

AI Impact & Autonomy on Space Exploration

Held at the Global Space Exploration Conference (GLEX 2025)

New Delhi, India
7-9 May 2025

ISBN: 979-8-3313-2116-1
DOI: <https://doi.org/10.52202/080565>

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© (2025) by International Astronautical Federation
All rights reserved.

Printed with permission by Curran Associates, Inc. (2025)

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

AI IMPACT & AUTONOMY ON SPACE EXPLORATION - SESSION 1

A Novel Technique for Health Assessment of Liquid Propulsion System Using Neural Networks	1
<i>P Aziya Nizin, Santhosh V, A Muralikrishna, Shooja A</i>	
Application of Artificial Intelligence for Real-Time Analysis.....	7
<i>Sumedh Deshpande</i>	
Revolutionizing Space Exploration: AI-Enhanced Autonomy Rover for Next-Generation Mars Missions	14
<i>Francesco Staffieri, Andrea Staffieri, Cristina Staffieri, Bushra Alzadjali, Fotios Kotzakioulafis, Maedeh Taherkhany, Juan Salvador Palacios Bett, Saumya Shekhar, Akanksha Bhagat, Noha Fathy</i>	
Enhanced Autonomy for Next-Generation Rover Missions Using Artificial Intelligence and Machine Learning (AI/ML).....	26
<i>Chris Gurjao, Vicksan Gurjao</i>	
The Role of AI in Space Weather Prediction	31
<i>Abhyuday Singh, Nalini Singh</i>	

AI IMPACT & AUTONOMY ON SPACE EXPLORATION - SESSION 2

Spacecraft Autonomy for Inter-Planetary Missions – Opportunities and Challenges.....	43
<i>Chaitra Rao, Anuradha Prakasha, Ritu Karidhal</i>	
A Conceptual Model of the AI Data Processing System for Lunar Science.....	48
<i>Mariya Romanova, Dmitry Zarubin, Vladimir Nazarov, Mark Mamchenko, Roman Meshcheryakov, Alena Zakharova, Maxim Pupkov, Art Prosvetov, Alexander Govorov, Alexander Andreev</i>	
Automated Detection and Segmentation of Craters and Boulders in Chandrayaan-2 Orbiter High-Resolution Camera (OHRC) Images	55
<i>Shreya Santra, Abhishek Mishra, Ashutosh Mishra</i>	
Adaptive Satellite State Estimation Using Liquid Neural Networks.....	62
<i>Isaac Alejandro Pimentel Morales, Diego Pérez Reyes, Nuria Hernández Alás, Hector Gomez Torres Torres, Alberto Báez Jiménez</i>	

AI IMPACT & AUTONOMY ON SPACE EXPLORATION - SESSION 3

A Deep Learning Approach to Estimate Natural Frequencies of Small-Diameter Fluid Lines in Launch Vehicles.....	68
<i>Vivek S, Sachin Sajikumar, Krishnajith Jayamani, Vinayaravi R, Suresh Mathew Thomas</i>	
Celestial Cartography: A Data Science Approach to Galactic Analysis	75
<i>Chinmayee Gade</i>	

Quantum Marvin: Exploring Artificial Intelligence and Quantum Computing for Moon Surface Navigation	79
<i>Nicole Rosi, Simon Köhl, Rory Tyrrell, Amer Delilbasic, Lionel Ferra, Lisa Denzer</i>	
Adaptive FPGA-Enhanced Rice Algorithm for High-Efficiency, Lossless Data Compression in Spaceborne Telemetry and Imaging Systems	94
<i>Anubhab Debnath, Tejas Naresh Reddy</i>	
Advanced Wavelet-Machine Learning Hybrid Methodology for Feature Extraction of Lunar Seismic Events: Insights from Chandrayaan-3 Data	104
<i>Shambhavi A S, Tejas Naresh Reddy, Prabhanjan Manjunath, Akshaya Bs, Arjun Suresh, Sanath Kumar Naik L, Vivekananda N</i>	

AI IMPACT & AUTONOMY ON SPACE EXPLORATION - SESSION 4

Tethered Debris Capture Experiment on POEM Platform Using Space Robotic Arm	112
<i>Abhijith Prakash, Ravi Kiran Jana, Sankalp Vishnoi, Nidhi Nidhi</i>	
The Role of Artificial Intelligence and Autonomy in the Future of Space Exploration: Opportunities, Challenges, and Implications	118
<i>Sai Prashant Bhosale, Sanjivani Sawant, Dinesh Kumar Bajaj</i>	
Pre-Flight Onboard Algorithm Validation Through Simulation Optimization and Deep Metric Learning	133
<i>Harris V John</i>	
Implementation of AI Adaptive Pressure Control System in Space Suits	140
<i>Abdulrahman Al-Essa, Azzam Alhussain, Abdulaziz Alfohaid</i>	
Adaptive Control System for Rover Stability in Low-Gravity and Uneven Terrain Exploration	144
<i>Raúl Gianmarco Chávez Chávez, Fidel Castro Suazo, Juan Salvador Palacios Bett</i>	

AI IMPACT & AUTONOMY ON SPACE EXPLORATION - IP SESSION

Automated Spacecraft Health Anomaly Detection Using YOLO Based Deep Learning Models	148
<i>Bijoy Kumar Dai, Priyanka Singh, Debashish Paul, Leo Jackson John, Nandini Harinath, Anilkumar A K, Sheli Sinha Chaudhuri</i>	
Autonomous Space Missions: Revolutionizing Accuracy and Risk Mitigation in Extraterrestrial Exploration"	153
<i>Nawras Bin Tareef, Mohamad Abu Amsha, Bashar E. A. Badr, Ahmad Yu, Abdalrahman Ghazal, Faisal Jalghoum</i>	
Ethical Considerations in Implementing AI Systems in Space Activities	166
<i>Nishith Mishra</i>	
Application of Machine Learning for Real-Time Fault Detection and Predictive Maintenance During Structural Testing of Cryogenic Launch Vehicle Hardwares	173
<i>Chippy V, Piyush Sonkar</i>	
Multi-Faceted AI Model for Comprehensive Spacecraft Operations	179
<i>Pramod Prakash, Deepan M, Shaik Mohammed Muzammil Ali, Amit Kumar Singh, Leo Jackson John, Nandini Harinath, Pavan Chakraborty</i>	

Defect Detection in Mechanical Hardware Using AI and Vision Technology.....	185
<i>Achindev J, Kumar K, Harikrishnan R, Asha Gs, Yaddula Venkata Swarnalatha</i>	
Enhancing Solar Energy Capture in Swarm Satellites with a Hybrid Particle Swarm Optimization and Gravitational Search Algorithm Approach.....	196
<i>Kavya Dichwalkar, Shivanandan P, Pranaya Mehrotra, Vaibhavi Rajguru</i>	
Weld Defect Detection and Classification Using Deep Learning.....	202
<i>Smitha K K, Lini K S, Ganesh Pillai M</i>	
Enhancing Spacecraft Autonomy with Transfer Learning and Generative Ai.....	208
<i>B M Manohara, Prarthana P Kulkarni, Khushi Choudki, Vibhashree Vasuki, Krishna Vidhiprasad, Pratiksha Gaddigimath, Karthik Shastry</i>	
AI-Driven Detection of Resident Space Objects (RSOs) Using Monochromatic Wide-Field Imaging for Space Situational Awareness (SSA).....	215
<i>Vithurshan Suthakar, Regina Lee</i>	
Application of Computer Vision Technologies for Envisioning Prospective Deep Space Propulsion	226
<i>Denis Egoshin, Ilya Andryushhenko, Daria Pasyukova, Victor Telekh</i>	
AI Based Crater Detection on Moon and Planetary Surfaces.....	231
<i>Sai Venkata Lakshmi A</i>	
A Hybrid Hardware In-Loop Approach to Fault Prediction Simulation in Satellite ADCS Architecture Based on 3-Axis Reaction Wheel: Integrating Probabilistic and Statistical ML Models with Traditional Control Systems	243
<i>Aman Bhavsar, Abhilash Karan, Aditya Nath Roy, Mridul Sengupta, Arya Das, Dipak Kumar Giri</i>	
Optimizing Deep-Space Operations: The Impact of LuzIA on Crew Communication and Productivity	254
<i>Diego Pérez Reyes, Hector Gomez Torres Torres, Nuria Hernández Alás, Alberto Báez Jiménez, Isaac Alejandro Pimentel Morales</i>	

Author Index