



Promoting Cooperative Solutions for Space Sustainability

The Non-Technical Challenges of Active Debris Removal

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Secure World Foundation

- Private, non-profit foundation (NGO) founded in 2004
- HQ just outside of Denver, CO, offices in Washington, DC and Brussels
- Focus on *space sustainability and space security*
- *Inform, facilitate, advocate*
- Strong role in both the *international and domestic policy* communities, linking technical and policy/legal initiatives

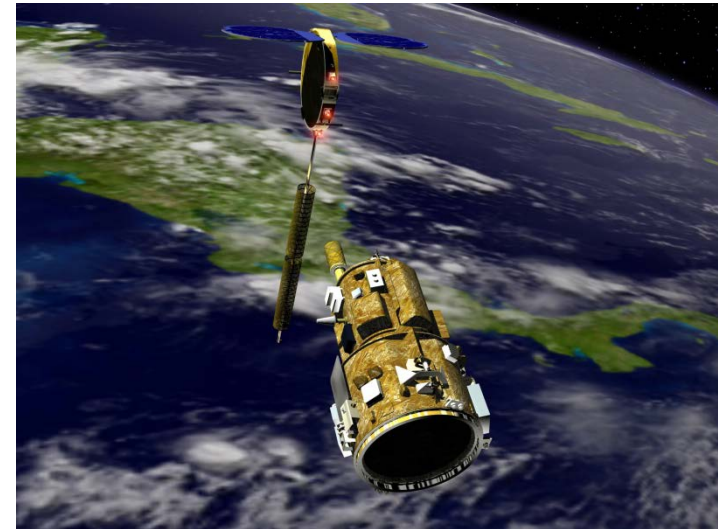
The focus of my presentation

- 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

What is “space debris”?

- There is not an international consensus on the legal definition of “space debris”
 - This was good in the early days of space activity as it enabled flexibility
- Is “space debris” a subset of “space objects”, and if so what legal status do they have?
- This may seem trivial to us engineers but to lawyers it is extremely important to figure out



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
- 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” (Russia?)
 - Removal mission is cover story for intelligence gathering or sabotage

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 is still liable for a space object beyond the end of life
- How do we coordinate permission to perform ADR?
 - What about cases where there are multiple Launching States for a single object? Do they need to give permission as well?

Who has the reference satellite catalog?

- US military currently maintains the most public and complete catalog, but it is not necessarily accurate nor exhaustive
- US does not have radar coverage over much of Asia, an area where Russia has excellent LEO radar coverage
 - Are there LEO debris objects in the Russian catalog but not in the American one?
- “Classification of Geostationary Objects” compiled annually by ESA/ECOC has additional ~200 debris objects not in public US catalog
- These are discrepancies above and beyond deliberate “omissions”

Is that an ASAT weapon?

- 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?
- Recent programs have had this transparency / dual-use concern
 - American X-37B
 - Chinese SJ-12

Bright shiny lasers

- Some techniques (including debris-debris collision avoidance) involve lasers fired from ground or another satellite)
- Significant challenges with using lasers, even when they are very lower power
 - How do you *prove* to commercial & national security operators that their satellites won't be accidentally "dazzled"?
- JSpOC currently operates the Laser Clearinghouse for all DoD laser firings into space, do we need an international version?



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Intellectual Property & National Security

- 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?
- What do we do about ITAR and related regimes?

- What radio frequencies are needed to conduct the debris removal mission?
 - TT&C for the removal vehicle?
 - Streaming video for rendezvous or delicate operations?
 - TT&C for detached deorbit module?
- Who will the frequency be registered with?
- If in GEO, which longitude will have the frequency registered?
 - What about if you plan to drift your removal vehicle around?
 - Will it interfere with satcom?

International cooperation

- An international technology demonstration mission is crucial
 - Increased **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 wonks and lawyers to discuss
 - Lay **technical, legal, and policy groundwork** for future ADR operations
- Think combined effort
 - Russian target, European bus, Japanese robotic arm, Indian launch vehicle, American \$\$\$?

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
 - Can we agree on what is debris without compromising national security?
- 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 problem of legal definitions and sovereignty

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

- SWF will be organizing a conference discussing the *technical, legal, and policy challenges with rendezvous and proximity operations* in *Brussels 30 October, 2012*
- Topics
 - On-Orbit Servicing
 - Active Debris Removal
- Possibility of also doing a table top scenario for an ADR mission to examine specific legal and policy issues
- Information will be available on our website (www.swfound.org) soon



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Thank you for your time. Questions?

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