

IAF Symposium on Security, Stability and Sustainability of Space Activities

Held at the 74th International Astronautical Congress
(IAC 2023)

Baku, Azerbaijan
2-6 October 2023

ISBN: 978-1-7138-8576-4

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© (2023) by International Astronautical Federation
All rights reserved.

Printed with permission by Curran Associates, Inc. (2024)

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

POLICY, LEGAL, INSTITUTIONAL, ECONOMIC AND SECURITY ASPECTS OF DEBRIS MITIGATION, DEBRIS REMEDIATION AND STM

ESA's Zero Debris Approach: A Responsible Path to Mitigate Space Debris in Valuable Orbits	1
<i>Tiago Soares, Sara Morales Serrano, Benedetta Margrethe Cattani, Sibyl-Anna De Courson, Calum Turner</i>	
Orbital Debris Mitigation Implementation Between the U.S. and International Community	7
<i>Aline McNaull</i>	
Space Environmental Governance: A Comprehensive Framework for Ensuring Security, Stability and Sustainability of Space Activities	8
<i>Zuoxin Zhou, Hui Du, Feng Gao, Zhengji Song, Zhongjian Liang, Guilin Liang, Qingbo Gu, Di Wu, Wenyi Yang</i>	
Fostering Multi-Stakeholder Collaboration for Space Sustainability Through an Incentive-based Mechanism	13
<i>Emmanuelle David, Adrien Saada, Anja Nakarada Pecujlic, Xiao-Shan Yap, Danielle Wood, Jean-Paul Kneib, Maruska Strah</i>	
International Approach to Space Situational Awareness and Collision Avoidance.....	28
<i>Diego Guerra, Ayberk Dulgeroglu, Yakov Bobrov, Elena Ancona, Adrian Fernandez Amil, Aida Silva, Anwar K Backer, Arun Jose K A, Claudia Medeiros, Dorottya Milánkovich, Jaime Silva, Kim Regnerij, Lauren Hanson, Marco Pascale, Masazumi Imai, Rachita Puri, Steven Armstrong, Thomas Hale, Tugçag Dumlupinar, Kirils Bistrovs, Carlos Eduardo De Sá Amaral Oliveira, Eric Dahlstrom</i>	
Analysis of Existing Rules in Space Traffic Management: Finding the Gaps in “Authorization”	41
<i>Yu Takeuchi, Maruska Strah, Mark A. Skinner, Hjalte Osborn Frandsen, Senjuti Mallick, Catrina Melograna, Elena Cirkovic</i>	
Coordinating and Converging Regulatory Frameworks for Space Debris Mitigation Through a Legal and Technical Review of State Practice.....	46
<i>Joe Humphries, Clarissa Luk, Trevor Owen, Veronica Moronese, Mahhad Nayyer, Irene Saiz Briones, Kaylee Li</i>	
A Comprehensive Debris Credit Framework for Allocation and Usage of Debris Credits for Furthering Sustainability in Space.....	48
<i>Abhinav Srivastava</i>	
Towards a Bottom-Up Approach to Space Debris Removal: on the Economic Convenience Behind Debris Mitigation Strategies	49
<i>Simonetta Di Pippo, Clelia Iacomino, Matteo Nori, Aristeia Saputo, Francesco Ventre, Federico Colantoni, Alessandro Rossi</i>	
In-Orbit Servicing and Insurance Markets: A Symbiotic Approach	64
<i>J Patrick Mathewson, Michael Mainelli, Charles Vermont, Morgane Lecas, David Eagleson, Hugh Selka</i>	
Compensation Versus Prevention. Quo Vadis Space Liability Regime? Matrix of Space, Environment and Insurance Laws.	78
<i>Katarzyna Malinowska, Bartosz Malinowski, Kaja Hopej</i>	

CYBER-BASED SECURITY THREATS TO SPACE MISSIONS: ESTABLISHING THE LEGAL, INSTITUTIONAL AND COLLABORATIVE FRAMEWORK TO COUNTERACT THEM

Assessing Cybersecurity Measures in Space and Cyber Laws 88
Clémence Poirier, Enzo Fogliano, Emeka Ibeneme, Devanshu Jha, Oumaima Nakrimi, Abraham Akinwale

Cybersecurity and Space: A Trans-Atlantic Perspective..... 89
Laura Morelli, Nicolas Peter

From Space to Cyber-Space; Towards a Cyber-Security Regime for Space Operations in the Era of the Free Flow of Big Data 103
Vera Palialexi, Georgios Chatzicharalampous

The IEEE SA Space Systems Cybersecurity Standard: Governance and Technical Elements of an International Standardization Effort.119
Nicolò Boschetti, Gregory Falco

Space, Cyberspace, and Artificial Intelligence (AI): Which Governance Models for a Sustainable Future?..... 120
Aurélie Trur

Hey You! Get off of My Satellite! 121
Paul Coggin

A Proactive Proposal and Dialogue for Embedding Cybersecurity Within Space Design and Space Sustainability Policy 124
Charles Mudd, Svetlana Hanson

NORMS AND STANDARDS FOR SAFE AND RESPONSIBLE BEHAVIOUR IN SPACE

Assessing Current Policy, Legal, and R&D Developments in the Field of In-Orbit Services 125
Clémence Poirier, François Buffenoir, Alberto Rueda Carazo, Clément Lingois

In the Case of an On-Orbit Servicing Mishap, a Study of Investigation, Insurance, and Liability 126
Liberty Shockley

Pathways to Norm Development: Responsible Behavior In, From, and Through Space 139
Andrea Harrington

Regulatory Actions Aiming for Increased Sustainability..... 149
Bernd M. Weiss, Rene Laufer, Anna Ohrwall Ronnback

The Safety and Sustainability of Space Operations: European Perspectives..... 150
Nicolas Peter, Claudiu Mihai Taiatu

Strategic Dynamics of Space Weaponization: A Game Theoretic Analysis. 151
Vladislav Kozarev, Artem Lomakin

INTERACTIVE PRESENTATIONS - IAF SYMPOSIUM ON SECURITY, STABILITY AND SUSTAINABILITY OF SPACE ACTIVITIES

Space and the 2030 Agenda: The Contribution of Space Technologies to Sustainable Social Development 152
Gabriela Garcez, Catherine De Souza Santos, Marcia Alvarenga Dos Santos

A Practical Perspective of Developing Sustainable Space for the EU with Essential Strategies & Policies Framework 153
Swarnajyoti Mukherjee, Francesco Ventre, Annamaria Nassisi

Advancements in Payload Hosting Operations for New Space: Addressing Challenges, Streamlining Processes, Enhancing Economic Viability, and Demonstrating Efficacy Through Empirical Evidence 162
Fakhri Babayev, Alastair Isaacs, Tobias Flecht

Space Sustainability: Environmental Impact of Reusable Space Hardware and In-Space Assembly, Manufacturing, and Remanufacturing 168
Bernd M. Weiss, Jan-Steffen Fischer, Rene Laufer, Anna Ohrwall Ronnback

LATE BREAKING ABSTRACTS (LBA)

Satellite with Drones System to Reduce the Space Debris Problem 169
Dulce Fernanda Lopez Salvador

Author Index