Artificial Intelligence and State Responsibility under the Outer Space Treaty

*George Anthony Long**

Abstract

Artificial intelligence is an emerging technology which is anticipated to revolutionize society and industry. Artificial intelligence also presents a potential technological component to ensure the cyber and physical security of space assets. However, the use of artificial intelligence in space assets may conflict with certain legal obligations or duties imposed by the space law treaty regime.

Outer Space Treaty Article VIII obligates a State to retain control over a space object it launches. Using artificial intelligence in space assets presents the question of whether such reliance abdicates a State's obligation to retain control over a space object it launched or which is registered to it. If so, then issues will exist regarding how a State may balance the use of artificial intelligence in space assets with its obligations under the Outer Space Treaty. For instance, in the emerging autonomous or driverless motor vehicle technology, some jurisdictions in the United States are contemplating laws which mandate human ability to override or otherwise intervene in decision making by artificial intelligence in certain circumstances.

Similarly, Article III of the Liability Convention imposes liability based on a State's fault or fault of persons for whom the State is responsible. The use of artificial intelligence in space assets presents the possibility of negating Article III's fault-based concept. The unsettled liability issues associated with autonomous motor vehicles may very well foreshadow liability and fault allocation issues arising from the use of artificial intelligence in space assets.

This paper will examine whether the use of artificial intelligence in space assets conforms with a State's obligation under Outer Space Treaty Article VIII and Liability Convention Article III and analyze what measures, if any, may be necessary to ensure that the provisions are not undermined by the use of artificial intelligence in space assets.

I. Introduction

This paper will briefly examine how the emergence of artificial intelligence in the operation of satellites and other space objects may impact certain existing

* Managing Member, Legal Parallax, LLC, United States. gal@legalparallax.com.

duties and obligations under the current space law treaty regime. Specifically, it will analyze how intelligent space objects may negate the fault-based liability scheme of Article III of the Convention on International Liability for Damage Caused by Space Objects ("Liability Convention") and the State responsibility obligations imposed by Articles VIII and VI the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies ("Outer Space Treaty"). Outer Space Treaty Article VIII obligates a Registry State to retain control over a space object subject to its registration while Article VI requires a State to supervise the space activities of its governmental entities as well as non-governmental entities subject to its sovereignty. For purposes of this paper such governmental and non governmental entities will be referred to as "Nationals" of a State. Artificial intelligence or "intelligent space objects" may conflict with these provisions of the Space Law Treaty regime because it is unclear whether operational decisions made by an "intelligent space object," rather than human beings, which cause damage in outer space or adversely affect the space activities of another State come within coverage of Liability Convention Article III or constitute compliance with Outer Space Treaty Articles VIII and VI.

II. What is Artificial Intelligence?

Prominent individuals have made "dire warnings about artificial intelligence--with Elon Musk predicting it will be the 'end of civilization'" and that "we're summoning the demon," and Stephen Hawking having said it will "spell the end of the human race."[1] Despite this concern over artificial intelligence, there is not a consensus definition for the term. It is suggested that instead of focusing on a definition for artificial intelligence, attention should be directed toward how technology is being used with machines to make them more autonomous.[2] Taking this approach, there are generally two types of artificial intelligence which can be designated as coded software and machine learning. Artificial intelligence springs from the concept that human intelligence is computational and the human mind can be "modelled as a program that runs on a computer."[3] To this extent, people have become accustomed to relying on computer algorithms for diverse recommendations such as driving routes, music selections, movie selections, whom to date, and how to invest.[4] This

1 Alison Arden Besunder, *Not Your Parents' Robot*, 90 New Yhork State Bar Journal 20, 20 (April 2018)
2 *See Id.*, at 21.
3 Lawrence B. Solum, *Legal Personhood for Artificial Intelligences*, 70 N.C.L. Rev. 1231, 1231 (1992).
4 Mariano-Florentino Cuellar, *A Simpler World? On Pruning Risaks and Harvesting Fruits in an Orchard of Whispering Algorithms*, 51 U.C. Davis Law Review, 27, 31-32 (Nov. 2017).

type of artificial intelligence is considered to be coded software as the computer or other machine only acts in compliance with the coded data humans input into it.

However, artificial intelligence has expanded beyond the use of coded software and has extended to the concept of "machine learning." Machine learning "is not unlike the brain of a human child – ready to be molded and shaped by its experiences."[5] This expansion of cyber capability essentially concerns coded software "evolving" over time.[6] The software evolution "involves the application of computing capacity and analytical techniques to enable computers to learn without being programed explicitly."[7] In other words, the computer or machine "will collect information without an express instruction to do so, select information from the universe of available data without direction, make calculations without being told to do so, make recommendations without being asked and implement decisions without further authorization."[8] The promise of AI is that the technology will be capable of taking large quantities of data and detecting patterns and trends, synthesizing the data in a condensed time frame in a way that humans cannot. Machine learning, therefore, occurs when the software interacts with the world and "looks to see which of its actions create the most successful results. It then incorporates its most successful actions into future behavior."[9]

In essence, this emergence of artificial intelligence is resulting in a shift from "computer-assisted human choice and human-ratified computer choice"[10] to nonhuman analysis, decision-making and implementation of action. This transformation presents novel and complex issues associated with fault allocation under Liability Convention Article III and the imposition of State responsibility by Outer Space Treaty Article VI. To appreciate the nature and scope of State responsibility, it is helpful to understand the liability scheme of the Outer Space Liability regime.

III. The Fault Liability Scheme Established by the Liability Convention

Artificial Intelligence and Fault Liability under the Liability Convention

Outer Space Treaty Article VII imposes international liability on a State for

5 *Weston Kowert, The Foreseeability of Human-artificial Intelligence Interactions,* 96 Texas Law Review 181, 183 (2017).
6 *Id.*
7 Cuellar, *supra* note 4, 51 U.C. Davis L. Rev. at 33.
8 Curtis E.A.Karnow, *Liability For Distributed Artificial Intelligences*, 11 Berkeley Technology Law Journal 147, 152 (1996).
9 Kowert, *supra* note 5, 96 Tex. L.R. at 183.
10 Cuellar, *supra* note 4, at 39.

damage[11] caused by a space object it is deemed to have launched or attempted to launch. Specifically, Article VII reads as follows:

> [e]ach State Party to the Treaty that launches or procures the launching of an object into outer space, including the Moon and other celestial bodies, and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air space or in outer space, including the Moon and other celestial bodies.

Article VII, therefore, assigns State liability based on the following three factors: 1) a State launching a space object, 2) a State procuring the launch of a space object, or 3) a space object being launched from a State's territory. The Liability Convention establishes the framework for the application and scope for the international liability imposed by Outer Space Treaty Article VII.

Liability Convention Articles II through VII allocate fault and set the criteria for applying absolute or strict liability, shared liability, apportioned liability and exoneration of liability. The *locus* of the damage occurrence determines which liability scheme applies.[12] Article II imposes absolute or strict liability for damage "caused by" a space object on the surface of the Earth or to aircraft in flight. Pursuant to Liability Convention Article VI(1), exoneration from absolute liability is possible if the damage results "either wholly or partially from gross negligence or from an act or omission done with intent to cause damage on the part of a claimant State or of natural or juridical persons it represents." This exoneration, however, is not available if the launching State has breached an obligation under the Outer Space Treaty.[13] Liability Convention Article VII provides a defense to absolute liability if the damage "caused by" a space object is suffered by a national of the launching State or to foreign nationals who participated in or associated with certain activities involving the space object.

---

11 Liability Convention Article 1(a) Article 1(a) defines "damage" to mean "loss of life, personal injury or other impairment of health; or loss of or damage to property of States or of persons, natural or juridical, or property of international intergovernmental organizations." The measure of recovery for damage is "determined in accordance with international law and the principles of justice and equity, in order to provide such reparation in respect of the damage as will restore the person, natural or juridical, State or international organization on whose behalf the claim is presented to the condition which would have existed if the damage had not occurred." Liability Convention Article XII. There is not any financial limitation on the amount of recovery. However, it is unclear whether the recovery is limited to direct damages or whether it can include indirect damages. Carl Q. Christol, *International Liability For Damage Caused By Space Objects*, 74 American Journal of International Law 346, 360 - 362 (1980).

12 Liability Convention, Article VI(2).

13 *Id*.

Liability Convention Article III, on the other hand, imposes fault liability if damage to another space object or to persons or property on board another space object occurs "elsewhere than on the surface of the Earth." Under Article III's fault liability scheme, launching State liability exists "if the damage is due to the fault or the faults of **persons** for whom it is responsible."

IV. The Scope of State Responsibility

Outer Space Treaty Article VI subjects a State to international responsibility for the space conduct of its nationals. This supervisory responsibility includes a State assuring that its nationals space activities are conducted with due regard to the corresponding interests of all other States. State responsibility "embraces all aspects of obligations incumbent upon States vis-'a-vis other States, whether voluntarily contracted or imposed by custom."[14] Article VI's State responsibility obligation, therefore, is much broader in scope and application than the international liability assessed pursuant to Outer Space Treaty Article VII and the Liability Convention.

While international liability under Outer Space Treaty Article VII and the Liability Convention is limited in its scope and application, that is not the circumstance with respect to State responsibility imposed by Outer Space Treaty Articles VI and VIII. Traditionally, State responsibility represents the classic concept for dealing with a State's violation of customary international law which causes injuries to another State or to nationals of another State.[15] A State suffers a distinct and separate injury when one of its nationals is injured by another state.[16] To this extent, the act does not have to be committed directly by a State as it is sufficient if the act or conduct can be attributable to the State.[17] A breach can be attributable to a State if the State plays an active role in causing the injury,[18] omits to perform an act,[19] or having knowledge of a hazardous condition fails to warn others of the hazard.[20] When a breach of international law attributable to a State inflicts

14 Sompong Sucharitkul, *State Responsibility and International Liability Under International Law,* 18 Loy. L.A. Int'l & Comp. L.J. 821, 832 (1996)

15 *Id.*

16 *See Avena and Other Mexican Nationals (Mex. v. U.S.)*, 2004 I.C.J. 12, 36 (Mar. 31)[The court noted that could submit a claim in its own name for injuries "suffered both directly and through the violation of individual rights conferred on Mexican nationals."]

17 Dan St. John, *The Trouble with Westphalia in Space: The State-Centric Liability Regime*, 40 Denv. J. Int'l L. & Pol'y 686, 706 (2012).

18 Dr. William C.G. Burns, *A Voice for the Fish? Climate Change Litigation and Potential Causes of Action for Impacts Under the United Nations Fish Stocks Agreement*, 48 Santa Clara L. Rev. 605, 644 (2008)

19 *United States Diplomatic and Consular Staff in Tehran (U.S. v. Iran)*, 1980 I.C.J. 3 (May 24)

20 *Corfu Channel, U.K. v. Albania, Judgment*, 1949 I.C.J. 4 (Apr. 9)

injury on another State or the nationals of another State, the duty is to make reparations.[21] Reparations are a mandatory duty which attaches to a State violating an international obligation.[22] The remedy is generally owned only to another State as individuals and other non-state entities traditionally lack standing under international law to pursue or collect reparations under State responsibility jurisprudence.[23] Reparations are meant to restore the injured party to the condition that existed prior to the breach of the international obligation.[24] If that is not possible, then a monetary payment corresponding to the value of the restitution is appropriate. If neither of these are totally sufficient, then reparations can take the form of an apology,[25]official recognition of the injury,[26] or promises or guarantees of non repetition of the injurious act or conduct.[27] Thus, while the Liability Convention limits its remedy to the payment of compensation for damage, State responsibility extends beyond compensation for damage.

Another divergence between State responsibility and international liability in space law is that the Liability Convention limits recovery to damage as defined in Article 1(a). Outer Space Treaty Article VI does not impose any such limitation. This means reparations for breach of a State responsibility obligation can encompass economic harm and injury excluded by the Liability Convention.[28] Moreover, the Liability Convention limits recovery to third party damage claims arising from a space asset colliding with other space objects in space or an airplane in flight or anything on Earth.[29] Recovery for breach of a State responsibility obligation is not limited to such third party claims.

Unlike the imposition of State liability, State responsibility is not limited to launching States. It extends to any State with "national activities in outer space"or whose nationals engage in any outer space activity. The exact

21 Sompong Sucharitkul, *supra* note 18, 18 Loy. L.A. Int'l & Comp. L.J. at 823.

22 Michael F. Blevins, J.D., M. Div., *Restorative Justice, Slavery, and the American Soul, A Policy-Oriented (Fnaa1) Intercultural Human Rights Approach to the Question of Reparations*, 31 T. Marshall L. Rev. 253, 276 (2006); Jon M. Van Dyke, *The Fundamental Human Right to Prosecution and Compensation*, 29 Denv. J. Int'l L. & Pol'y 77, 89 (2001)

23 Libby Adler and Peer Zumbansen, *The Forgetfulness of Noblesse: A Critique of the German Foundation Law Compensating Slave and Forced Laborers of the Third Reich*, 39 Harv. J. on Legis. 1, 46 (2002)

24 *Factory at Chorzow (Ger. v. Pol.)*, 1928 P.C.I.J. (ser. A) No. 17, at 29 (Sept. 13).

25 Dan St. John, *supra* note 21, 40 Denv. J. Int'l L. & Pol'y at 706.

26 *Id.*

27 Daniel Bodansky, John R. Crook, et al, *Righting Wrongs: Reparations in the Articles on State Responsibility*, 96 Am. J. Int'l L. 833, 839 (2002)

28 See Sarah M. Mountin, *The Legality and Implications of Intentional Interference with Commercial Communication Satellite Signals*, 90 Int'l L. Stud. 101, 146 (2014).

29 Dr. Frans G. von der Dunk, *Passing the Buck to Rogers: International Liability Issues in Private Spaceflight*, 86 Neb. L. Rev. 400, 412 (2007).

breath of this coverage is uncertain in as much as "activities in outer space" is an undefined term. The lack of a definition creates uncertainty on scope in as much as it is unresolved if the phrase "national activities in outer space" is restricted to acts performed in space or if it includes activities in space remotely controlled by a person on Earth. The lack of a restrictive definition suggests that Article VI's responsibility encompasses "all the concomitant activities associated with what actually occurs in outer space, both before and after."[30] Moreover, even a narrow reading of Article VI can reasonably lead to the conclusion that the supervising responsibility includes "terrestrial activities directly related to concurrent activities in outer space."[31]

V. Acts and Omissions of an Intelligent Space Object

Liability Convention Article III and Outer Space Treaty Article VI impose liability and responsibility, respectively, on a State for conduct of its nationals in Outer Space or for acts which are attributable to a State. Outer Space Treaty Article VIII, on the other hand, obligates a Registry State to retain control over a space object subject to its registry. The emergence of intelligent space objects may disrupt the fault-based liability scheme of Article III as well as the State responsibility imposed by Outer Space Treaty Articles VI and VIII since such decisions are not made a person and may not always be attributable to a State.

A. Can a Decision Made by an Intelligent Space Object be Deemed an Act or Omission of a Natural or Juridical Person?

Generally, we think of a person as a human being.[32] In the legal arena, the term "person" generally refers to an entity which is subject to legal rights and duties.[33] Accordingly, the law considers artificial entities like corporations, partnerships, joint ventures, and trusts to be a "person" as they are subject to legal rights and duties. [34] Additionally, in certain instances the law recognizes and imposes legal rights and duties on certain inanimate objects like ships, land, and goods which results in such inanimate objects being subject to judicial jurisdiction as well as being subject to a judgment rendered against it.[35] However, the legal rights and duties imposed on artificial entities and inanimate objects flow from actions or conduct engaged in by human

30 Bin Cheng, *Article VI Of The 1967 Space Treaty Revisited: "International Responsibility," "National Activities," And The Appropriate State."* 26 Journal of Space Law 7, 19 (1998) .

31 Michael C. Mineiro, *Law And Regulations Governing U.S. Commercial Spaceports: Licensing, Liability, And Legal Challenges*, 73 J. Air L. & Com. 759, 768 (Fall 2008).

32 Solum, *supra* note 1, 70 N.C.L. Rev. at 1238.

33 *Id*., at 1238-1239.

34 *Id*.

35 *Id*., at 1239.

beings. That is not necessarily the case for actions or conduct taken based on machine intelligence.

Although a machine can learn independently from human input and make decisions based on its learning and available information, that does not necessarily equate with legal personhood. As noted, decisions and conduct of legal persons are ultimately decisions made by a human being. This means the decision is not based solely on intellect or data, but is also the product of human factors such as a conscious, emotion, and discretion.[36] Thus, the concept of legal personhood is ultimately premised on humanity. Decisions and conduct based on machine learning which is divorced from human oversight or control arguably lack consideration of human factors such as a conscious, emotion and discretion.[37] The lack of direct or indirect human considerations in the decision making of an intelligent machine together with such an object not having any legal rights or duties under existing law means that decisions by an intelligent space object are not made by a natural or legal person. Since fault liability under Liability Convention Article II is premised on the "fault or the faults of persons," a decision by an intelligent space object will not be the "fault of persons for whom it is responsible." Accordingly, State liability for a decision made by an intelligent space object depends upon whether such a decision can be attributable to the State.

Since State responsibility rests on an act being attributable to a State, it seems the same analysis will apply with respect to determining State liability under Article III of the Liability Convention or State responsibility under Articles VI and VIII of the Outer Space Treaty based on the act or omission of an intelligent space object.

B. Can a Decision Made by an Intelligent Space Object be Attributable to a State?

Generally, liability for damage or injury attributable to States is traceable to human acts or omissions. This basis for imposing liability appears to be inapplicable when damage or injury in outer space is caused by an analysis, decision, and implementation of a course of action made by a machine without human approval.[38] Liability premised on human acts or omission fails when no particular human possessed the ability to prevent the injury, short of making the decision to install artificial intelligence in a space object.[39] For sure, it is substantively difficult to draw a line between reliance on artificial intelligence to supplant the judgment of a human decision maker and the propriety of allowing a machine, or nonhuman, to decide and

36 *Id*.,at 1262 - 1287.
37 *Id*.
38 Karnow, *supra* note 8, 96 Tex. L. Rev. at 189-190.
39 *Id*.

implement a course of action.[40] To this extent, it seems neither liability nor responsibility can be premised solely on the decision to deploy an intelligent space object as such a sweeping basis for liability or responsibility would effectively retard the development of intelligent space objects by relegating them to being merely a tool for supplementing or aiding the judgment of a human decision maker.[41] Thus, damage and harm resulting from the decision of an intelligent space asset present novel and complex issues associated with foreseeability and proximate cause which are crucial elements for establishing State liability.[42] Indeed, decisions made and implemented by intelligent machines complicate attributing State liability as people generally will not be able to ascertain how a given decision was made.[43] This complexity suggests that a breach of State responsibility under Outer Space Treaty Articles VI and VII present a more appropriate avenue for pursuing redress for damage or harm in outer space caused by an intelligent space object.

Outer Space Treaty Article VIII obligates a Registry State to retain control over a space object it registers. Thus, to the extent, decisions of an intelligent space object are claimed not to be attributed to a State, then recourse is available against the Registry State as it failed to maintain control over the intelligent space object subject to its registry. This recourse, however, can be easily defeated since there is not any requirement to register a space object. Indeed, States can simply cease registering intelligent space objects. This effectively leaves Outer Space Treaty Article VI as the most prudent grounds for seeking recourse for damage or harm in outer space caused by the decision of an intelligent space object.

Outer Space Treaty Article VI mandates that the space object or governmental and non-governmental objects comply with the Outer Space Treaty. To ensure compliance by non-governmental entities, Article VI this provides, in pertinent part, that:

> "[t]he activities of non-governmental entities in outer space, including the Moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State party."

Pursuant to Article VI, a State must ensure that a space object of its governmental entities does not harm or damage other space objects or property or nationals of another State, Additionally, Article VI's plain language expressly mandates State "authorization and continuing supervision" over the space activities of non-governmental entities. This mandate strongly implies the

40 *Id*.
41 Kowert, *supra* note 5, 70 N.C.L. Rev. at 193
42 *Id*., generally; Cuellar, *supra* note 4, 51 U.C. Davis L. Rev., 27; Karnow, *supra* note 8, 11 Berk. Tech. L.J. 147.
43 Cuellar, *supra* note 4, 51 U.C. Davis L. Rev. 27

necessity of human oversight or approval of, at least certain, decisions made or conduct of an intelligent space object owned by a non-governmental entity. A State's failure to ensure compliance with the Outer Space Treaty by a governmental or non-governmental entity can be construed as a breach of a State's international responsibility under Article VI.

VI. CONCLUSION

Artificial intelligence based on machine learning appears to be more suitable for use in outer space than in the terrestrial environment. However, the Liability Convention is somewhat archaic if the use of such technology results in damage or harm to property or nationals of another State in the space environment. Decisions made and acts or omissions of an intelligent space object which damages or injures another State or its nationals are not decisions of persons under Liability Convention Article III. Furthermore, the notions of foreseeability and proximate cause may be insufficient at worse and too convoluted at best, to attribute the damage or harm to a State pursuant to Article III. This leaves the State responsibility obligation of Outer Space Treaty Articles VI and VIII as a viable means to redress such damage or injury without becoming entangled in the legal intricacies of proximate cause associated with intelligent machines that acted based upon the knowledge it learned from its own experiences and interactions. Reliance on Outer Space Treaty Article VIII is not totally viable as responsibility can be circumvented by a State declining to register its intelligent space objects. Accordingly, Outer Space Treaty Article VI appears to be the viable source for redressing harm or injury in outer space caused by an act or omission of an intelligent space object.