Page 5015 - 5032 **DOI:** *https://doij.org/10.10000/IJLMH.119582*

INTERNATIONAL JOURNAL OF LAW MANAGEMENT & HUMANITIES

[ISSN 2581-5369]

Volume 8 | Issue 2

2025

International Space Law: Exploring the Juridical Implications of AI in Extraterrestrial Conflict

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ABSTRACT

As humanity ventures further into space, the prospect of extra-terrestrial conflicts—whether between human nations, human and extra-terrestrial civilizations, or even AI systems—presents unprecedented challenges in the realm of international space law. Any use of an anti-satellite weapon in outer space increases tensions around the possibility of an outer space arms race. The prospect that a conflict could be waged from earth to space, space to earth, or in space itself inches closer to reality. The integration of artificial intelligence (AI) into space activities, especially in warfare or conflict resolution scenarios, amplifies these challenges by introducing complexities related to accountability, the ethics of autonomous decision-making, and the governance of space-based assets, which will have a revolutionary impact on space operations. Existing space treaties, such as the Outer Space Treaty, the Liability Convention, and the Registration Convention were crafted in an era where AI and extra-terrestrial conflicts were not foreseen, leaving significant gaps in regulation.

This paper explores the juridical implications of AI in extra-terrestrial conflicts, focusing on four key areas: the legal status of AI in space warfare, accountability for autonomous systems, ethics and human rights, and the management of extra-terrestrial resources. Further, this paper examines the application of the various 'soft-law' instruments focused on the responsible development of AI systems to space-based AI systems. This study advocates for creating updated international agreements and treaties to regulate the use of AI in space, addressing the growing intersection of militarization, AI technology, and the peaceful use of space. The juridical landscape for space will need to evolve to accommodate the transformative role of AI, ensuring that outer space remains a domain for exploration and cooperation, rather than conflict.

Keywords*: Extra-terrestrial conflict, space law, Artificial intelligence (AI), Accountability, Soft-law instruments.*

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 [ISSN 2581-5369]

I. INTRODUCTION

Artificial Intelligence is the concept initially said to be developed by John McCarthy, who was considered the founding father of AI. Alan Turing, Marvin Minsky, Allen Newell, and Herbert A Simon were also considered to be contributorsto the field of AI. The concept of AI was initiated in the year 1930s, at that time in layman'sterms it just started with the idea of "Turing Machine", which eventually was just abandoned as a machine and was not able to suffice with the concept of AI.[4]

Over the past decades, scholars have unraveled the myriad ways in which AI systems and digital technologies influence pillars of law in areas ranging from human rights law, constitutional law, and criminal law, to tortious liability and contracts, administrative law, international humanitarian law, and so on.[5]Based on the High-Level Expert Group on Liability and New Technologies Formation, set up by the European Commission in 2018, the challenges brought forth by AI in the legal domain depend on the complexity, opacity, openness, autonomy, predictability, and vulnerability of computers that mimic human intelligence.[6]

Since the mid-2010s, scholars and institutions have given more attention to another essential aspect of this legal disruption, namely, the challenges of AI in outer space. The array of AI systems for collision avoidance, AI that supports human activities, or AI and space data may raise serious issues of space law regarding damages to be covered, the liability regime to be applied, or the method to be followed once such damages occur in space or here down on Earth. One of the assumptions of the present paper is that the cornerstones of the existing legal structure—that is, the international treaties pertaining to outer space signed under the auspices of the United Nations in the 1960s and 1970s— fall short increasingly in coping with the challenges of AI. Thus, this paper focuses primarily on the juridical implications of AI in Extra-terrestrial conflict.

We contend that the unique features of AI technologies, once displayed in outer space, potentiate current trends in space technology that will require adopting new legal standards. The regulation of AI technologies will be significant when they proliferate and become more widespread. Since the value of such systems and theirassociated risks of damage to persons,

[4] PURVI POKHARIYAL, AMIT K KASHYAP, ARUN B PRASAD, ARTIFICIAL INTELLIGENCE-LAW AND POLICY IMPLICATIONS 39 (1st edn., EBC Publishing (P) Ltd., Lucknow, 2020).
[5] Barfield. W., & Pagallo. U, *Advanced Introduction to the Law and Artificial Intelligence*, ELGAR (2020) and Pagallo. U, *The Laws of Robots: Crimes, Contracts, and Torts*, SPRINGER (2013).
[6] Ugo Pagallo, Eleonora Bassi, Massimo Durante, *The Normative Challenges of AI in outer Space: Law, Ethics, and the Realignment of Terrestrial Standards* (2023) SPRINGER LINK (February 23, 2025), https://link.springer.com/article/10.1007/s13347-023-00626-7.

 [ISSN 2581-5369]

property, and the environment become more apparent, guidance is vital to ensure standards of quality in the development and deployment of space-based AI systems.

II. EXTRA-TERRESTRIAL CONFLICT

Extra-terrestrial conflicts refer to potential or hypothetical conflicts in outer space, involving either human entities (nations or organizations) or extra-terrestrial civilizations or entities.

Yet, the weaponization of outer space is ongoing. Globally, Nations are making unique commitments towards civilian space exploration as well as its militarization. Along with active investment in counter-space activities by France, India, Iran, Japan, and North Korea, dominant players such as China, Russia, and the United States lead in the research, development, testing, and systems and weapons operationalization spaces, increasing the risk of future conflicts in space.[7]

(A) Weaponization of outer space:

The weaponization of space describes the process leading to the deployment of weapons in space that could subsequently become a theatre of conflict through the utilization of weapons targeting destruction of objects either in orbit or on Earth's surface.[8]

Any application of an anti-satellite weapon in outer space increases tensions around the possibility of an outer space arms race. The prospect that a conflict could be waged from the earth to space, space to the earth, orin space itself moves us one step closer to reality.[9]

The sole to-date operational space-based weapon is an anti-satellite (ASAT) weapon, intended specifically for the purpose of disabling or destroying satellites. The World's first ASAT was 'Bold Orion' developed by US in 1958. In response to the Bold Orion, Soviet Union developed 'Co-orbitals' in 1960s and 1970s. The United States developed ASM-135 weapon in 1980s.[10]TheUnited States designed 'Program 437' during the 1960sthat incorporated nuclear attack plans against opponent satellites. It was a time during the early 1960s when the Soviet Union ASAT programbegan. The initial Soviet ASAT system was designated as 'Istrebitel

[7] Dr. Joanna Rozpedowski, *Space Wars: How State Conflict is Going Extra-terrestrial*, GEOPOLITICAL MONITOR (27 October, 2022), https://www.geopoliticalmonitor.com/space-wars-how-state-conflict-is-going-extra-terrestrial/.

[8] *Weaponisation of Space*, VISION IAS (21 May 2024), https://visionias.in/current-affairs/monthly-magazine/2024-05-21/security/weaponisation-of space#:~:text=Weaponization%20of%20space%20defines%20the,orbit%20or%20on%20Earth's%20surface.

[9] *Space Wars: How outer space became a military Zone*, MAYNOOTH UNIVERSITY (February 22 2025), https://www.maynoothuniversity.ie/research/spotlight-research/space-wars-how-outer-space-became-military-zone.

[10] *Anti-Satellite Weapons and the Emerging Space Arms Race*, HARVARD INTERNATIONAL REVIEW (May 26, 2020), https://hir.harvard.edu/anti-satellite-weapons-and-the-emerging-space-arms-race/.

Sputnikov' (Satellite Destroyer) and was developed to intercept and destroy hostile satellites in low Earth orbit. The latest accomplishment of the Soviet ASAT programme was the successful test of the 'Nudol' system, which proved the capability to destroy satellites in orbit. In 2007, China also conducted an anti-satellite weapon test by destroying its weather satellite and sending space debris into Earth's orbit.Apart from the 'cosmic triangle' (US, Russia, China),India performed an ASAT weapon test in 2019 with the name 'Mission Shakti', making it the fourth country in the world to have demonstrated the capability to destroy a satellite in space.[11]

(B) Testing weapons in outer space

Weapons tests had been conducted in the proximity of outer space as early as the late 1950s and continued into the 1960s, testing nuclear weapons at high altitudes. Because of the devastating impacts observed in these tests, the Soviet Union and the US agreed on the Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water (Limited Test Ban Treaty) in 1963. This prohibition was reinforced by Art IV of the 1967 Outer Space Treaty, which forbids states from placing nuclear weapons or weapons of mass destruction into orbit or stationing them in outer space.But apart from these two categories, there is no explicit ban on placing and deploying other 'conventional' weapons in outerspace.[12]

Most kinds of space weapons are still theoretical or in the experimental phase, such as plasma weapons, kinetic bombardment, laser weapons, electromagnetic weapons, or other kinds of orbital weapons. The initial space weapon was discovered on 'Almaz', the first Soviet space station. It was a 23 mm cannon that could be fired using an optical sight. So far, the R-23M on the Almaz station was the sole weaponized military spacecraft to have flown into space. During the 1960s, the United States Air Force developed a military program called 'Project Thor', with the idea of launching a 6-metre tungsten rod from space to strike targets on the planet and provide the impact of a nuclear weapon without the radioactive fallout.[13]

Though still in the experimental phase, the advent of directed-energy weapons (DEWs) as a new generation of military equipment, especially high-energy lasers (HELs) and high-power radio frequency (HPRF) weapons, has influenced the nature of contemporary warfare significantly. High-energy lasers can destroy attacking missiles with such precision as to make

[11] Bogdon Stojanovic, *Astro-politics and the militarization of Space: The new arms race, DIPLOFOUNDATION* (January 20, 2025), https://www.diplomacy.edu/blog/militarisation-of-space/#:~:text=Many%20types%20of%20space%20weapons,one%20of%20them%20to%20explod.
[12] Space Wars, *supra note* 6, at 4.
[13] Space Wars, *supra note* 6, at 4.

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one of them explode. [14]

III. MEASURES UNDERTAKEN TO MITIGATE CONFLICTS IN SPACE

(A) Existing Legal Instruments

- *Committee on the Peaceful Uses of Outer Space, 1959* (COPUOS) - To regulate the exploration and utilization of space for the benefit of mankind.
- *Outer Space Treaty,1967* - Forbids nuclear weapons or any other weapons of mass destruction in outer space.
- *Space Liability Convention, 1972* - The launching state is liable for damage done by its space objects.
- *Launch Registration Convention, 1975* - The Launching State shall register the space object in a suitable registry and notify the same to the UN Secretary-General.
- *Moon Agreement, 1979* - The agreement prohibits the setting up of military bases, installations, and fortifications on the Moon and, the testing of any type of weapons on the Moon. [15]

While the existing international legal instruments relating to outer space do, to a certain degree, ban and limit the deployment of weapons, use of force as well as military operations in some areas of space, the provisions relating thereto them are perceived by some states to be narrow in scope and hence insufficient to avert weaponization of outer space. The advancement of science and technology may render it imperative to reinforce the existing international legal regime.[16]

(B) Processes and proposals

There are several proposals and processes ongoing:

- Prevention of an arms race in outer space (PAROS)
- Prevention of the placement of weapons in outer space (PPWT)
- Transparency and confidence-building measures (TCBMs) in outer space
- Group of Governmental Experts (GGE)
- International Code of Conduct for Outer Space Activities

[14] Space Wars, *supra note* 6, at 4.
[15] Weaponisation of Space, *supra note* 5, at 4.
[16] *Preventing a Arms Race in Outer Space*, REACHING CRITICAL WILL (February 25, 2025), https://www.reachingcriticalwill.org/resources/fact-sheets/critical-issues/5448-outer-space.

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Prevention of an arms race in outer space (PAROS):

The enormous member states of United Nations are concerned that the weaponization of outer space will lead to an arms race and insist that a multilateral treaty is the sole way to prevent such an arms race, emphasizing that this treaty would not limit access to space, but would prevent such limitations. In 2006, Russia countered that if all states observed a prohibition on space weaponization, there would be no arms race. Russia and China also support establishing an obligation of non-use or threat of use of force against space objects and have submitted a draft treaty to the UN on preventing the placement of weapons in outer space.[17]

Prevention of the placement of weapons in outer space (PPWT):

Certain delegations, such as the United States, have argued that PAROS is not the most relevant term or treaty to pursue. Discussion in the Conference on Disarmament (CD) has recently focused on a treaty to prevent the placement of weapons in outer space. Changing the language from the prevention of an arms race to the prevention of the placement of weapons in outer space circumvents the US argument against PAROS, but it does not address issues of definitions regarding where outer space begins, the kind of weapon to be banned, or if the treaty can be verified.

On 12 February 2008, Russia's Foreign Minister, Sergey Lavrov, addressed the Conference and proposed a joint Russia-China draft Treaty on the Prevention of the Placement of Weapons in Outer Space, and the Threat or Use of Force against Outer Space Objects (PPWT). The Bush administration dismissed the offer out of hand, referring to the move to preserve space for peaceful uses as "a diplomatic ploy by the two nations to secure a military advantage."

A second draft was proposed by Ambassador Borodavkin of the Russian Federation on 10 June 2014. The new draft witnesses quite several alterations from the initial version as far as definitions and procedural aspects are concerned. The US administration continues to reject the second PPWT draft treaty based on an elaborate analysis as provided in CD/1998.[18]

Transparency and confidence-building measures (TCBMs) in outer space:

In 2007, the UN Secretary-General released a report that consolidated the positions of member states regarding the matter of TCMBs in outer space, as mandated by a General Assembly resolution. In 2010, the General Assembly consented to convene a Group of Governmental Experts (GGE) to examine TCBMs that could be undertaken to strengthen space security.[19]

[17] Preventing a Arms Race in Outer Space, *supra note* 13, at 6.
[18] Preventing a Arms Race in Outer Space, *supra note* 13, at 6.
[19] Preventing a Arms Race in Outer Space, *supra note* 13, at 6.

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Group of Governmental Experts (GGE):

The GGE consists of a small group of international space experts from a selection of space-faring nations to enhance international cooperation and minimizethethreats of misunderstanding and miscommunication in outer space endeavors. The ultimateaim for the group is to provide a consensus report that identifies conclusions and suggestions on transparency and confidence-building measures for space security and sustainability.

The outcome consensus report was tabled to the 68th Session of the UN General Assembly in 2013 and comprises a voluntary set of TCBMs for outer space activities and is recommended to the states. It suggested establishing enhanced coordination among the Office for Disarmament Affairs, the Office for Outer Space Affairs, and other relevant UN entities.[20]

International Code of Conduct for Outer Space Activities:

The European Union (EU) in 2008 initiated a process of creating an International Code of Conduct for Outer Space Activities (ICoC). The code will not be used as a legally binding treaty but will be a set of principles and guidelines agreed to voluntarily amongst states. It will not have any formal enforcement mechanisms.

The objective behind the ICoC is to promote safety and security in outer space through the development and implementation of transparency and confidence-building measures.

The ICoC is based on 3 main principles:

1) Inheritable right of all states to utilize space for peaceful purposes;

2) Protection of security and reliability of space objects in orbit; and

3) Taking into account legitimate defence interests of states.

Australia, Canada, Japan, and the United States have already endorsed the ICoC while others have not been so receptive. Countries such as Brazil, Russia, India, and China have been disappointed with not having been adequately consulted during its development. Along with other space developing nations they also expressed concerns that the ICoC might serve as a means of constraining their future potential for further outer space activities.[21]

(C) Advent of AI

Artificial Intelligence is a field of computer science thatemphasizes the creation of machines that canwork and react like humans. It aims at achieving efficiency and accuracy in human

[20] Preventing a Arms Race in Outer Space, *supra note* 13, at 6.
[21] Preventing a Arms Race in Outer Space, *supra note* 13, at 6.

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decision-making by replicating human intelligence. It could be said that it is intelligence demonstrated by machines, in contrast to the natural intelligence displayed by humans and other animals. In today's period, AI has covered the whole of the nation, in almost every aspect of the field of knowledge such as education, medicine, entertainment, automobiles, including outer space.[22]

There is a lingering question, of whether AI should be given the status of personhood. Though the scope and capabilities of AI are vast, they are not unique and irreplaceable like human beings and even if they develop cognitive capabilities like humans including characteristics of self-awareness and consciousness, they lack the senses as well as human and emotional intelligence required. AI systems are devoid of intentions and lack emotional intelligence unlike humans whose decisions are influenced by both the motives and intentions that arise from the causal power of biological brains which are absent in AI systems hence, they lack essential attributes to be considered as a person.[23]

Notably, one of the attributes of AI that have most attracted the interests of scholars and the general public is the "autonomy" of such systems. Autonomy refers to the fact that AI systems are capable of modifying their internal states or properties independently of external stimuli, thus controlling their actions without direct human intervention.[24] The mounting application of AI systems that facilitate or substitute for human analysis and decision-making, interpreting huge streams of data or establishing and refining decision-making rules independently, is a good instance of third-order technology in operation. The ramifications of such independence, from the legal perspective, can be however controversial.[25]

The balance to be achieved between human control and AI autonomy can be quantified by the extent of “social acceptability” concerning the risk associated with the process of automation, as well as the amountof social and political unity that considers the values and principles under threat with the emergence of ever more autonomous technologies.[26]The impact of autonomous technologies on matters of liability, accountability, and responsibility depends on the criminal law, international humanitarian law, tort law, administrative law, etc. In the field of space law, scholars have progressively discussed principles and rules of the field that might be lacking

[22] PURVI POKHARIYAL, AMIT K KASHYAP, ARUN B PRASAD, ARTIFICIAL INTELLIGENCE-LAW AND POLICY IMPLICATIONS 1 (1st edn., EBC Publishing (P) Ltd., Lucknow, 2020).
[23] PURVI POKHARIYAL, AMIT K KASHYAP, ARUN B PRASAD, ARTIFICIAL INTELLIGENCE-LAW AND POLICY IMPLICATIONS 3 (1st edn., EBC Publishing (P) Ltd., Lucknow, 2020).
[24] Pagallo. U, *The Laws of Robots: Crimes, Contracts, and Torts*, SPRINGER (2013).
[25] Ugo Pagallo, *supra note* 3, at 3.
[26] Pagallo. U. & Durante. M., *The Pros and Cons of Legal Automation and its Governance* (2016), 323–334 EUROPEAN JOURNAL OF RISK REGULATION, https://www.researchgate.net/publication/311795343_The_Pros_and_Cons_of_Legal_Automation_and_its_Governance.

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when it comes to addressing the interactivity, opacity, and unpredictability of autonomous "space objects."[27]

IV. DILEMMAS OF INTERNATIONAL SPACE LAW

In order to inform the discussion of regulating AI in space, it is imperative to look at the pertinent international legal instruments. United Nations negotiated and adopted five space treaties which include the Outer Space Treaty (OST),[28] the Liability Convention,[29] and the Registration Convention.[30] These treaties were drafted in the 1960s and 1970s and mainly focused to avoid conflict in outer space.[31] Although these treaties do not deal directly with AI,[32] they form a general foundation for regulation of space activities and enjoy near-universal acceptance worldwide. While some have suggested that it is very important to form a new space treaty to explicitly deal with contemporary advancement like AI in space,[33] this seems improbable to develop soon because there is a lack of political willpower. Rather, it would be more practical to clarify prevailing treaty obligations by formulating guidelines and confidence-building measures.[34]

The OST enunciates space law principles such as the prohibition against national appropriation of outer space [Art. II], the use of international law applicable to space activities [Art. III], States' responsibility for their national space activities [Art. VI], States' liability for damage caused by their space objects [Art. VII] and States' jurisdiction over objects launched into space [Art. VIII].[35]Article III adds international law to outer space activities, and so could allow recognition of new norms, if they acquire the status of customary international law through *opinio juris*[36] but it cannot be operated as a 'catch-all' provision that authorizes any other rules

[27] Ugo Pagallo, *supra note* 3, at 3.
[28] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, opened for signature 27 January 1967, UNTS 610 8843 (entered into force 10 October 1967).
[29] Convention on International Liability for Damage Caused by Space Objects, opened for signature 29 March 1972, UNTS 961 13810 (entered into force 1 September 1972).
[30] Convention on Registration of Objects Launched into Outer Space, opened for signature 14 January 1975, UNTS 1023 15020 (entered into force 15 September 1976).
[31] Thomas Graham, Kathirawan Thangavel, Anne-Sophie Martin, *New challenges for International Space Law: Artificial Intelligence and Liability* (2023) RESEARCHGATE, https://www.researchgate.net/publication/369201650_New_Challenges_for_International_Space_Law_Artificial_Intelligence_and_Liability.
[32] S. Freeland, *Challenges for the future international regulation of space activities: Space law in a changing technological paradigm* (2020) (42) (3) Bull. Law Soc. S. Aust.16.
[33] L. Li, *Space Debris Mitigation as an International Law Obligation* (2015) (17) (3) Int. Community Law Rev. 310-311.
[34] *Id* at 30.
[35]Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, opened for signature 27 January 1967, UNTS 610 8843 (entered into force 10 October 1967).
[36] *Id* at 30.

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of international law to be applied to this special sphere. It is not constructed as such by the international community.[37]

The Liability Convention extends on Article VII of the OST by defining a two-pronged liability system consisting of fault-based and absolute liability rely on the location of the damage [Art. II - III]. This treaty is regarding the damage to space objects caused by space debris and collisions between space objects controlled by automated systems. The Liability Convention makes launching States jointly and severally responsible for any ensuring damage [Art. V],[38]which encouraging the States to reduce risks and follow the best practices as well as their international treaty obligations. Given thatunder the Conventionliability is not limited, this motivates States to enact proper national space laws.[39]

The Registration Convention deals with the registration of objects which send into space, with the information to be recorded in both State-based registers and the UN-based international register [Art. II - III]. These registers must have the details of the launching State, the name/designator, launch time and launch place, orbital parameters, and the general purpose of the object [Art. IV]. Interestingly, the Convention take on the definitions of "launching State" and "space object" established in the Liability Convention [Art. I].[40]

(A) Accountability of AI under space law

The absence of established jurisprudence concerning the liability for space-based AI systems in extra-terrestrial conflicts increases many questions that cannot be fully explored withinin one paper. Rather, this paper seeks to draw attention to certain points regarding the definitions and liability structures provided in the existing treaties that need clarification.

For example, one question in this regard is whether AI can be considered a 'space object' under the Liability and Registration Conventions and whether AI systems need to be registered like physical objects, particularly given the intangible nature that AI systems possess. The definitions established in the Liability Convention provide the uncertainty in their application to AI systems. Given that "launching States" are made liable, the definition of a "launching State" need to examined. Article I(c) provides that a "launching State" means "A State which launches or procures the launching of a space object" or "A State from whose territory or facility

[37] S. Freeland, The *limits of law: Challenges to the global governance of space activities* (2020) (153) (477/478) J. Proc. R. Soc. New South Wale 76-77.
[38] Convention on International Liability for Damage Caused by Space Objects, opened for signature 29 March 1972, UNTS 961 13810 (entered into force 1 September 1972).
[39] Thomas Graham, *supra note* 28 at 11.
[40] Convention on Registration of Objects Launched into Outer Space, opened for signature 14 January 1975, UNTS 1023 15020 (entered into force 15 September 1976).

a space object is launched". [41]

The Outer Space Treaty (OST) does not define the term "space object" exactly but accepted general definition that it would include any object made by human beings that was launched or designates to be launched into outer space, including inoperative objects like space debris. The Liability Convention also defines "space object includes *component parts* of a space object as well as its launch vehicle and parts thereof".[42]The term 'Component parts' is not defined specifically in the document, and does not provide any examples, making it as a vague term.The term "component part" is defined underauthoritative dictionaries as a compound phrase meaning "something (as a building or part of a building) that cannot be removed without *substantial damage* to itself or to the immovable property to which it is attached".[43] This is in accord with other researchers' attention to the physical form of the "greater" space object and arguing that without the presence of a "component part", the object would not be whole.[44] In this regard, AI in space, this would imply that an AI system that could not be detached at any cost without inflicting immense damage to the object that it is occupying would itself qualify as a space object in terms of the Liability Convention. Therefore, the State which initiated the object, and any other participating States, could be held liable.[45]

Separately, as noted by others, the Liability Convention does not directly address the operation of AI systems in outer space, resulting in uncertainty about causation, fault, and liability in case of damage caused by AI-powered space objects. These problems are more intricate and likely more challenging to overcome than the definitional issues discussed above. Some have suggested that launching States should be held responsible for damage caused by AI-powered space objects, considering that the regime of liability rests on the launching State(s) of an object. This would imply that launching States must approve and supervise all "intelligent" space objects launched by them,making sure they exercise due diligence in taking measures to avoid potential damage. This kind of proposal would be opposed by the launching states that do not want to be held jointly and severally liable for damage they alleged to have been caused by a

[41] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, opened for signature 27 January 1967, UNTS 610 8843 (entered into force 10 October 1967) Art. I(c).
[42] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, opened for signature 27 January 1967, UNTS 610 8843 (entered into force 10 October 1967) Art. I(d).
[43] Thomas Graham, *supra note* 28 at 11.
[44] S. Gorove, *International Protection of Astronauts and Space Objects* (1971) (20) (3) DePaul Law Rev. 607.
[45] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, opened for signature 27 January 1967, UNTS 610 8843 (entered into force 10 October 1967) Art. V.

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badly designed AI system procured by another launching State beyond their control.[46]

(B) Potential international law solutions

The existing international legal regime on space activities is presently insufficient to address damage claims in space caused by AI and would be improved by new multilateral treaties or amendments. One potential solution is a binding supplementary protocol to the Liability Convention that defines terms such as "space object", "damages", "fault" and "gross negligence", and more clearly outlines the relationships between the Outer Space Treaty and the Liability Convention, which currently makes the application of prevailing international space law to AI systems.[47] For instance, a revised definition of "space object" could include "any object launched or attempted to be launched into outer space, including all of its tangible and intangible parts—like software, hardware, equipment, installations, launch vehicles, and other connected components—without which the complete functioning of the space object would be impossible". This would provide more precise direction for dealing with damages involving AI, without straying from the existing definition of "space object"under the Liability Convention.[48]

The idea of creating a specialized registry to monitor the details of AI-enabled space objects has been put forward in order to promote transparency in AI-driven space activities.[49]This specialized registry could record details such as the type of AI model used, the purpose of the system, creator and operator/licensor, a brief description of the data used to train the relevant AI models, and the object of the launching State. Although such a registry would enhance knowledge of the design, functioning, and ownership of AI systems, it could be resisted on grounds of exposing sensitive information and the attendant legal and financial liability in case of an accident.The establishment and enforcement of such a registry would require careful consideration and negotiation to facilitate widespread adoption.[50]

Separately, there has been suggestion that principles of international law may be broughtinto the space domain under Article III of the Outer Space Treaty in order to provide States with certainty on their duties under Article IX as regards fault and due diligence.[51]Although this

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46 Thomas Graham, *supra note* 28 at 11.
47 I. Bratu, A. Lodder, and T. V. D. Linden, *Autonomous Space Objects and International Space Law: Navigating the Liability Gap*, INDONES. J. INT. LAW (2021), https://heinonline.org/HOL/LandingPage?handle=hein.journals/indjil18&div=23&id=&page.
48 Thomas Graham, *supra note* 28 at 11.
49 J. Robinson, *Transparency and confidence-building measures for space security* (2016) (37) SPACE POLICY 144.
50 A.-S. Martin and S. Freeland, *The Advent of Artificial Intelligence in Space Activities: New Legal Challenges* (2021) (55) SPACE POLICY, https://www.sciencedirect.com/science/article/abs/pii/S0265964620300503.
51 I. Bratu, *supra note* 44 at 14.

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strategy is attractive, it is necessary to take into account the specific legal and technological environment of outer space and adapt international law principles to this environment to prevent future regulatory problems.[52]

While the suggested remedies would be of value, reforming international space law to address AI-related issues likely to be difficult, as evidenced by thefailure to produce new treaties since the 1979 *Moon Agreement* as well as intricacy of amending existing treaties.[53] Additionally, the international space law community is most concerned with issues likespace debris, space traffic management, and weaponization of outer space, and thus there are minimal chances of significant international regulation of AI in space in the immediate future. Consequently, any loopholes in the current framework would have to be plugged by national AI legislation, insurance, and guidelines for the foreseeable future.[54]

(C) Soft Law Guidance:

'Soft-law' instruments, such as guidelines, standards, and confidence-building measures, play a vital role in facilitating a mature environment for the governance of space and AI activities, especially where there is no established international and national law exist. Widespread acceptance of these standards can be helpful in negotiating binding legal documents and even support the development of customary international law.[55]

Documents such as the *Space Debris Mitigation Guidelines* and the *Long-Term Sustainability Guidelines* of COPUOS provide guidelines for sustainable space operation, with a focus on safety and minimization of space debris.[56]The Long-Term Sustainability Guidelines further promote the use of international technical standards, such as those of the International Organization for Standardization (ISO), in the formulation of regulatory measures for outer space activities, such as AI systems in outer space.[57]

(D) Potential strategies to adapt AI in space activities

Organizations for international standards such as the International Organization for

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[52] S. Freeland and E. Gruttner, *The Laws of War in Outer Space* (2020) HANDBOOK OF SPACE SECURITY: POLICIES, APPLICATIONS AND PROGRAMS, CHAM: SPRINGER INTERNATIONAL PUBLISHING 15.
[53] Agreement Governing the Activities on the Moon and Other Celestial Bodies, opened for signature 18 December 1979, UNTS 1363 23002 (entered into force 11 July 1984).
[54] Thomas Graham, *supra note* 28 at 11.
[55] S. Freeland, *Challenges for the future international regulation of space activities: Space law in a changing technological paradigm* (2020) (42) (3) Bull. Law Soc. S. Aust.17.
[56] *Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space*, UNITED NATIONS OFFICE FOR OUTER SPACE AFFAIRS (February 28, 2025) https://www.unoosa.org/pdf/publications/st_space_49E.pdf.
[57] *UN Doc A/AC105/2018.CRP20E*, '*Guidelines for the Long-term Sustainability of Outer Space Activities*, UN Doc A/AC105/2018.CRP20E (27 June 2018)'R. A.2(f).

Standardization (ISO) and the Institute of Electrical and Electronics Engineers (IEEE) are striving to level the playing field between jurisdictions by making and executing performance and safety standards as well as conformity assessment of products and processes. These organizations are currently targeting on standardization of AI and have established committees to make AI standards and models for assessment. For instance, the ISO has set up a subcommittee on AI (SC42) to make standards on the technical aspects of AI development and conformity assessments and publish guidelines on the management systems for AI.[58] The IEEE is developing AI standards in such areas as trustworthy AI, bias, ethics, and system quality which includes the Standard for Transparency of Autonomous Systems.[59]

Further, some international organizations have published documents concerning responsible AI development. The United Nations Chief Executives Board (UN CEB) has stressed the need of "ethical" AI in its discussions,[60] and 193 Member States of UNESCOhave adopted an international agreement on ethical AI development.[61] The Organisation for Economic Co-operation and Development (OECD) has also signed up to principles for robust, safe, fair, and reliable AI, adopted by 42 countries,[62] and the World Economic Forum (WEF) has published a white paper concerning public sector procurement of reliable AI systems.[63] These initiatives indicate a change in the method AI development is discussed and potentially influence future regulation and the industry norms.[64]

V. CONCLUDING REMARKS

Outer space is now illustrative of mankind's scientific and technologicaladvancement,which presents numerous advantageous explorations as well as discovery opportunities. But, simultaneously, it is still a high-tension regionliable to turn into a weapon zone.Although the Outer Space Treaty reserves the utilization of outer space for peaceful use, the reality of the

[58] *Information technology-Artificial intelligence-Management system*, ISO/IEC JTC 1/SC 42, ISO/IEC DIS 42001 (2023), https://www.iso.org/obp/ui/en/#iso:std:iso-iec:42001:ed-1:v1:en.
[59] *IEEE Standard for Transparency of Autonomous Systems*, VT/ITS - Intelligent Transportation Systems, IEEE 7001-2021 (Mar. 2022), https://standards.ieee.org/beyond-standards/how-to-make-autonomous-systems-more-transparent-and-trustworthy/.
[60] *Principles for the Ethical Use of AI in the United Nations System*, United Nations Chief Executives Board for Coordination, High-Level Committee on Programmes (HLCP), Inter-Agency Working Group on Artificial Intelligence (2022), https://unsceb.org/sites/default/files/2022-09/Principles%20for%20the%20Ethical%20Use%20of%20AI%20in%20the%20UN%20System_0.pdf.
[61] *Recommendation on the Ethics of Artificial Intelligence*, UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION (2021), https://unesdoc.unesco.org/ark:/48223/pf000038113.
[62] *Recommendation of the Council on Artificial Intelligence*, OECD, OECD/LEGAL/0449 (2019) https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0449.
[63] R. C. de Fassio and C. C. Langevin, *Unpacking AI Procurement in a Box: Insights from Implementation*, WORLD ECONOMIC FORUM, BRAZIL, WHITE PAPER (2022), https://www.weforum.org/publications/unpacking-ai-procurement-in-a-box-insights-from-implementation/.
[64] Thomas Graham, *supra note* 28 at 11.

technological advancement of AI and the rise in weapons tests has made states perceive Outer Space as a prospective battlefield.

The general purpose of the analysis is to supplement ongoing debates on whether and how the standards of behaviour in space law need to be improved with an additional set of issues that concern the creation of new standards for multiple AI systems in outer space expeditions.

(A) Suggestions

The exploration of artificial intelligence (AI) in the context of extra-terrestrial conflicts raises before us a range of legal, ethical, and practical issues that need to be examined carefully within the prism of International Space Law. As human activities in space become more advanced, with AI technologies at the forefront, there is a pressing need to consider the legal ramifications that are likely to occur in case of wars in outer space.

The role of AI towards potential extra-terrestrial war again underlines the need for novel paradigms that capture the doctrine of common heritage of mankind incorporated in space law. The shared heritage of mankind concept must be framed so that the use of AI in outer space shall never be employed in the interest of individual states or private entities but for peaceful pursuits, cooperation between nations, and the management of space resources on a sustainable basis. Only through international cooperation, extensive regulation, and continuous advancement of space law can we render AI a power of peace rather than a portent of war.

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 [ISSN 2581-5369]

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