



Promoting Cooperative Solutions for Space Sustainability

The Non-Technical Challenges of Active Debris Removal

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The focus of my presentation

- Active debris removal is more than just a technical issue
 - Legal, policy, and economic concerns are deeply imbedded in the concept and will affect mission success
- A *technically feasible* solution may not be a *politically feasible* solution
 - We may need to accept a less optimal technical solution to satisfy the other concerns

Thinking about active debris removal from a multidisciplinary and international context from the beginning is essential to success

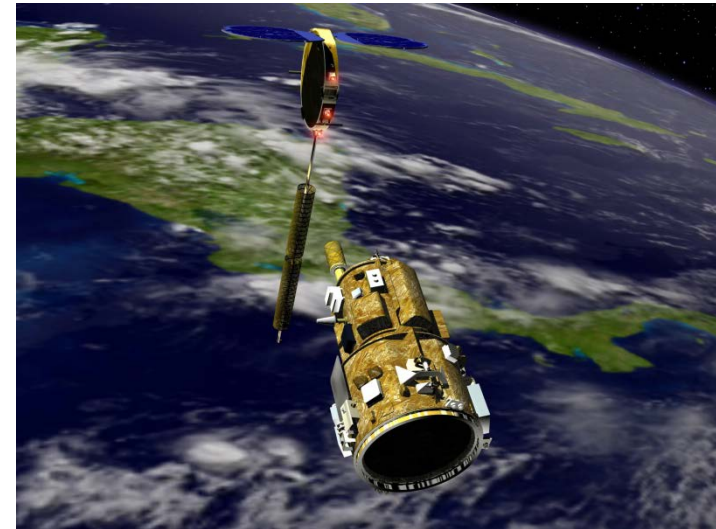


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A SELECTION OF *SOME* KEY NON-TECHNICAL ISSUES

What is “space debris”?

- Are all space objects the same from a legal standpoint?
- Is there a legal difference between a functional satellite and a piece of space debris?
- Before interacting with a piece of space debris, does the removing entity need to identify the Launching State(s)?
- What if they cannot?
 - Currently 500,000 pieces of debris between 1 and 10 cm uncataloged



Which objects should be removed?

- There needs to be general international agreement and transparency on the technical merits for removing objects in general
- There needs to be general international agreement and transparency on which objects are selected for removal
 - Is the goal to protect spacecraft *now* (and thus remove small debris) or to reduce the long-term threat in the *future* (and thus remove large debris)
- Lack of consensus or buy-in could lead to perception that objects are being selected for removal due to political motivation
 - Unduly labeling certain States as “bad actors”
 - Removal mission is a cover for military activities

Who is allowed to remove it?

- The Liability Convention has two different (sometimes overlapping) definitions of who has liability for a space object

The term “launching State” means:

- (i) A State which launches or procures the launching of a space object;
- (ii) A State from whose territory or facility a space object is launched;

- The treaties also establish a “State of Registry” which is responsible for operations and control of a space object
- As currently accepted, the launching State(s) are still liable for a space object beyond the end of life
- What role do the Launching State(s) & State of Registry play in negotiating ADR contracts and operations ?

Is there a reference catalog of space objects?

- UN Registry generally only includes satellites and rocket bodies, not small pieces of space debris and does not contain accurate location information
 - 1,060 active satellites in orbit
 - 21,000 debris objects in orbit bigger than 10 cm
 - 500,000 debris objects in orbit between 1 and 10 cm
- US military currently maintains the most public and complete catalog of space objects, but other satellite catalogs are maintained by the Russian military, ESA, and other governments
- None of these national catalogs are exhaustive and there are discrepancies between all of them

Is that an ASAT weapon or ADR vehicle?

- Active debris removal is not an anti-satellite activity, but some of the same technologies being considered for active debris removal could also be developed for ASAT capabilities
- A State developing and deploying active debris removal technologies *without sufficient transparency* could be *perceived* as covert ASAT development
- Can the debris removal activities be monitored and verified as harmless?

Can lasers be used safely?

- Some techniques (including debris-debris collision avoidance) involve lasers fired from ground or another satellites
- Significant challenges with using lasers, even when they are very lower power
- How do you *prove* to other satellite operators that their satellites won't be accidentally “dazzled”?
- The US military currently operates the Laser Clearing House for all its laser firings into space but not other parts of the US government
 - Do we need an *International Laser Clearing House*?



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Intellectual property & export controls

- If an object is selected for active removal, what information does the owner need to provide to facilitate efficient and safe removal?
- If there are sensitive national security satellites in the area, how do you protect them?
- If a State or private entity docks with a piece of “space debris”, what examinations are they allowed to conduct to dock/attach/verify?
- How is this impacted by technology and export control regimes?

Radio frequencies allocation

- What radio frequencies are needed to conduct the debris removal mission?
 - Command and control for the removal vehicle?
 - Streaming video for rendezvous or delicate operations?
 - Will a separate vehicle detach to complete the removal?
- If the removal vehicle is moving throughout the GEO belt, can it get a spectrum license around the entire globe?

The importance of international cooperation

- Many of these challenges can begin to be addressed by conducting one or more ***international technology demonstration missions***
- Increase ***awareness of the severity*** of the space sustainability problem and space debris in general for all space actors
- Provides the necessary ***transparency*** on the project to help stave off diplomatic and political objections
- Provide a ***specific example*** for the policy experts and lawyers to discuss
- Lay ***technical, legal, and policy groundwork*** for future ADR operations

Additional recommendations

- Truly international cooperation and research to provide consensus on which objects are a priority for removal and *why*
- Begin an international conversation on the problem of heterogeneous satellite catalogs
- Improving space situational awareness and ability to monitor and provide transparency/verification for debris removal activities
- Bring together legal and technical experts to start discussing the legal “grey areas”

The stark reality of economics

- The odds of developing an economic incentive mechanism for removing space debris in LEO are ***extremely small*** because there's ***little direct economic value in LEO***
 - Nearly all the economic activity in space takes place in GEO
 - Total value of global space activities: \$280 billion
 - Total private benefits from LEO: ~\$3 billion
 - Almost all users of LEO are public entities deriving social benefits
- The ***debris problem was largely created by governments*** using public money (legacy debt that needs to be dealt with)
- Any ***funding of ADR activities is likely to come from public money*** and either be governments conducting missions themselves or purchasing services from private sector



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Making progress

- SWF is in the process of holding a series of events to foster an international dialog on these issues between various stakeholders
- Washington, DC: Scenario Workshop in June, 2012
- Brussels, Belgium: Public Conference in October, 2012
- ***Singapore – Scenario Workshop and Public Conference on February 19-20, 2013***
- ***Washington, DC: Capstone Panel Discussion in Fall 2013***
- Information is available on our website (www.swfound.org)



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Thank you for your time. Questions?

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