



ISSUE PAPER

Space Debris - Preventing Catastrophe in Orbit

ISSUE

Space assets critical to our nation's economy and national security are threatened by on-orbit debris. Currently, there are over 22,000 pieces of debris larger than 10 centimeters (~4 inches), with an estimated 500,000 items between 1 and 10 cm now in orbit. Presently, U.S. tracking systems are following less than five percent - from large deactivated satellites to fragments of satellites and launch vehicles orbiting around the earth. Given the inextricable integration of space assets into our nation's defense, these objects put our nation's vital space assets at risk; we must get better at tracking and mitigating this debris.

Although moving satellites to avoid collisions and designing spacecraft to withstand minor debris impacts are workable mitigation techniques for low numbers of objects, active removal of space debris would greatly help to clean the space environment. Without debris removal, the number of objects in orbit could eventually become so numerous that they would continually collide with one another creating more debris resulting in a "cascade" of collisions making low Earth orbit unusable. Several methods of debris removal are under development, and these methods should be implemented as soon as possible.

RECOMMENDATION

AIA recommends a stronger national plan for debris mitigation and eventually, active removal of space debris. Currently, we do not have a practical technical solution for removal but there is much that we could do to preclude debris creation and improve risk awareness allowing avoidance maneuvers. Meanwhile, long lead investment should begin on removal technologies which will likely take a long time to develop:

- Increased funding for a more-robust *Space Situational Awareness* capability and data sharing.
- Increased *international collaboration* on debris issues – most critically to increase adherence to debris mitigation standards of spacecraft and launch vehicle design and operation.
- Over the long run, we urge support for developing methods and technologies for *Debris Removal* which could include lasers, electro-dynamic or momentum exchange tethers, tugs and drag enhancement devices.

AIA believes that the DOD and NASA should work together to develop a comprehensive plan for debris mitigation and removal. With respect to NASA's specific role in debris mitigation research, a 2011 National Research Council assessment of the NASA's orbital debris programs recommended that NASA take steps aimed at "improvements in long-term modeling, better measurements, more regular updates of the debris environmental models, and other actions to better characterize the long-term evolution of the debris environment."

BACKGROUND

Since the dawn of the space age, humans have been depositing extraneous items - from parts of satellites to launch vehicle components into orbit. Those that are low enough eventually disintegrate into the atmosphere; others travel at incredibly high speeds and can cause catastrophic damage to satellites; in one Space Shuttle mission, a piece of debris later identified as a paint flake created a visible crater on the outermost layer of window glass in the cockpit.

In recent years, the amount of debris has increased as a result of collisions between objects on-orbit. On January 11, 2007, the Chinese launched an anti-satellite weapon test resulting in the destruction of their FY-1C satellite and leaving behind over 3,000 trackable debris objects. Then, on February 10, 2009, the Cosmos 2251 satellite accidentally collided with an Iridium 33 satellite, yielding 2,000 tracked objects. Coupled with subsequent collisions with other objects already on orbit, the amount of debris as a result of these collisions continues to rise.

Unfortunately, our ability to track these objects is quite limited. The U.S. military is the primary source for information on orbital debris tracking for the entire world. USSTRATCOM's Joint Space Operations Center (JSpOC) monitors the Space Surveillance System, a network of 29 space surveillance sensors, to monitor more than 22,000 orbiting objects and update the position of each one around the clock. Of the objects tracked, only five percent are functioning payloads or satellites, eight percent are rocket bodies, and the remaining 87 percent amount to space debris.

Further, the nation is beginning to upgrade our 1960s era Space Situational Awareness capabilities. The USAF has been developing a new system called the Space Fence, capable of detecting much smaller objects than current Air Force capabilities permit; this new radar system site could be in operation by 2017. And DARPA's new Space View program enlists volunteer home astronomers to use high-quality hardware to track debris and provide information back to the Air Force.

Beyond improving tracking and mitigation techniques, the U.S. government has sponsored programs to develop debris removal technologies. From the DARPA sponsored Electrodynamic Debris Eliminator (EDDE), a debris-catching net concept, to DARPA's Phoenix robotic satellite recycling concepts, the government is actively funding research into new methods for debris removal. These concepts, however, are still in the theoretical stage.

Space debris, is more than an American issue; the international community must come together to remove the junk on orbit. Article VIII of the Outer Space Treaty states that any object placed on orbit is property of the launching nation; this includes space debris. A nation cannot remove the property of another nation on orbit. Compounding this property issue, U.S. space objects are subject to ITAR restrictions and any removal of them by another country could create intellectual property concerns. The legal framework behind debris removal must be fixed before any actions are taken to clean the space environment.

KEY POINTS

- Over 22,000 pieces of space debris over 10 cm in size threaten the nation's space assets on orbit today.
 - USSTRATCOM's Tracking capabilities must be updated from their current 1960s technology.
- Cleaning up the space environment would potentially open up more slots in Geostationary Orbit, protect spacecraft in Low Earth Orbit and, provide additional opportunities for commercial companies to launch innovative new space services.
- The government must work with international partners to develop a new legal framework that would allow nations to cooperate on debris removal.
- The Federal Government should invest to develop technologies to remove orbital debris and work with industry to implement these ideas and protect space investments.