# Resolving Dangers of Space Debris

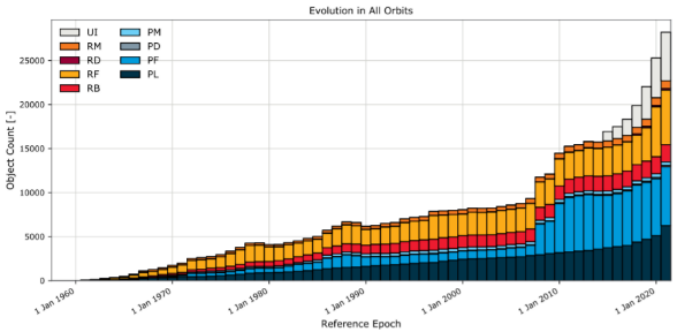
**Forum**: Disarmament Commission
**Student Officer:** Shawn Kim, Deputy Chair

## Introduction

The National Aeronautics and Space Administration (NASA) defines space debris as "human made space objects that are not used anymore." Most orbital space debris comprises derelict satellites, parts of space craft, flecks of paint, and natural meteoroids. These debris enter the low Earth orbit (LEO) and join the millions of space junk orbiting in the LEO. The micrometeoroids and orbital debris (MMOD) may cause detrimental damage by colliding with space crafts or entering the Earth's atmosphere. Experts have tried to avoid MMODs by using implements such as the U.S. Space Surveillance Network that can track and catalogue approximately 20,000 large space debris objects. However, the undetected population of MMOD still imposes serious risk for space travelling.



## Background




*Evolution of Space Objects in Orbit*

From the launching of the first satellite in 1957 to the first human space travel in 1961, human expansion to space began in 1957. In 1959, the General Assembly established the Committee on the Peaceful Uses of Outer Space (COPUOS) in order to "govern the exploration and use of space for the benefit of all humanity." Ever since the beginning of the space age, activities in the space environment has increased exponentially with approximately 12450 satellites placed into Earth orbit, over 25000 identified objects in Earth orbit, and more than 630 collisions. These space debris originate from various different sources.

For example, on February 10, 2009, a Russian spacecraft collided and destroyed an American satellite, which added more than 2,300 pieces of trackable debris and many more smaller debris into space. Indeed, these debris cause numerous collisions and near misses. For example, in 1981, the Soviet Kosmos 1275 satellite disintegrated after a month of launch. This is one of many examples of collisions caused by orbital debris.

Perhaps the most detrimental aspect of these collisions is the Kessler Syndrome. Kessler Syndrome is when the abundance of space debris creates collisions between the space debris, creating even more debris. The Kessler Syndrome has caused a sudden exponential growth of space debris. The space debris created by the Kessler Syndrome are small but lethal. This can make space

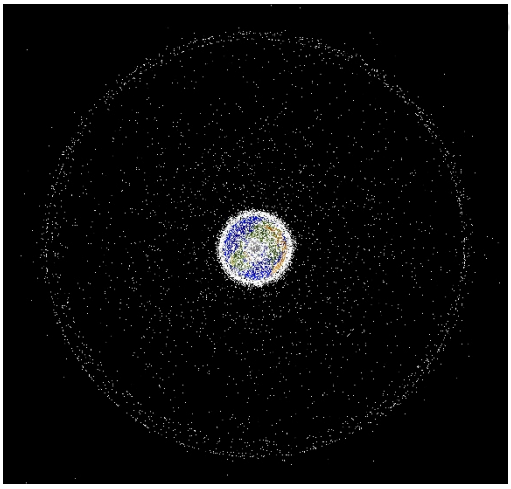
travelling almost impossible soon. Fortunately, Kessler Syndrome is still in the early stages. Nevertheless, when the orbital amount passes a certain critical value, the Kessler Syndrome will continue in a rapid pace. Although there has not been a grave case of space debris collision that has caused death, with the increasing numbers of MMOD, it is only a matter of time until a catastrophic event occurs.

Therefore, a collective legislation must be enacted to ensure safe space exploration. The COPUOS and Space Liability Convention only distributes liability to any damage caused by space debris but does not address the issue of resolving the dangers of space debris. It is crucial that there is an international law created to reduce space debris and the risk of travelling within the LEO.

Without immediate measures to clean up the LEO, space debris will only grow in numbers. Soon, setting up satellites and space travelling will be difficult. Without satellites, the daily conveniences such as GPS, internet, and TV networks will be unavailable, possibly leading to a global panic.

## International Actions

According to statistics from NASA, there are close to 6000 tons of materials in the LEO. Although many space organizations acknowledge that removing debris from the LEO is an urgent matter, there are no international laws that obligate the clean-up of debris in the LEO. Currently, space laws only include COPUOS and the Space Liability Convention, which only addresses the peaceful use of space and the legal issues with liability when damage is caused by space debris, respectively. It has been difficult to create an international law to clean and prevent space debris because of the high cost and risk involved. Space debris can reach speeds of 18,000 miles per hour, approximately 7 times faster than a bullet. Cleaning space debris comes with the risk of dealing with such dangerously travelling objects. Additionally, removing unused satellites and space debris comes with extremely high costs due to the need for design measures, surveillance and tracking, moving satellites, and launching missions. This makes space organizations hesitant of taking on such duties. However, these risks and costs are only in the short-term. If countries continue to neglect the dangers of space debris, in the long-term, space might become inaccessible.



*Objects in LEO and in the geosynchronous region.*

Fortunately, some efforts were made such as the NASA Procedural Requirements for Limiting Orbital Debris and Evaluating the Meteoroid and Orbital Debris Environments, which gives specific procedures for space travelling entities to follow to minimize space debris. Additionally, space travel organizations such as NASA and ESA have developed technologies to avoid collisions with the space debris when space travelling. However, these technologies are only able to detect large debris and fails to detect the millions of small debris that can still cause damage.

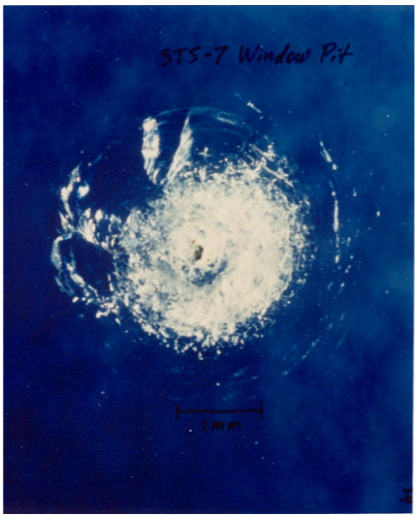
## Possible Solutions

1. Improve of Space Debris Radars:
    a. As a mean to avoid damage caused by orbital debris, space organizations spend majority of their time calculating the perfect route to avoid all space debris. In order to know where the space debris are, space organizations use space debris radars to detect orbiting space debris. Currently, these radars have been able to detect almost 20,000 space debris. However, these radars are not perfect and fails to detect millions of MMODs. For example, the U.S. Space Surveillance Network has a detection range threshold of 5 to 10 cm. Objects smaller than 5 cm may seem negligible but micro debris can still cause massive destructions because of its high travelling speed. According to COPUOS Fifty Sixth session, micro debris (less than 1 mm in diameter) "can inflict critical damage on satellites because its impact velocity is 10 km/s on average." Although there is a radar developed by NASA that is capable of detecting objects as small as 2 mm, the radar, 70-m Goldstone, is only able to detect objects at altitudes below 1000 km, which does not reach all of LEO. Therefore, the enactment of a collective agreement to incentive and support the development of radar technology is a possible solution to resolve the dangers of space debris when space travelling because it would reduce the risk of space travelling.


70-m Goldstone antenna located near Barstow, CA.

2. Encouragement of Active Debris Removal
    a. According to the European Space Agency (ESA), studies performed by the DELTA model have shown that the number of orbital debris will increase progressively and uncontrollably if the current rate of space debris in the LEO is continued. Since the dependency on satellites for uses such as internet and space technology is projected to increase, limiting launch rate is infeasible and unhelpful. The most efficient method to decrease the rate of formation of space debris is to encourage Active Debris Removal (ADR). Actively supported by the ESA and NASA, ADR removes carefully selected space orbital debris in a strategically selected region. ESA has been most involved with the ADR, planning eDeorbit, the first orbital removal mission. ESA's planned eDeorbit mission may be the first ADR mission but should not be the last. More involvement in ADR from countries and organizations will ensure a better quality of space travelling for all space travelling nations.
3. Development of Debris Removal Methods
    a. Evidently, ADR requires the development of methods to remove the debris. There are numerous proposed theories of removing orbital debris, such as using an electrodynamic tether, sling shot, and solar ail, but still none have been practiced thus

far. Considering that space usage will only increase and debris removal will only become more necessary, it is crucial to encourage space traversing nations to continue to develop methods to remove space debris. If a nation or organization develops a practical and feasible method to remove space debris, it is important that the nation share the research to clean the LEO together. To achieve this, there must be a legislation in order to incentivize research and the sharing of information.




Damage caused by 0.2 mm paint chip on a space shuttle's window

## Glossary

*Space Debris/Orbital Debris:* Space debris, or orbital debris, refers to any human made object in space. In the discussion of Resolving Dangers of Space Debris, space debris, or orbital debris, specifically refers to debris that orbits the Earth, especially the LEO.

*National Aeronautics and Space Administration (NASA):* Established in October 1, 1958, NASA, funded by the American government, is in charge of U.S. science and technology that involves space and airplanes.



*European Space Agency (ESA):* Established in 1975, ESA is an organization with 22 member states that coordinates financial and intellectual resources for the development of Europe's space capability.

*Low Earth Orbit (LEO):* LEO is the lowest Earth-centered orbital region encompassing an altitude of 2,000 km or less. It is also the region with the most space debris, being labelled as the "space junkyard."

*Committee on the Peaceful Uses of Outer Space (COPUOS):* The COPUOS was established in 1959 by the general assembly of the United Nations. The COPUOS aims to regulate space exploration to benefit all humanity for peace, security, and development.

*Kessler Syndrome:* The Kessler Syndrome refers to the idea of exponentially increasing space debris due to the collision between the space debris. This term was developed by John Gabbard in 1978.

## Timeline

*1957* – Russia launches the first space satellite called Sputnik 1.
*1959* – The General Assembly establishes COPUOS.

*1981* – Cosmos 1275 is destroyed due to collision with space debris.
*1991* – A shuttle barely avoids a fragment of Cosmos 955.
*1996* – CERISE (Fr.) is damaged by Ariane upper stage fragment.
*2006* – Express-AM11 (Rus.) is disabled due to collision with space debris.
*2009* – Massive collision between Iridium-33 and Cosmos 2251 occurs adding 2,300 detectable fragments and millions of small fragments into space.
*2009* – ISS nearly gets hit by fragments from Cosmos 1275.
*2012* – ISS nearly avoids fragment of Iridium-33.

## Sources

"Active Debris Removal." *ESA*, ESA, https://www.esa.int/Safety_Security/Space_Debris/Active_debris_removal.

"Committee on the Peaceful Uses of Outer Space." *United Nations Office for Outer Space Affairs*, UN, 1959, https://www.unoosa.org/oosa/en/ourwork/copuos/index.html.

Dodson, Brian. "Space Debris: Where Does It Come from, and What Can We Do about It?" *New Atlas*, New Atlas, 12 Nov. 2012, https://newatlas.com/space-debris-kessler-syndrome-nasa-debrisat/24911/.

Elburn, Darcy. "Low Earth Orbit Economy." *NASA*, NASA, 20 Nov. 2021, https://www.nasa.gov/leo-economy/faqs/.

"Environment Report." *Space Environment Statistics*, ESA, 5 Jan. 2022, https://sdup.esoc.esa.int/discosweb/statistics/.

Garcia, Mark. "Space Debris and Human Spacecraft." *NASA*, NASA, 27 May 2021, https://www.nasa.gov/mission_pages/station/news/orbital_debris.html.

Hoffpauir, Daniel. "Space Debris: Understanding the Risks to NASA Spacecraft." *NASA*, NASA, 11 July 2016, https://www.nasa.gov/offices/nesc/articles/space-debris/.

Keeter, Bill. "Space Debris." *NASA*, NASA, 2 July 2019, https://www.nasa.gov/centers/hq/library/find/bibliographies/space_debris.

Kessler, Donald J. *The Kessler Syndrome*. University of Western Ontario , 8 Mar. 2009, https://aquarid.physics.uwo.ca/kessler/KesSym.html.

"Orbital Debris Program Office." *Astromaterials Research & Exploration Science* , NASA, https://orbitaldebris.jsc.nasa.gov/photo-gallery/.

UN. "About the Office of Commercial Space Transportation." *About the Office of Commercial Space Transportation | Federal Aviation Administration*, UN, https://www.faa.gov/about/office_org/headquarters_offices/ast.