Research Report

Environmental Commission

International efforts to eradicate space debris and minimize future space debris

MUNISH

Forum	Environmental Committee
Issue:	International efforts to eradicate space debris and minimize future space debris
Student Officer:	Naomi Scheithe
Position:	Deputy President

Introduction

On 10 February 2009, the satellites Iridium 33 and Kosmos-2251 collided above Siberia. Kosmos-2251 was no longer operational at the time and not controlled. The collision destroyed both spacecrafts and led to a large amount of space debris, with parts of the satellites now floating through space without use. This was the first high speed collision and it had a great impact on space debris. To date, there have been eight high-speed collisions in total, although this one was the largest.

Space debris is a growing issue in regard to space activity. Although space debris does not affect us on earth directly, it has effects on all space activity which is very important to our society. Space debris, sometimes referred to as space junk is basically any kind of manmade material, which is not of any use anymore and which now just floats in outer space. Space debris hinders space activities, as larger pieces of space debris can lead to collision and smaller particles erode active spacecrafts.

Definition of Key Terms

Space debris

Space debris are all manmade objects including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non-functional. (From: http://www.scholarpedia.org/article/Space_debris)

Geosynchronous orbit (GEO)

A circular orbit positioned approximately 35,900 km (22,258 mi) above Earth's equator and having a period of the same duration and direction as the rotation of the Earth.

An object in this orbit will appear stationary relative to the rotating Earth. Communication and weather satellites are usually placed in a geostationary orbit. (From: http://www.thefreedictionary.com/geostationary+orbit)

Low earth orbit (LEO)

Low earth orbit is defined as an orbit within a locus extending from the earth's surface up to an altitude of 1,200 miles. (From: http://www.techopedia.com/definition/8044/low-earth-orbit-leo)

Kessler syndrome

The Kessler Syndrome is a scenario, proposed by The National Aeronautics and Space Administration (NASA) consultant Donald J. Kessler, in which the volume of space debris in Low Earth Orbit is so high that objects in orbit are struck by debris, creating even more space debris and a greater risk of further impacts. The implication of this scenario is that the escalating amount of debris in orbit could eventually render space exploration, and even the use of satellites, too prone to loss to be feasible for many generations. (From: http://www.seadict.com/en/en/kessler%20syndrome)

Booster

A rocket motor, either solid-or liquid-fuelled, that assists the normal propulsive system or sustained engine of a rocket or aeronautical vehicle in some phase of its flight. A rocket used to set a vehicle in motion before another engine takes over. (From: http://www.answers.com/topic/booster-rocket-1)

Mitigation

Mitigation is the elimination or reduction of the frequency, magnitude or severity of exposure to risks. It could also be defined as the minimization of the potential impact of a threat or warning. (From: http://www.businessdictionary.com/definition/mitigation.html)

General Overview

The Importance of Outer Space

There are many reasons as to why outer space is very important for our society. There are many fields that rely on work in outer space or function in outer space such as space science, earth observation, meteorology, climate research, telecommunication and

navigation. Especially telecommunication, navigation and climate research are vital to our everyday life. All of these activities can only continue if the issue of space debris is solved. It is therefore crucial to eradicate space debris and minimize future space debris.

Explaining Space Debris

Space debris exists in many different sizes. Starting from particles as small as a grain of dust to a dead spacecraft, every size is possible. Most space debris is smaller than 1cm. This space debris does cause erosive damage creating yet more space debris. Space debris which is wider than 10cm across is considered large and can be detected and tracked. In order to avoid danger from these pieces of space debris, it is vital to manoeuvre the spacecraft in question around the space debris. However, if there is too much space debris, it is hard to manoeuvre around a piece without colliding with another piece of debris.

The Kessler syndrome is an important factor when considering the issue of space debris. One refers to the Kessler syndrome when the creation of new space debris happens faster than it is naturally removed. This means that more space debris is created than can decay because of natural forces leading to a total increase of space debris. The result of this is a chain reaction causing even more space debris. It should therefore be the goal to prevent a Kessler syndrome from occurring.

Space debris naturally decays. Debris does however decay at different speeds. In lower zones of space, air drag makes them decay faster. In higher altitudes however it can take decades or even centuries until space debris decays. A possible way of eliminating space debris is therefore directing it to lower orbits.

Sources of Space Debris

There are many factors which lead to space debris. The most important sources are dead space craft, explosions, collisions, boosters, natural erosion and lost equipment. These sources lead to space debris in different sizes. When trying to minimise future space debris, these sources must be kept in mind.

A space craft which is not in use anymore is called a dead spacecraft. Within the last fifty years a total of 6600 satellites were sent off to space. 3600 of these still are in space and only about 1000 are still actively in use. This leaves about 2600 satellites which are considered space debris. They have no function anymore and can no longer be navigated. Some of them are programmed to remove themselves to a graveyard orbit at the end of their lives. This is now an international requirement for new spacecrafts. There is however limited room in these graveyards.

Explosions sometimes occur in space. The main cause of these explosions is due to residual fuel that remains in tanks and can leak to the outside. This can sometimes lead to an explosion. These explosions can destroy parts of spacecrafts leading to further space debris.

Another cause of space debris is collisions. When two spacecrafts, two pieces of space debris or a spacecraft and a large piece of space debris collide, this can lead to parts of the objects breaking off and becoming space debris. These pieces of space debris can again collide with spacecrafts creating even more space debris. So the more space debris there is the faster more space debris develops. This is a vicious circle.

In order to launch spacecrafts, boosters are required. They bring the spacecraft up into orbit until the spacecraft can fuel themselves. Once this point is reached, the booster is discarded. It now falls into the category of space debris.

Spaceships can stay active in space for approximately 25 years. During the course of this time, parts of it, such as paint, slowly erode. This means that tiny particles of space debris float around space. Although, at the moment, these are not very dangerous, if their numbers increase, they could become dangerous.

When manned missions are carried out in space, objects are lost. As far it is known, a glove, two cameras, 10 garbage bags, a wrench, a toothbrush, a pair of pliers and a briefcase-sized tool bag were lost in outer space. Lost items are obviously very hard to retrieve right away as they float away. These objects also count as space debris.

There are many different sources of space debris. Some are due to human failure such as explosions, lost objects and to some extent collisions. Some, such as dead spacecrafts and boosters are part of the way space transport works. They could however be avoided with new technology. Natural erosion is hard to prevent although different kinds of paint might be a solution. In order to minimise future space debris, these sources need to be minimised.

Dangers of Space Debris

Space debris can be very dangerous for all activities in outer space. Although it does not affect us on earth directly, we would indirectly be affected if space activities were reduced substantially or entirely shut down. The danger of space debris is collision. If there is too much space debris floating around, activities in space would have to end. This means that any kind of research in space, earth observation, climate research, telecommunication and navigation would have to end as well. This would have a tremendous impact on our society.

Dealing with Space Debris

There are already some ways of dealing with space debris. The International Telecommunication Union (ITU) has created a requirement, which states that all satellites must be able to remove themselves to a graveyard orbit. Although this does not decrease the amount of space debris in space, it means that the biggest pieces are all in one place reducing risk for collision. Sometimes satellites and other space craft are directed to lower orbits at the end of their lifespan. There, the air drag is stronger, making them decay faster. Furthermore alternatives to boosters are being researched. However no sufficient alternative has been found so far. In addition to that, remotely controlled vehicles are sent to meet space debris, capture it and bring it to a station. This however is not very effective regarding the fact that 19000 pieces of debris, larger than 5 cm are being tracked. There are several other technologies developed for dealing with space debris, these are however all not effective enough, which is why this still is a problematic issue.

Major Parties Involved and Their Views

European Space Agency (ESA)

The European Space Agency (ESA) is an intergovernmental, European organization which currently has 20 member states. ESA was established in 1975 and its headquarters are located in Paris, France. The organization is dedicated to space exploration and works closely with NASA. ESA has several active missions and continues to take part in space research to this day. As ESA works in outer space their wish is too keep it free from space debris as far as possible.

National Aeronautics and Space Administration (NASA)

The National Aeronautics and Space Administration (NASA) is an agency of the United States of America. The agency is responsible for American missions in outer space, and everything related to them. NASA was founded in 1958, which makes it one of the oldest organizations related to outer space. Its headquarters are situated in Washington, D.C. and has more than 18.000 employees. Just like ESA it is NASAs goal to keep outer space clean, so they can continue their missions.

International Telecommunication Union (ITU)

ITU is an UN agency focused on issues regarding information and communication technologies. ITU therefore also deals with satellite activities and has created guidelines for these. ITU was established in 1865 and its headquarters are in Geneva, Switzerland. It is a member of the United Nations Development group and works together with space agencies such as NASA and ESA. As it is part of ITUs assignments to coordinate satellites it is in their best interest to keep space debris to a minimum.

United Nations Committee on the Peaceful Uses of Outer Space (COPOUS)

COPOUS is an ad hoc committee of the UN. It was established in 1958 and its mission is to establish the peaceful use of outer space and encourage research in space. It has two subcommittees: The Scientific and Technical Subcommittee and the Legal Subcommittee. It makes sure of the implementation of five UN treaties and agreements in regard to outer space.

Inter-Agency Space Debris Coordination Committee (IADC)

IADC is an intergovernmental organization, which coordinates measures to solving the issue of space debris. It has twelve members, all of which are space agencies and was founded in 1993. These space agencies include NASA and ESA. It is IADCs goal to eliminate the problem of space debris in a structured way working together with all space agencies, which are members.

Timeline of Events

Throughout the last fifty years of space activity, there have been several collisions, explosions and other incidents leading to a great amount of space debris being created. I have therefore only listed the two most important and largest incidents.

Date	Description of event
1865	ITU established
1958	NASA founded
1958	COPOUS established
21 July 1969	Armstrong sets foot on the moon
1975	ESA founded
1993	IADC established

Jan, 2007	Chinese anti-satellite missile test
Feb, 2007	Russian booster explodes
2009	First accidental hypervelocity collision in space

UN involvement, Relevant Resolutions, Treaties and Events

There is no internationally ratified treaty regarding space debris yet. However in 2007 COPUOS published voluntary guidelines regarding this issue. The UN has however established COPUOS which also deals with space debris which is a step in the right direction. There is only the following resolution also concerning space debris.

- International cooperation in the peaceful use of outer space, 1 February 2008, **(RES/62/216)**

Evaluation of Previous Attempts to Resolve the Issue

There have been some efforts to solve the issue so far. Although all parties have the same views on the issue, no binding treaties have been created so far which is a weak point. The researches on technology regarding space debris removal are a great step towards solving this problem. There still is however need for concrete plans and treaties in order to ensure an efficient process.

Possible Solutions

There are many different ways of dealing with this issue. Firstly concrete treaties should be created and ratified in order for all parties to work closely together. Secondly it should be invested in further research, in order to create spacecrafts which emit debris and technologies for space debris removal. Another idea could be to make it companies and space agencies obligation to pay and organise removal of their dead spacecrafts. In general the roots of the problem should be eliminated in order to solve the issue itself.

Bibliography

"2009 Satellite Collision." *Wikipedia*. Wikimedia Foundation, 08 Feb. 2013. Web. 23 June 2013. <http://en.wikipedia.org/wiki/2009_satellite_collision>.

"COPUOS." *Wikipedia*. Wikimedia Foundation, 08 Apr. 2013. Web. 23 June 2013. <http://en.wikipedia.org/wiki/COPUOS>.

"ESA Space Debris Office / Space Debris / Operations / Our Activities / ESA." *European Space Agency*. N.p., n.d. Web. 23 June 2013. <http://www.esa.int/Our_Activities/Operations/Space_Debris/ESA_Space_Debris_Office>.

"International Telecommunication Union." *Wikipedia*. Wikimedia Foundation, 09 Apr. 2013. Web. 23 June 2013. <http://en.wikipedia.org/wiki/International_Telecommunication_Union>.

"ITU: Committed to Connecting the World." *ITU*. N.p., n.d. Web. 23 June 2013. <http://www.itu.int/en/Pages/default.aspx>.

"The Kessler Syndrome." *The Long Now Blog RSS*. N.p., n.d. Web. 23 June 2013. <http://blog.longnow.org/02009/02/27/the-kessler-syndrome/>.

"Space Debris." *Wikipedia*. Wikimedia Foundation, 21 Aug. 2013. Web. 23 June 2013. <http://en.wikipedia.org/wiki/Space_debris>.

UN General Assembly. "International Cooperation in the Peaceful Uses of Outer Space." *A/RES/62/217*. N.p., 01 Feb. 2008. Web. 23 June 2013. <http://www.oosa.unvienna.org/pdf/gares/ARES_62_217E.pdf>.

"United Nations Office for Outer Space Affairs." *United Nations Committee on the Peaceful Uses of Outer Space*. N.p., n.d. Web. 23 June 2013. <http://www.oosa.unvienna.org/oosa/COPUOS/copuos.html>.

"United Nations Office for Outer Space Affairs." *United Nations Office for Outer Space Affairs*. N.p., n.d. Web. 23 June 2013. <http://www.oosa.unvienna.org/>.

Wikipedia. Wikimedia Foundation, n.d. Web. 23 June 2013. <http://en.wikipedia.org/w/index.php?title=Special:Search>.