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THE LEGAL AMBIGUITY BETWEEN FAULT-BASED LIABILITY AND STRICT LIABILITY, ESPECIALLY FOR ACCIDENTS IN OUTER SPACE

AUTHOR - AVIJITH A V* & DR. K. JAMEELA**

* RESEARCH SCHOLAR, SCHOOL OF LAW, HINDUSTAN INSTITUTE OF TECHNOLOGY AND SCIENCE, CHENNAI.

** ASSISTANT PROFESSOR, SENIOR GRADE, SCHOOL OF LAW, HINDUSTAN INSTITUTE OF TECHNOLOGY AND SCIENCE, CHENNAI.

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ABSTRACT

Liability for accidents in outer space is governed primarily by the 1967 Outer Space Treaty and the 1972 Convention on International Liability for Damage Caused by Space Objects. These instruments establish a dual liability regime: strict liability for damage caused on the surface of the Earth or to aircraft in flight, and fault-based liability for damage caused in outer space.[78] While this distinction appears straightforward, in practice it has produced deep ambiguities. The treaties do not define "fault," fail to specify standards of care for space operations, and provide little guidance on apportioning liability when multiple actors are involved.

With the proliferation of private operators, mega-constellations, and orbital debris, the limitations of this framework are increasingly evident. Determining fault in a high-velocity orbital collision is technically and legally complex. Similarly, applying strict liability to surface damage but not to orbital accidents fails to reflect the cascading risks posed by collisions in outer space. The problem is compounded by procedural weaknesses: claims under the Liability Convention must be pursued through diplomatic channels, leaving injured private parties without direct recourse.

This article examines the ambiguities in the current liability regime. It begins with the drafting history of the Liability Convention, then analyzes its provisions in light of modern developments. It compares space liability with aviation and maritime collision law, which provide more detailed negligence standards. Finally, it argues for a hybrid model: a clarified negligence standard in orbit, presumptive joint liability for multi-party accidents, and compulsory arbitration for dispute settlement. Such reforms would reduce uncertainty, enhance accountability, and align liability rules with the realities of contemporary space activities.

[78] 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), Jan. 27, 1967, 18 U.S.T. 2410, 610 U.N.T.S. 205.

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I. Introduction

The expansion of human activity in outer space has transformed liability for accidents from a theoretical concern into a pressing legal issue. The exponential increase in satellites fueled by mega-constellations such as Starlink and OneWeb has dramatically raised the probability of orbital collisions.[79] Meanwhile, the accumulation of space debris has created cascading risks where a single impact can trigger widespread damage, known as the "Kessler Syndrome."[80]

International space law, however, continues to rest on a bifurcated liability regime formulated in the 1960s and 1970s. The Outer Space Treaty establishes the principle of international responsibility, while the Liability Convention details the scope of liability. The regime differentiates between strict liability for surface damage and fault-based liability for damage in orbit.[81] The rationale was that damage on Earth was foreseeable and controllable, while collisions in orbit involved complex factors beyond easy attribution.[82]

Yet, as technology and practice have evolved, this distinction has become increasingly untenable. In space, negligence is difficult to prove due to technical uncertainty and lack of transparency. Strict liability for Earth-based damage offers clarity, but excludes the very risks most likely to occur today: orbital collisions between satellites.[83] The absence of clear standards creates ambiguity, undermining both deterrence and compensation.

This article explores these ambiguities. Part II outlines the legal framework. Part III analyzes the distinction between strict liability and fault-based liability. Part IV examines state practice and notable incidents. Part V draws comparisons to aviation and maritime law. Part VI proposes reforms to establish a clearer and more effective liability regime.

II. The Existing Legal Framework

A. The Outer Space Treaty

The Outer Space Treaty of 1967 is the foundation of international space law. Article VI provides that states bear international responsibility for both governmental and private activities in outer space.[84] Article VII establishes liability for damage caused by space objects but leaves the details to a subsequent convention.[85] Importantly, the Treaty makes states the primary bearers of liability, even for private actors, ensuring that liability remains a matter of inter-state relations.[86]

B. The Liability Convention of 1972

The Liability Convention elaborates on Article VII of the OST. It distinguishes two categories of liability:

1. **Strict Liability for Surface Damage.** Article II provides that a launching state is absolutely liable for damage caused on the surface of the Earth or to aircraft in flight.[87] Strict liability eliminates the need to prove fault, reflecting the view that innocent victims of space activities should be fully compensated.
2. **Fault-Based Liability for Outer Space Damage.** Article III provides that when damage occurs elsewhere than on the surface of the Earth, liability arises only if the damage is due to the fault of the launching state or its persons.[88] This introduces a negligence standard, but the Convention provides no definition of fault.

The Convention further establishes joint liability among multiple launching states, provides

[79] See Brian Weeden, 2009 Iridium–Cosmos Collision Fact Sheet, Secure World Foundation (2009).
[80] Donald J. Kessler & Burton G. Cour-Palais, Collision Frequency of Artificial Satellites: The Creation of a Debris Belt, 83 J. Geophys. Res. 2637, 2638–39 (1978).
[81] Outer Space Treaty, supra note 1, arts. VI–VII.
[82] Bin Cheng, Studies in International Space Law 225–32 (1997)
[83] Fabio Tronchetti, Fundamental Principles of Space Law Revisited 64–72 (2019).
[84] Outer Space Treaty, supra note 1, art. VI.
[85] Id. art. VII
[86] Francis Lyall & Paul B. Larsen, Space Law: A Treatise 172–78 (2d ed. 2018).
[87] Convention on International Liability for Damage Caused by Space Objects (Liability Convention), Mar. 29, 1972, 961 U.N.T.S. 187, art. II.
[88] Id. art. III.

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mechanisms for claims through diplomatic channels, and outlines procedures for settlement, including the possibility of a Claims Commission.[89]

C. Limitations of the Current Framework

Despite its innovations, the Liability Convention suffers from several limitations. It does not define key terms such as "fault" or "damage."[90] Its claims procedure is inter-state only, preventing private victims from initiating claims directly.[91] Enforcement is weak, as the Convention relies on voluntary compliance rather than judicial authority. Most importantly, the strict/fault dichotomy creates gaps in coverage for the most common risks today: satellite collisions in orbit.[92]

III. Strict Liability Versus Fault-Based Liability

A. The Rationale for Strict Liability

Strict liability reflects the principle that those who engage in inherently dangerous activities should bear the risk of harm. In the space context, states recognized that space launches carried extraordinary risks for people and property on Earth.[93] Victims of falling debris cannot easily establish negligence, making strict liability the most equitable approach.[94]

B. The Case for Fault-Based Liability in Orbit

By contrast, orbital collisions involve complex causation. Delegates drafting the Liability Convention argued that requiring fault in orbit would prevent unfair burdens on launching states for accidents beyond their control.[95] For example, space debris from decades-old missions might strike a new satellite, raising questions about causation and foreseeability.[96]

C. The Ambiguity of "Fault"

The Convention, however, never defined "fault." Does fault require negligence measured against international standards of due care? Or does it depend on national regulatory frameworks? Without clarity, states interpret fault inconsistently.[97] The lack of transparency in satellite operations further complicates attribution. For example, determining whether a collision resulted from inadequate maneuvering, poor coordination, or unavoidable circumstances often requires data that states are unwilling to share.[98]

IV. State Practice and Incidents

A. The Cosmos 954 Incident

The Cosmos 954 incident in 1978 remains the only major claim under the Liability Convention. A Soviet satellite carrying a nuclear reactor re-entered over Canada, scattering radioactive debris. Canada filed a claim for damages under the strict liability provisions and eventually settled for CAD 3 million.[99] The case demonstrated the effectiveness of strict liability for Earth-based damage but did not test fault-based liability in orbit.

B. Orbital Collisions: Iridium–Cosmos 2009

The 2009 collision between the commercial Iridium 33 satellite and the defunct Russian Cosmos 2251 highlighted the ambiguities of fault-based liability. Both satellites were in orbit, and the collision created thousands of debris fragments.[100] Yet no claim was filed, reflecting both the difficulty of proving fault and the diplomatic reluctance to pursue litigation.

C. China's 2007 ASAT Test

China's 2007 anti-satellite test, which destroyed the Fengyun-1C satellite, created significant debris hazards. Although widely criticized, no formal claims were filed under the Liability Convention.[101] The case illustrates how

[89] Id. arts. V–X.
[90] Stephan Hobe, The Liability Convention: Time for Revision?, 34 J. Space L. 1, 9–12 (2008).
[91] Id. at 13.
[92] Fabio Tronchetti, The Regulation of Space Resource Exploitation: Between National and International Law, 66 Zeitschrift für Luft- und Weltraumrecht 321, 329–35 (2017).
[93] Hobe, supra note 13, at 3–4.
[94] Id.
[95] Bin Cheng, supra note 5, at 229–30.
[96] Id.
[97] Tronchetti, supra note 6, at 67–69
[98] Ram Jakhu & Joseph Pelton, Global Space Governance: An International Study 147–48 (2017).
[99] Govt. of Canada, Claim Against the Union of Soviet Socialist Republics for Damage Caused by "Cosmos 954" (1979).
[100] Weeden, supra note 2.
[101] U.S. Dep't of State, Remarks on Chinese Anti-Satellite Test (2007).

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geopolitical considerations often outweigh legal recourse, further weakening the liability framework.

V. Comparative Analogies

A. Aviation Law

In aviation, liability for mid-air collisions is generally fault-based, but international conventions such as the Warsaw and Montreal Conventions establish clear standards for carrier liability.[102] States have developed detailed rules of the air, making negligence determinations more straightforward.[103]

B. Maritime Collision Law

Maritime law distinguishes between fault-based liability for collisions and strict liability for pollution damage. The International Regulations for Preventing Collisions at Sea provide codified navigation rules, enabling clear attribution of fault.[104] Joint liability may apply when multiple vessels contribute to damage.[105]

C. Lessons for Space Law

Both aviation and maritime law demonstrate that liability regimes require detailed operational standards to make fault determinations workable. Without such standards, fault-based liability in space remains ambiguous. Moreover, the absence of compulsory dispute resolution mechanisms weakens enforcement compared to maritime law's established tribunals.[106]

VI. Toward a Hybrid Liability Regime

A. Clarifying Standards of Fault

International law should establish a clear standard of due care in orbital operations, perhaps through guidelines on collision avoidance, debris mitigation, and data-sharing. These could be developed by COPUOS or embedded in new treaties.[107]

B. Presumptive Joint Liability

For multi-party collisions, presumptive joint liability could ensure that victims are compensated even when causation is uncertain. Launching states could then apportion liability among themselves through arbitration.[108]

C. Compulsory Arbitration

To address enforcement weaknesses, claims should be subject to compulsory arbitration under the Permanent Court of Arbitration's Optional Rules for Space Activities. This would provide neutral adjudication and avoid the diplomatic hurdles of the current system.[109]

D. Balancing Strict and Fault-Based Liability

A hybrid system could apply strict liability not only to surface damage but also to collisions involving defunct satellites or debris, where no active operator can be blamed. Fault-based liability would apply to active satellites, but with clarified negligence standards. This balance would promote accountability while avoiding over-deterrence.[110]

VII. Addressing Counterarguments

A. Sovereignty and National Interests

Some states resist stricter liability rules, fearing disproportionate burdens on active spacefaring nations. Yet liability is essential for legitimacy; without accountability, non-spacefaring states may perceive exploitation as unjust.[111]

B. Investor Concerns

Private operators worry that expanded liability may discourage investment. However, as

[102] Convention for the Unification of Certain Rules Relating to International Carriage by Air (Warsaw Convention), Oct. 12, 1929, 137 L.N.T.S. 11.
[103] Convention for the Unification of Certain Rules for International Carriage by Air (Montreal Convention), May 28, 1999, 2242 U.N.T.S. 350.
[104] International Regulations for Preventing Collisions at Sea, Oct. 20, 1972, 1050 U.N.T.S. 16.
[105] Id. rules 17–20.
[106] Alan Boyle, Dispute Settlement and the Law of the Sea Convention: Problems of Fragmentation and Jurisdiction, 46 Int'l & Comp. L.Q. 37, 41–44 (1997).
[107] U.N. Comm. on the Peaceful Uses of Outer Space, Guidelines for the Long-Term Sustainability of Outer Space Activities, U.N. Doc. A/74/20 (2019)
[108] Liability Convention, supra note 10, art. V.
[109] Permanent Ct. Arb., Optional Rules for Arbitration of Disputes Relating to Outer Space Activities (2011), https://pca-cpa.org/en/services/arbitration-services/space-activities/ (last visited Sept. 15, 2025).
[110] Stephan Hobe, A Modern Liability Regime for Space, 61 Proc. Int'l Inst. Space L. 93, 98–100 (2019).
[111] Id.

terrestrial industries show, clear liability rules reduce uncertainty and facilitate insurance markets.[112] Ambiguity is more damaging than predictable responsibility.

C. Enforcement Practicalities

Skeptics argue that enforcement in space is impractical. Yet compulsory arbitration, transparency obligations, and insurance mechanisms can make enforcement workable.[113] International cooperation in aviation and maritime contexts shows that complex liability regimes can be enforced effectively.

VIII. Conclusion

The dual liability system of the Liability Convention reflected the realities of the 1970s, but it is increasingly inadequate for today's space environment. Strict liability for surface damage remains sound, but fault-based liability in orbit has proven unworkable in practice. The absence of clear standards, enforcement mechanisms, and remedies for private actors undermines both deterrence and compensation.

This article has argued for a hybrid liability regime: clearer negligence standards, presumptive joint liability, and compulsory arbitration. Such reforms would align liability law with the risks of modern space activity, enhance accountability, and provide legal certainty for both states and private operators. By clarifying the ambiguity between strict and fault-based liability, international law can ensure that outer space remains a safe and sustainable domain for all humankind.[114]

[112] Henry R. Hertzfeld & Frans G. von der Dunk, Bringing Space L. into the Commercial World: Property Rights Without Sovereignty, 6 Chi. J. Int'l L. 81, 92 (2005).
[113] Tronchetti, supra note 15, at 332–33.
[114] Lyall & Larsen, supra note 9, at 182–83