BSAMUN 2024

Office for Outer Space Affairs

Minimising Excessive Waste and Debris in Outer Space

President Chair: Mathilde Billiet
Deputy Chair: Debora Lazarev

Introduction

The rapid expansion of human activity in outer space has led to a concerning consequence, the accumulation of space debris. This debris, consisting of defunct satellites, previously sent rocket stages and other remains of space missions, poses significant risks to ongoing and future space activities.

Space debris threatens the sustainability of space activities by increasing collision risks for operational spacecrafts and potentially rendering certain orbital regions unusable. The exponential growth of debris increases these risks, necessitating comprehensive solutions surrounding technological innovations, regulating frameworks, international cooperation, and public awareness.

Key Terms

Space Debris: Refers to defunct human-made objects in space, including fragments from spacecraft, discarded rocket stages, and debris from collisions.

Orbital Debris: Objects orbiting the Earth that no longer serve any useful purpose.

Satellite Collisions: Instances where operational satellites or spacecraft collide with space debris, potentially creating more debris and posing a risk to other space assets.

Spacecraft Disposal: Procedures for safely disposing of satellites and spacecraft at the end of their operational life to prevent them from becoming space debris.

Space Sustainability: The concept of maintaining the usability of space for current and future generations by mitigating the creation of space debris and ensuring responsible space activities.

Space Debris Removal: Techniques and missions designed to remove space debris from orbit to reduce the risk of collisions.

Space Debris Tracking: Monitoring the location and trajectory of space debris to predict potential collisions and protect operational satellites.

Orbital Debris Mitigation Strategies: Mitigation measures can take the form of curtailing or preventing the creation of new debris, designing satellites to withstand impacts by small debris, and implementing operational procedures such as using orbital regimes with less debris, adopting specific spacecraft attitudes, and even manoeuvring to avoid collisions with debris.

International Space Law: The body of law governing space-related activities. Space law, much like general international law, comprises a variety of international agreements, treaties, conventions, and United Nations General Assembly resolutions as well as rules and regulations of international organisations.

Space Debris Mitigation Technologies: Solutions and technologies designed to address the challenges of space debris.

General Overview

The exploration and utilisation of outer space have propelled humanity into a new era of scientific, and technological innovation, and global connectivity. Satellites orbiting Earth facilitate communication, navigation, weather forecasting and scientific research, amounting to countless other applications that have become indispensable to modern life. However, this progress has come with many consequences, including the accumulation of space debris. Space debris, consisting of defunct satellites, sent rocket stages, and fragments from collisions, poses significant risks to ongoing and future space activities.

The increase in space debris presents a complex and multifaceted challenge that requires urgent attention and collaboration on a global scale. Without intervention, the growth of debris threatens the sustainability of space activities by increasing collision risks for operational spacecrafts and potentially rendering certain orbital regions unusable. Collisions between debris objects and operational satellites jeopardise critical space infrastructure and generate more debris in a cascading effect.

Efforts to address the problem of space debris encompass a wide range of strategies and solutions, each requiring care consideration and coordination among delegates. Technological innovation plays a crucial role in developing debris removal technologies capable of capturing and deorbiting large debris objects from orbit. Robotic arms,

harpoons, nets, and tethers are among the tools being explored to address this challenge, with missions targeting high-risk debris objects identified as potential collision hazards.

Enhancing space surveillance capabilities is equally important in tracking and monitoring the wide range of debris objects orbiting Earth. By improving tracking systems through the deployment of additional ground-based radars, space-based sensors, and telescopes, the accuracy and coverage of debris tracking can be significantly improved. This increased awareness of debris trajectories will enable better space traffic management, including the development of automated collision avoidance systems and standardisation of orbital trajectories to minimise collision risks.

Furthermore, regulator frameworks and international cooperation are essential components of efforts to mitigate space debris. Establishing common standards and best practices for space debris mitigation, removal, and end-of-life disposal is crucial for fostering cooperation among spacefaring nations and ensuring compliance with responsible space behaviour. Organisations such as the United Nations Office for Outer Space Affairs (UNOOSA) and the Inter-Agency Space Debris Coordination Committee (IADC) play key roles in coordinating international and developing guidelines for space debris management.

In summary, addressing the problem of space debris requires a comprehensive and coordinated approach encompassing technological innovations, international cooperation, and public awareness initiatives. By working together, the international community can develop effective solutions to minimise excessive waste and debris in outer space.

Major Parties/Countries Involved

USA: The United States has played a significant role in the accumulation of space debris through its extensive satellite launches and space missions. NASA, the country's space agency, has been actively involved in research on space debris mitigation and removal technologies. The United States has also contributed to international efforts to develop guidelines and standards for space debris management through organisations such as the United Nations Office for Outer Space Affairs.

Russia: With a long history of space exploration dating back to the Soviet era, Russia has launched numerous satellites and spacecraft into orbit, contributing to the problem of space debris. Roscosmos, the Russian space agency, has been involved in efforts to monitor and track space debris, as well as develop technologies for debris removal. Russia also participates in international initiatives aimed at addressing the challenges posed by space debris.

China: China has rapidly emerged as a major party in space exploration, with ambitious plans for lunar exploration, Mars missions, and a space station. The country's space agency, the China National Space Administration (CNSA), has conducted numerous satellite launches and space missions, adding to the space debris population. China has been investing in technologies for space debris mitigation and removal and participating in international discussions on space sustainability.

European Union member states: European countries, collectively represented by the European Space Agency (ESA), have been actively involved in space exploration and satellite launches. ESA researches space debris and develops technologies for debris mitigation and removal. European countries also collaborate on initiatives aimed at promoting space sustainability and responsible space practices.

India: India has made significant strides in space exploration, with achievements such as the Chandrayaan and Mars Orbiter missions. The Indian Space Research Organisation (ISRO) has launched many satellites into orbit, contributing to the problem of space debris. ISRO is engaged in research on space debris mitigation and removal technologies and collaborates with other countries and organisations on space sustainability initiatives.

Japan: Japan has a strong space program led by the Japanese Aerospace Exploration Agency (JAXA), which has conducted missions to the Moon, asteroids and beyond. Japan has launched numerous satellites into orbit, and JAXA is actively involved in research on space debris mitigation and removal technologies. Japan also participates in international efforts to address space debris through collaboration with other countries and organisations.

Brazil: Brazil has been expanding its presence in space initiatives such as the Brazilian Space Agency (AEB) and satellite capabilities. While Brazil's space program is still developing, the country is becoming increasingly aware of the importance of space sustainability. It may contribute to international efforts to address space debris in the future.

South Korea: South Korea has been investing in space exploration and satellite technology, with the Korea Aerospace Research Institute (KARI) leading the country's space program. South Korea has launched satellites into orbit and is engaged in research on space debris mitigation and removal technologies. The country may become more involved in international efforts to address space debris as its space capabilities continue to grow.

Iran: Iran has been developing its space program, conducting satellite launches and advancing its space technology capabilities. While Iran's space program is still in its early stages, the country may become a player in discussions on space sustainability and debris mitigation in the future.

United Arab Emirates: The United Arab Emirates (UAE) has been making significant investments in space exploration and satellite technology, with initiatives such as the UAE Space Agency and the Emirates Mars Mission. The UAE has launched satellites into orbit and is involved in research on space debris mitigation and removal technologies. As the UAE's space program continues to develop, the country may continue international efforts to address space debris.

Timeline of Key Events

1957: Launch of Sputnik 1 by the Soviet Union marks the beginning of the space age and the start of human-made objects entering Earth's orbit.

1978: NASA scientist Donald J. Kessler publishes a seminal paper predicting the possibility of a cascading collision chain reaction in Earth's orbit, now known as the Kessler syndrome.

1983: NASA's Orbital Debris Program Office is established to address the growing concern of space debris and its potential risks to spacecraft.

1993: The Inter-Agency Space Debris Coordination Committee (IADC) is formed to coordinate international efforts and monitoring and mitigating space debris.

2007: China conducts an anti-satellite missile test, resulting in the destruction of one of its weather satellites and generating thousands of fragments of space debris.

2009: The collision between the operational Iridium 33 satellite and the defunct Russian satellite Cosmos 2251 further highlights the risk posed by space debris to operational spacecraft.

2011: The United States issues its National Space Policy, emphasising the importance of space sustainability and responsible space behaviour, including the mitigation of space debris.

2019: The European Space Agency (ESA) successfully launches its ClearSpace-1, aiming to demonstrate the feasibility of capturing and removing space debris from orbit.

2020: SpaceX launched the first batch of its Starlink satellites, part of a mega-constellation intended to provide global internet coverage. Concerns are raised about the potential impact of such mega-constellations on space debris levels.

2021: The United Nations General Assembly adopts guidelines for the long-term sustainability of outer space activities, including recommendations for the mitigation of space debris.

2023: The first International Space Debris Conference is held, bringing together experts from around the world to discuss challenges and solutions related to space debris mitigation and management.

2024: The International Astronautical Federation (IAF) establishes a working group dedicated to developing international standards and best practices for space debris mitigation in their committee brief winter 2024.

UN Involvement & Relevant Resolutions

The United Nations plays an important role in addressing the issue of minimising excessive waste and debris in outer space through various initiatives and relevant resolutions. Here are some key aspects of UN involvement to try and solve this issue.

The United Nations Office for Outer Space Affairs (UNOOSA) has developed guidelines on space debris mitigation. These guidelines offer recommendations for spacecraft design, end-of-life disposal, and other measures to minimise the creation of debris. UNOOSA works closely with member states and international organisations to promote these guidelines and facilitate cooperation in space debris mitigation efforts.

The UN Committee on the Peaceful Uses of Outer Space (COPUOS) is a UN body that is dedicated to addressing matters related to outer space. Established in 1959, COPUOS facilitates international cooperation in the peaceful exploration of outer space. It regularly discusses issues such as space debris mitigation and space sustainability, providing a platform for member states to collaborate and share information on best practices.

The UN General Assembly makes resolutions that address concerns related to outer space activities including space debris. These resolutions often emphasise the importance of space sustainability and the need for international cooperation in mitigating the risks associated with space debris. They make principles of peaceful uses of outer space and call for collective action to ensure long-term activities in outer space.

The International Interagency Space Debris Coordination Committee (IADC) is an international cooperation for coordination activities related to space debris. It includes space agencies from around the world and collaborates on research, data sharing, and best practices for space debris mitigation. The IADC complements UN efforts by providing a platform for technical collaboration and coordination amongst spacefaring nations.

Overall, UN involvement in addressing the challenges of minimising space debris in outer space is a topic that needs involvement from many member states, resolutions, guidelines, and collaborative initiatives aimed at promoting space sustainability and responsible space behaviour on a global scale.

Previous Attempts to Solve this Issue

There have been many previous attempts to solve the issue of space debris, using various strategies and technologies. Here are some examples.

Space debris removal demonstrations have been conducted by several space agencies and organisations. For example, the European Space Agency's (ESA) e.Deorbit mission aimed to capture and deorbit a defunct satellite using a robotic arm. Similarly, Japan's space agency, JAXA, conducted a demonstration of a magnetic tether system to deorbit space debris.

Graveyard orbits have been proposed as a way to manage space debris. This approach involved moving defunct satellites and previous rocket stages to a "graveyard", where they pose minimal collision risks to operational spacecraft. Some satellite operators have adopted this practice as a part of their end-of-life disposal procedures.

Efforts have been made to improve space traffic management systems to reduce the risk of collisions between operation spacecraft debris. This included developing automated collision avoidance systems and establishing standard procedures for manoeuvring spacecraft to avoid potential collisions.

International guidelines and standards have been developed by organisations such as the Inter-Agency Space Debris Coordination Committee (IADC) and the United Nations of Outer Space Affairs (UNOOSA). These guidelines include recommendations for spacecraft design, end-of-life disposal, and collision avoidance procedures.

While these attempts represent significant progress in addressing the challenge of space debris, the problem still remains a complex issue. Continued efforts are needed to develop new technologies, enhance international cooperation and promote responsible space behaviour to ensure the long-term sustainability of outer space.

Possible Solutions:

To address the challenges of space debris effectively, a multifaceted approach is necessary. Firstly, advancements in debris removal technologies are crucial. Research and development efforts should focus on creating innovative solutions such as robotic arms, harpoons, nets and tethers capable of capturing and deorbiting large debris objects. Additionally, active debris removal missions should be launched specifically to target and remove high-risk debris objects from congested orbits, reducing the likelihood of collisions with operational spacecrafts.

Enhancing space surveillance is equally important. By improving tracking and monitoring systems through the development of additional ground-based radars, space-based sensors, and optical telescopes, the accuracy and coverage of debris tracking can be significantly enhanced. This heightened awareness of debris trajectories will enable better space traffic management, including the development of automated collision avoidance systems and the standardisation of orbital trajectories to minimise collision risks.

Another critical aspect of mitigating debris is designing spacecraft with built-it features to minimise debris. This includes implementing measures such as deployable shields for impact protection, propulsion systems for controlled deorbiting, and passivation measures to disable spacecraft systems after retirement. Moreover, enforcing end-of-life disposal requirements for spacecraft operators is essential. Regulations mandating the deorbiting of satellites or their placement into graveyard orbits upon retirement, coupled with financial incentives or penalties, can ensure compliance and reduce the accumulation of debris.

International collaboration and the establishment of common standards are vital for effective space debris mitigation. Spacefaring nations, space agencies, and international organisations must work together to develop and implement regulations, share data and resources, and coordinate efforts to address the global challenges of space debris. Education and awareness initiatives are also essential to promote understanding of the importance of space debris mitigation among stakeholders and the general public, as well as foster a culture of responsible space practices.

Furthermore, continued investment in research and innovation is crucial to drive progress in space debris mitigation. This included developing advanced materials for spacecraft shielding, innovative propulsion systems for debris removal, and novel concepts for active debris removal missions. Finally, establishing a robust policy and governance framework at the international level is essential. This involves strengthening legal regimes for liability, approving regulations for space activities, and establishing mechanisms for resolving disputes related to space debris mitigation. Through these measures, the global community can work towards minimising the excessive waste and debris in outer space and ensuring the sustainability of space activities.

Bibliography

- AeroSpace. “A Brief History of Space Debris | the Aerospace Corporation.” Aerospace Corporation, 2 Nov. 2022,aerospace.org/article/brief-history-space-debris.
- Wikipedia Contributors. “Space Debris.” Wikipedia, Wikimedia Foundation, 2 June 2019, en.wikipedia.org/wiki/Space_debris .
- “ARES | Orbital Debris Program Office | Debris Mitigation.” Orbitaldebris.jsc.nasa.gov,orbital debris.jsc.nasa.gov/mitigation/#:~:text=Mitigation%20measures%20can%20take%20the.
- UNOOSA. “Space Law.” Unoosa.org, 2019, www.unoosa.org/oosa/en/ourwork/spacelaw/index.html.
- “KOREA AEROSPACE RESERACH INSTITUTE.” Www.kari.re.kr, www.kari.re.kr/eng.do.
- Federation, International Astronautical. “IAF : Brazilian Space Agency (AEB).” Www.iafastro.org, www.iafastro.org/membership/all-members/brazilian-space-agency-aeb.html.
- Wikipedia Contributors. “List of Government Space Agencies.” Wikipedia, Wikimedia Foundation, 20 Nov. 2019, en.wikipedia.org/wiki/List_of_government_space_agencies.
- NASA. “National Aeronautics and Space Administration.” NASA, NASA, 17 Feb. 2021, www.nasa.gov/.
- https://www.iafastro.org/assets/files/publications/committeebrief/2024/Space%20Security_Winter%202024-Brief_2024-01-31_FINAL%20online.pdf
- Iyer, Vijay. “How Do You Clean up 170 Million Pieces of Space Junk?” Federation of American Scientists, 24 May 2023, fas.org/publication/how-do-you-clean-up-170-million-pieces-of-space-junk/.

- NASA Seeks Solutions to Detect, Track, Clean up Small Space Debris - NASA. 25 Sept. 2023, www.nasa.gov/directorates/stmd/stmd-prizes-challenges-crowdsourcing-program/center-of-excellence-for-collaborative-innovation-coeci/coeci-news/nasa-seeks-solutions-to-detect-track-clean-up-small-space-debris/.
- “Space Surveillance and Tracking - SST Segment.” Www.esa.int, www.esa.int/Space_Safety/Space_Surveillance_and_Tracking_-_SST_Segment.
- ---. “Satellite Built as Low-Cost Way to Reduce Space Junk Reenters Atmosphere Years Early.” Phys.org, phys.org/news/2023-08-satellite-built-low-cost-space-junk.html.
- “Space Debris Mitigation Standards Compendium - Update.” Www.unoosa.org, www.unoosa.org/oosa/en/ourwork/topics/space-debris/compendium.html.
- “Following Collision of Satellites, UN Space Office Calls for Preventive Steps | UN News.” News.un.org, 13 Feb. 2009, news.un.org/en/story/2009/02/291242. Accessed 5 Mar. 2024.
- “Following Collision of Satellites, UN Space Office Calls for Preventive Steps | UN News.” News.un.org, 13 Feb. 2009, news.un.org/en/story/2009/02/291242. Accessed 5 Mar. 2024.
- “ESA’s E.Deorbit Debris Removal Mission Reborn as Servicing Vehicle.” Www.esa.int, www.esa.int/Space_Safety/Clean_Space/ESA_s_e.Deorbit_debris_removal_mission_reborn_as_servicing_vehicle.
- “Mitigation Scenarios: Graveyard Orbit 300 Km above GEO.” Www.esa.int, www.esa.int/ESA_Multimedia/Images/2008/03/Mitigation_scenarios_Graveyard_orbit_300_km_above_GEO.
- “Space Traffic Management - European Commission.” Defence-Industry-Space.ec.europa.eu, defence-industry-space.ec.europa.eu/eu-space-policy/space-traffic-management_en.