPACE MANIPULATOR SYSTEM BASED ON NEURAL NETWORK	24
<i>Shuang Li, Yinkang Li</i>	
WHAT'S NEXT AFTER INDUSTRY DISRUPTION BY CUBESATS? – INDUSTRY DISRUPTION BY OPEN SOURCE.....	25
<i>Anita Bernie, John Paffett</i>	
A "LAYERED PIE" IN NEAR-EARTH SPACE: A CONCEPT OF A UNIVERSAL HYBRID SATELLITE SYSTEM, ALGORITHMS OF FUNCTIONING AS A GIANT FINITE AUTOMATON	34
<i>Tatyana V. Labutkina, Vladimir O. Larin, Vladimir Belikov, Maksym Lazarets, Oleksandr Lehenkov, Yaroslav Lytvynenko</i>	
SPACE HOSPITAL: HOW FUTURE SPACE-BASED MEDICAL INFRASTRUCTURES COULD REVOLUTIONIZE TOMORROW'S HEALTH CARE SYSTEM	35
<i>Paolo Marzioli, Maurizio Renda</i>	
DESIGN AND DEVELOPMENT OF ATTITUDE CONTROLLED SYSTEMS USING ADAPTIVE NEURAL NETWORKS.....	40
<i>Raja Munusamy, Ugur Guven, Kartikay Singh, Aishwerya Singh Gahlot, Ayush Gupta</i>	
PHASE-A DESIGN OF A TRIBOELECTRIC SENSOR FOR SPACE APPLICATIONS	48
<i>Francesco Ventre, Aloisia Russo, Greta De Marco, Swarnajyoti Mukherjee</i>	
CUTTING EDGE SOLUTION FOR EFFECTIVE AND SAFE MISSIONS- NEUROARCHITECTURE SYSTEM OF VINCI POWER NAP® -REVOLUTION IN FAST STRESS REDUCTION, REGENERATING BODY & MIND WHICH CAN HELP YOU, PILOTS, ASTRONAUTS:BEFORE,DURING AND AFTER SPACE TRAVELS	58
<i>Magdalena Filcek</i>	

SPACE SYSTEMS ARCHITECTURES

THE RECYCLER: AN INNOVATIVE APPROACH TO ON-ORBIT SERVICING AND REPURPOSING.....	73
<i>Paolo Guardabasso, Michele Pio Savino, Calum Turner, Roberta Valeriani, Marie-Laure Vuyge, Nicholas Barbara, Stéphanie Lizy-Destrez</i>	

AI-EXPRESS IN-ORBIT SMART SERVICES FOR SMALL SATELLITES	87
<i>Leonardo Amoruso, Cristoforo Abbattista, Stefano Antonetti, Daniela Drimaco, Lorenzo Feruglio, Vito Fortunato, Michele Iacobellis</i>	
EO-ALERT: A NOVEL ARCHITECTURE FOR THE NEXT GENERATION OF EARTH OBSERVATION SATELLITES SUPPORTING RAPID CIVIL ALERTS.....	94
<i>Murray Kerr, Stefania Tonetti, Stefania Cornara, Aniello Fiengo, Juan Ignacio Bravo, Robert Hinz, Antonio Latorre, Francisco Membibre, Chiara Solimini, Stefan Wiehle, Helko Breit, Björn Tings, Otto Koudelka, Franz Teschl, Enrico Magli, Tiziano Bianchi, Andrea Migliorati, Paolo Motto Ros, Michele Caon, Riccardo Freddi, Michele Benetti, Fabio Milani, Guido Curci, Silvia Fraile, Lucia Garcia, Cecilia Marcos</i>	
SYSTEMS ARCHITECTURE STUDY OF SATELLITE CONSTELLATIONS FOR INTERNET OF THINGS CONNECTIVITY	107
<i>Ksenia Osipova, Nicola Garzaniti, Simone Briatore, Alessandro Golkar</i>	
TRANSFORMABLE SPACECRAFT: FEASIBILITY STUDY AND CONCEPTUAL DESIGN	122
<i>Yoshiki Sugawara, Toshihiro Chujo, Yuki Kubo, Yasutaka Satou, Masatsugu Otsuki, Ryota Ikeda, Kotaro Ikeda, Masahiro Fujita, Kenichiro Sawada, Kohji Tsumura, Shuji Matsuura, Takayuki Kotani, Ahmed Kiyoshi Sugihara El Maghraby, Ayako Torisaka, Osamu Mori, Shigeo Kawasaki, Junichiro Kawaguchi</i>	
MODULAR ARCHITECTURE FOR THE ACCOMMODATION OF LUNAR EXPLORATION PAYLOADS ON THE LUVMI-X ROVER.....	131
<i>Diego A. Urbina, Thibaud Chupin, Hemanth Madakashira, Mathieu Deremetz, Karsten Kullack, Jeremi Gancet, Janos Biswas, Christian Gscheidle, Martin J. Losekamm</i>	
<u>TECHNOLOGIES TO ENABLE SPACE SYSTEMS</u>	
DIRECT ROBOTIC EXTRUSION OF PHOTOPOLYMERS FOR IN-SPACE APPLICATIONS	133
<i>Michael Kringer, Moritz Frey, Christoph Boehrer, Markus Pietras</i>	
EMBEDDED GRAPHENE-SILICON OXYCARBIDE POROUS CERAMICS FOR THERMOELECTRIC APPLICATIONS	138
<i>Elizabeth Barrios</i>	
MAGNETIC BUOYANCY-BASED WATER ELECTROLYSIS IN ZERO-GRAVITY	149
<i>Álvaro Romero-Calvo, Gabriel Cano Gómez, Hanspeter Schaub</i>	
ON-BOARD LOW LATENCY PROCESSING OF EARTH OBSERVATION PRODUCTS IN A MULTI-BOARD SCHEME USING MULTI-CORE AND FPGA-BASED ARCHITECTURE	160
<i>Antonio Latorre, Francisco Membibre, Juan Ignacio Bravo, Robert Hinz, Alexis Ramos, Murray Kerr</i>	
A DETERMINISTIC AND HIGH PERFORMANCE PARALLEL DATA PROCESSING APPROACH TO INCREASE GUIDANCE NAVIGATION AND CONTROL ROBUSTNESS.	171
<i>Pablo Ghiglino</i>	
PROCESSOR-IN-THE-LOOP TESTING OF AI-AIDED ALGORITHMS FOR SPACECRAFT GNC	180
<i>Stefano Silvestrini, Michèle Lavagna</i>	

SPACE SYSTEMS ENGINEERING - METHODS, PROCESSES AND TOOLS (1)

SYSTEMS ENGINEERING APPLIED TO ORBIT AND ATTITUDE CONTROL SYSTEM (AOCS) OF FORMATION FLYING SATELLITES	185
<i>Iván Felipe Rodríguez Barón, Geilson Loureiro, Jaime Enrique Orduy Rodriguez</i>	
MULTI-ATTRIBUTE EVALUATION APPROACH FOR SMALL LAUNCH VEHICLE WITH MULTI-OBJECTIVE MULTI-DISCIPLINE DESIGN OPTIMIZATION	192
<i>Pengcheng Wang, Hao Zhu, Luxi Xie, Mingyang Xiao, Hui Tian, Guobiao Cai</i>	
DIGITAL ENGINEERING INFORMATION EXCHANGE MODEL FOR SPACE MISSIONS ARCHITECTURE: A CASE STUDY OF A CUBESAT MISSION	207
<i>Yaroslav Menshenin, Yana Brovar, Dominik Knoll, Edward Crawley, Clement Fortin</i>	
ACCELERATE SPACECRAFT PROX-OPS DESIGN AND ANALYSIS WITH SODA	214
<i>Nazareth Bedrossian, Evgeny Menkin, Billy McCallister McCallister, James S Peters</i>	
MISSION-AWARE DIGITAL CONTINUUM IN SYSTEMS DESIGN WITH DATA-DRIVEN SYSTEMS ENGINEERING AND DIGITAL MISSION ENGINEERING	215
<i>Kuldeep Rambhai Barad, Louise Lindblad, Marco Witzmann, Stefan Sjarov</i>	
A NOVEL APPROACH TO PLANETARY ROVER GUIDANCE, NAVIGATION AND CONTROL BASED ON THE ESTIMATION OF THE REMAINING USEFUL LIFE.....	216
<i>Jasmine Rimani, Nicole Viola, Stéphanie Lizy-Destrez</i>	
MULTIDISCIPLINARY OPTIMIZATION FOR NANO-SATELLITE LAUNCH VEHICLES	224
<i>Daniel McCammon, Sadben Khan, Scott Lindsay</i>	

SPACE SYSTEMS ENGINEERING - METHODS, PROCESSES AND TOOLS (2)

THE PATH TOWARDS THE FUTURE OF THE NEW OLD SPACE INDUSTRY	230
<i>Michal Jashinski</i>	
A NOVEL TOOL FOR EARTH OBSERVATION CUBESAT CONSTELLATION PRELIMINARY MISSION DESIGN.....	231
<i>Iliass Tanouti</i>	
SPACEFACTORY – ROBOTIC ASSEMBLY, INTEGRATION AND AUTOMATED TESTING OF SMALL SATELLITES	232
<i>Oliver Ruf</i>	
MODEL-BASED APPROACH FOR REQUIREMENTS MANAGEMENT CONNECTION WITH VERIFICATION PROCEDURES APPLIED TO SPACE SYSTEMS	233
<i>Karolina Latserus, Petr Mukhachev, Anton Ivanov, Angelina Prokopeva</i>	
MODEL-DRIVEN ENGINEERING FOR SWARM-BASED SPACE EXPLORATION MISSIONS	245
<i>Roberto Nardone, Francesco Buccafurri, Vincenzo De Angelis, Cecilia Labrini, Gianluca Lax, Lorenzo Musarella, Antonia Russo</i>	
COMPARISON OF MULTIDISCIPLINARY DESIGN OPTIMIZATION ARCHITECTURES FOR THE DESIGN OF DISTRIBUTED SPACE SYSTEMS.....	251
<i>Raja Pandi Perumal, Holger Voos, Florio Dalla Vedova, Hubert Anton Moser</i>	

SIMULATION DRIVEN PRODUCT DEVELOPMENT - FASTER AND CHEAPER DEVELOPMENT OF ROBUST SPACE PRODUCTS.....	266
<i>Javad Fatemi</i>	
ENTRY, DESCENT AND IMPACT SYSTEM DESIGN AND ANALYSIS OF A SMALL PLATFORM IN MARTIAN ENVIRONMENT.....	267
<i>Daniele Calvi, Fabrizio Stesina, Sabrina Corpino</i>	
TEST SYSTEM FOR FUNCTIONAL VERIFICATION OF A SBCDA/ARGOS-2 RECEPTOR - STUDY OF CASE: ENVIRONMENTAL DATA COLLECTOR.....	279
<i>Thiago Messias, José Duarte, Francisco José Targino Vidal</i>	
AN EFFICIENT FRAMEWORK FOR RELIABILITY-BASED MULTIDISCIPLINARY DESIGN OPTIMIZATION USING SYSTEM SENSITIVITY ANALYSIS	283
<i>Jafar Roshanian, Elyas Fadakar, Masoud Ebrahimi</i>	
A MISSION ANALYSIS TOOL FOR AIDING FEASIBILITY STUDIES IN SMALL SATELLITE MISSION PROJECTS.....	293
<i>Alexander Kharlan</i>	
TOWARDS EXTENDING RISK MANAGEMENT APPROACHES FOR CUBESATS SOLUTION: A CASE STUDY OF THE CONASAT PROGRAM.....	294
<i>Nícolas França Medeiros, Giuliani Garbi, Manoel Jozeane Mafra De Carvalho, Alessandra Urbano Rodrigues</i>	
<u>LESSONS LEARNED IN SPACE SYSTEMS: ACHIEVEMENTS, CHALLENGES, BEST PRACTICES, STANDARDS.</u>	
PROPOSAL OF SYSTEM EVALUATION METHOD AND REDESIGN METHOD OF CUBESAT FOR IMPROVING MISSION ACHIEVEMENT RATE	295
<i>Ryo Futamata</i>	
ASSEMBLY, INTEGRATION AND TEST (AIT) CAMPAIGN OF THE AMAZONIA-1 SATELLITE.....	296
<i>Gabriel Gustavo Coronel Mariño, Felipe Lopes Marques, Guilherme Venticinque, Geilson Loureiro</i>	
EARTH OBSERVATION SATELLITE - CBERS4A – PRELIMINARY LESSONS AFTER AIT CAMPAIGN AND ITS SUCCESSFUL LAUNCHING.....	305
<i>Guilherme Venticinque, Geilson Loureiro, Gabriel Gustavo Coronel Mariño, Felipe Lopes Marques</i>	
THREE NATIONS COLLABORATE TO BUILD MARS SPACECRAFT FLIGHT SOFTWARE	314
<i>Ibrahim Alharthi</i>	
LESSONS LEARNED PROCESS ROLE IN FUTURE MISSIONS.	315
<i>Noora Alarai</i>	
BROADENING JPL’S MISSION FORMULATION PARADIGM WITH HUMAN CENTERED DESIGN	318
<i>Tibor Balint, Mihaly Horanyi, Neal Turner</i>	
EXTENDING THE LIFE OF THE MOBILE SERVICING SYSTEM (MSS) TO SUPPORT EXTENSION OF INTERNATIONAL SPACE STATION (ISS) OPERATIONS.....	331
<i>Juhaina Khan, Rodney Hautot, Iqbal Kassam, Oneil D'Silva, Darin Buckland</i>	

LESSONS FROM THE HISTORY OF SPACE NUCLEAR DEVELOPMENT PROJECTS	339
<i>Lincoln Butcher, Bhavya Lal</i>	

COOPERATIVE AND ROBOTIC SPACE SYSTEMS

VALIDATION AND DEMONSTRATION OF EROSS PROJECT: EUROPEAN ROBOTIC ORBITAL SUPPORT SERVICES	347
<i>Vincent Dubanchet, Sabrina Andiappane, Pablo Lopez Negro, Davide Casu, Anne Giovannini, Gautier Durand, Jurij D'Amico</i>	

MULTI-FUNCTIONAL SELF-RECONFIGURABLE ROBOTIC ARM (RAMSES) AND ADJOINED SOLAR PANEL PRELIMINARY DESIGN FOR LUNAR ENTRY APPROACH PLATFORM FOR RESEARCH ON GROUND (LEAPFROG)	358
<i>Aloisia Russo, Pierluigi Di Lizia, David Barnhart</i>	

MOSAR-WM: A RELOCATABLE ROBOTIC ARM DEMONSTRATOR FOR FUTURE ON-ORBIT APPLICATIONS.....	371
<i>Mathieu Deremetz, Pierre Letier, Gerhard Grunwald, Maximo Roa, Bernhard Brunner, Benoit Lietaer, Michel Ilzkovitz</i>	

DESIGNING AND TESTING A ROBOTIC AVATAR FOR SPACE-TO-GROUND TELEOPERATION: THE DEVELOPERS' INSIGHTS	381
<i>Thomas Krueger, Edmundo Ferreira, Andrei Gherghescu, Lukas Hann, Emiel Den Exter, Frank Van Der Hulst, Levin Gerdes, Leonardo Cencetti, Aaron Pereira, Harsimran Singh, Michael Panzirsch, Thomas Hulin, Ribin Balachandran, Bernhard Weber, Neal Lii</i>	

INT-BALL2 FOR FULLY-TELEOPERATED JEM ONBOARD CAMERA DRONE WITHOUT CREW AID	393
<i>Daichi Hirano, Shinji Mitani, Keisuke Watanabe, Taisei Nishishita, Yuta Kawai, Shota Inoue, Seiko Piotr Yamaguchi, Hideyuki Watanabe, Masaru Wada</i>	

IN SITU 3D PRINTING FOR MODULAR ROBOT MISSION ADAPTATION	400
<i>Troy Cordie</i>	

MODEL BASED MULTI-AGENT NUMERIC PLANNING SYSTEM FOR SPACECRAFT	401
<i>Yuting Zhao, Rui Xu, Zhaoyu Li, Zhu Shengying, Zixuan Liang, Pingyuan Cui</i>	

SMALL ROBOTIC SWARM TECHNOLOGIES FOR LUNAR SURFACE EXPLORATION.....	407
<i>Rod Mamin, Charles Lauer, Pavlo Tanasyuk</i>	

VIRTUAL PRESENTATIONS - IAF SPACE SYSTEMS SYMPOSIUM

FORCE/POSITION IMPEDANCE CONTROL FOR INSERTION AND PULL OF COMPONENTS IN SPACE MANIPULATOR STATION.....	408
<i>Chen-Dong Zeng, Li Chen</i>	

OUTPUT FEEDBACK CONTROL BASED ON SLIDING MODE AND VIBRATION SUPPRESSION FOR A FLEXIBLE-BASE TWO-FLEXIBLE-LINK AND TWO-FLEXIBLE-JOINT SPACE ROBOT WITH ACTUATOR SATURATION.....	417
<i>Xiaodong Fu, Li Chen</i>	

MITIGATION STRATEGY AGAINST SOLAR FLARES	423
<i>Nischith Raj, Harshit Raj, T Ananda Mukesh, S Karthik, Sushmith Thuluva, Manoj P, Ananya Kodukula, Diksha Arora, Vrushali Chittaranjan, Vridhi Kamath, Ajay Sriram, Anusri S, Chiranthan K, Rahul S, Soma Rohith, Gaurav R, Bhavana B Rao, Aditya Balasubramaniam</i>	

Author Index